Biophysical Assessment (Terrestrial Vertebrate Fauna & Flora) Haib Copper Project, Updated Infrastructure Layout (Noordoewer Area)

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Expertise and Declaration of Independence

Peter Cunningham t.a. Environment and Wildlife Consultancy, Namibia (EWC Namibia), has prepared this vertebrate fauna and flora section of the EIA based on updated infrastructure layout on behalf of the proponent (Knight Piésold (Pty) Ltd). EWC, Namibia assists as local ecologist/specialist for a variety of environmental projects, mainly in Southern Africa and the Arabian Peninsula and is independent of the proponent and has no vested or financial interest in the proposed project, except for fair renumeration for professional services rendered.

EXECUTIVE SUMMARY

The Haib Copper Project site layout has been designed around critical landform features such as topography, sensitive biodiversity areas, and heritage features. The optimisation has additionally considered the efficiencies required for the mining operation.

It must be noted that this updated infrastructure site layout represents the results of preliminary studies, however, it is not final. The final layout will be informed by specialist impact studies and the broader environmental and social impact assessment, as well as ongoing design processes. This finalisation process will also integrate considerations received through the regulatory public consultation process.

The general Noordoewer area is regarded as “low” in overall (all terrestrial species) diversity while the overall terrestrial endemism is “average”. It is estimated that at least 53 reptile, 11 amphibian, 64 mammal, 153 bird species (breeding residents), at least 54 species of larger trees and shrubs (>1m in height) and up to 49 grasses are known to or expected to occur in the general area of which a high proportion (e.g., 52.8% of reptiles) are endemics.

Important areas in the general vicinity are viewed as the Orange River; Haib River; ephemeral drainage lines (especially those with seeps such as the TSF5 area); rocky areas (especially the well vegetated plateau area in the HLP2, TSF3 & western portion of the WRD1); booted eagle nest site(s) & bird fly paths – See Section 6.4 and Figures 75 & 76.

Alternative sites for the contentious TSF Options 3 & 5 and HLP Option 2 and western portions of the WRD1 infrastructure sites are recommended so as not to destroy these unique habitats (See Section 7; Figure 77).

Alternative pipeline and 33Kv OTL routes are suggested (See Section 7; Figure 28, 75 & 76).

It is not expected that the Haib Copper Project developments will adversely affect any unique vertebrate fauna and flora, or at least be ameliorated, especially if the proposed recommendations (mitigation measures) and alternative options are incorporated – See Sections 6.3, 6.4, 7 & 8. This is especially important for the TSF Options 3 & 5 and HLP Option 2 and western portions of the WRD Option 1 sites currently proposed within unique habitats.

CONTENTS

Acronyms, abbreviations and units

CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
EIA	Environmental Impact Assessment
EO	Environmental Officer
IUCN	International Union for the Conservation of Nature and Natural Resources
MEFT	DNPW Ministry of Environment, Forestry and Tourism: Directorate of National Parks and Wildlife
OTL	Overhead Transmission Line
RT&E	Rare, Threatened and Endangered Species
SARDB	South African Red Data Book
Spp.	Species
ToR	Terms of Reference

Glossary of Terms

Protected Species (in Namibia): Species are considered protected in Namibia as per the Forestry Act and the Nature Conservation Ordinance. This is based on endemic classification, restricted range, extent of use/exploitation, population size/rarity**.**

Important species: Defined here as Species of Conservation Concern (SCC) or species classified as Protected in Namibia.

Modified habitats (As per IFC PS 6): an area where human activity has significantly altered its ecological functions and species composition, often by introducing non-native species. Note modified habitats can hold significant biodiversity value.

Natural habitats (As per IFC PS 6): are areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.

Critical habitats (As per IFC PS 6): Are a subset of natural or modified habitats and are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species (ii) habitat of significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.

1 Introduction

A desktop study (i.e., literature review) was conducted between 13 and 17 November 2023 on the vertebrate fauna (e.g., reptiles, amphibians, mammals, and birds) and flora (larger trees and shrubs and grasses) expected to occur in the general Noordoewer area. This was followed by a 1st rapid site assessment between 23 and 27 November 2023 to determine actual vertebrate fauna and flora (including unique habitats) at the proposed development areas. A 2nd site assessment was conducted between 30 September and 3 October 2025 with the focus being on the updated infrastructure layout. The aim was to determine the vertebrate fauna and flora, including unique habitats potentially impacted; rank various infrastructure layouts according to their perceived impacts on the environment and propose alternative sites should these developments proceed (Figure 1). This report includes data collected during the 1st assessment conducted during November 2023 combined with the 2nd assessment conducted during October 2025.

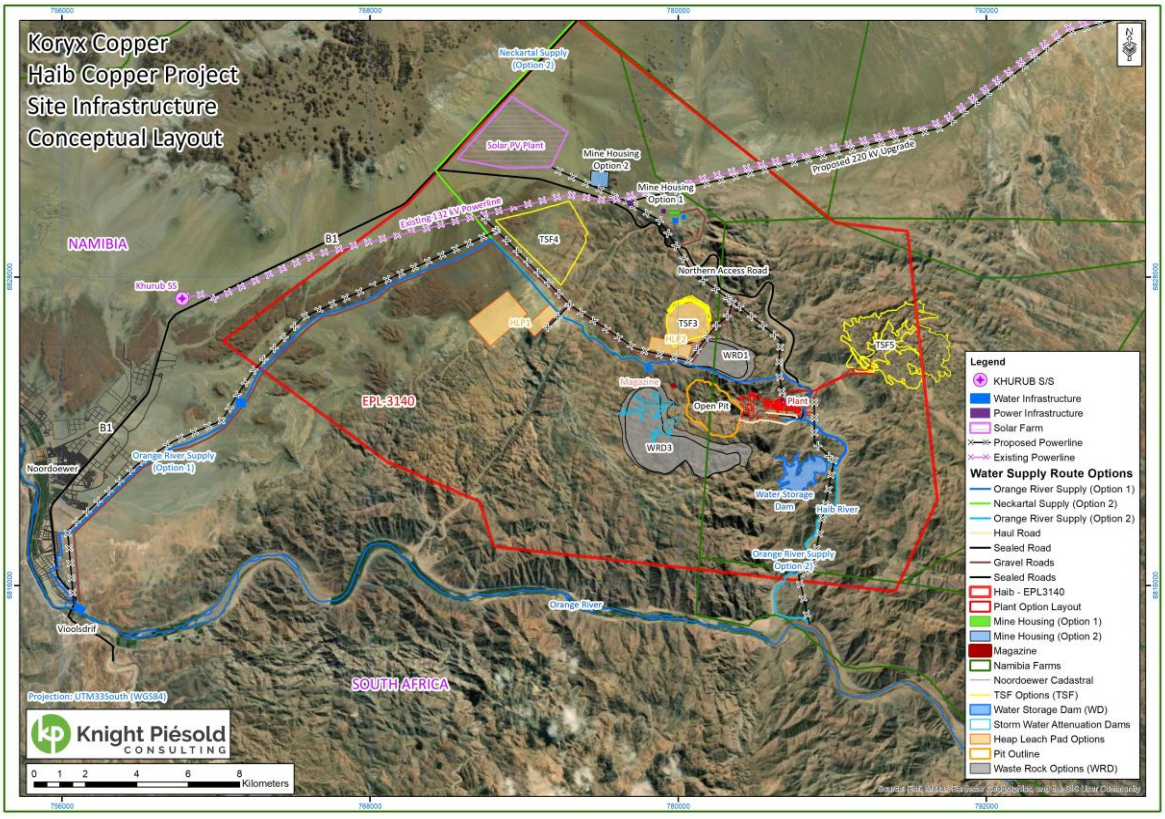

Figure 1. The updated conceptual Haib Copper Project infrastructure layout in the vicinity of Noordoewer in the Karas Region (©Knight Piésold Consulting).

The literature review was to determine the actual as well as potential vertebrate fauna and flora associated with the general area commonly referred to as the Dwarf Shrub Savannah (Giess 1971) or Karas Dwarf Shrubland (Mendelsohn *et al.* 2002, Jarvis *et al.* 2022). The vegetation structure is classified as grasslands and low shrubs (Mendelsohn *et al.* 2002). The Haib Copper Project area is situated just north of the Orange River with the ephemeral Haib River and its tributaries one of the larger drainage lines in the general area. Such ephemeral rivers are viewed as sites of special ecological importance due to their biotic richness, throughout Namibia (Curtis and Barnard 1998). The perennial Orange River, to the south, is an important habitat in an otherwise marginal environment.

The Savannah Biome – of which the Haib Copper Project area forms part of – is underrepresented in the protected area network in Namibia covering 37% of the land area, but only 7.5% of the biome (Barnard 1998). More specifically, the Dwarf Shrub Savannah is badly underrepresented in the protected area network with 1.9% of the area having formal protection (Barnard 1998). The closest Government protected area is the Ai-Ais Richtersveld National Park, approximately 40km to the northwest.

The //Gamaseb communal conservancy (1,748km²) is located to the north of Noordoewer with the major wildlife resources viewed as steenbok, oryx and springbok (NACSO 2010, MEFT/NACSO 2021). No, freehold (commercial) conservancies occur in the immediate area (Mendelsohn *et al.* 2002, See: www.canam.iway.na).

The general Noordoewer area is regarded as "low" in overall (all terrestrial species) diversity while the overall terrestrial endemism is "average" (Mendelsohn *et al.* 2002). According to Simmons (1998a) southern Namibia has between 81-120 endemic vertebrates (all vertebrates included). The overall diversity and abundance of large herbivorous mammals (big game) is viewed as "low" with 3-4 species while the overall diversity of large carnivorous mammals (large predators) is also "low" with 1 species – leopard – being the most important with "low" densities (Mendelsohn *et al.* 2002).

According to Maggs (1998) there are approximately 4344 higher plant species with the most species being within the grasses (422), composites (Asteraceae) (385), legumes (Fabaceae) (377) and fygies (Mesembryanthemaceae) (177), recorded from Namibia. Total species richness depends on further collecting and taxonomic revisions. High species richness is found in the Okavango, Otavi/Karstveld, Kaokoveld, southern Namib and Central Highland (Windhoek Mountains) areas. Endemic species – approximately 687 species in total – are manly associated with the Kaokoveld (northwestern) and the succulent Karoo (southwestern) Namibia. The major threats to the floral diversity in Namibia are:
1). Conversion of the land to agriculture (with associated problems) and,
2). poorly considered development (Maggs 1998, Mendelsohn *et al.* 2002).

The vegetation structure is classified as grasslands and low shrubs (Mendelsohn *et al.* 2002). The larger trees – *Acacia erioloba, A. karroo and Tamarix usneoides* – are mainly confined to areas along river-courses while small "Karoo bushes" – *Catophractes alexandri*, *Eriocephalus* species and *Rhigozum trichotomum* – are characteristic of the area. Other bigger tree species in the general area include *Acacia nebrownii*, *Boscia albitrunca*, *B. foetida* and *Parkinsonia africana* while the grasses are varied depending on soil types and dominated by *Stipagrostis* species with other valuable grasses including *Anthephora* pubescens, *A. ramosa*, *Brachiaria nigropedata*, *Digitaria eriantha*, *Panicum arbusculum* and *Setaria appendiculata* (Giess 1971).

The average plant production is "very low" with the variation in green vegetation biomass "low" estimated at 5-10% (Mendelsohn *et al.* 2002). The availability of browse and grass is "average" and bush thickening (encroachment) is not problematic, although *Rhigozum trichotomum* may become a problem shrub in some areas, although usually further north than the Noordoewer area (Bester 1996, Cunningham 1998, Mendelsohn *et al.* 2002). An important plant species in the general area is *Aloe dichotoma* (Mendelsohn *et al.* 2002). The risk to farming is "high" and the tourism potential is "low to average" in the general area (Mendelsohn *et al.* 2002).

The overall plant diversity (all species - "higher" plants) in the general area is "low" and estimated at between 100-149 species while plant endemism is "low" with between 6-15 species expected from the general area (Mendelsohn *et al.* 2002). Jarvis *et al.* (2022) puts the diversity at 150-299 species and endemics at 2-9 species including 1 localised endemic.

Simmons (1998a) puts the plant endemism in the general area at between 1-10 species depending on the locality.

It is estimated that at least 53 reptile, 11 amphibian, 64 mammal, 153 bird species (breeding residents), at least 56 species of larger trees and shrubs (>1m in height) – 54 species in total – and up to 49 grasses are known to or expected to occur in the general area of which a high proportion (e.g., 52.8% of reptiles) are endemics.

2 Terms of Reference (ToR)

1. Assess the bio-physical (vertebrate fauna & flora) issues relevant to the above-mentioned area.
2. Assess the significance of development and environmental impact that such development(s) may have on the vertebrate fauna & flora at the proposed development site(s) including general comments.

3 Approach and Methodology

3.1 Assumptions, Limitations, and Information Gaps

It is assumed that:

- all the relevant documents/maps have been supplied;
- all the proposed development activities have been indicated;
- all the areas to be developed have been indicated; and
- no additional developments planned consequently to this study being undertaken.

Limitations:

- The overall project area is massive and although the focus of the fieldwork was on the proposed development areas (See Figure 1), it cannot be assumed that all species potentially present in the area were accounted for. This could mean that species – especially cryptic and lesser-known species – such as burrowing reptiles, rodents, and bats, may be excluded. However, this is unlikely with more species indicated as potentially occurring in the general area due to the greater extent of the literature study conducted;
- Species, especially reptiles, are constantly being revised taxonomically and although the latest nomenclature was followed, species may split or merge as subspecies or full species and/or have name changes as the project progresses;
- No quantification for vertebrate fauna is available or possible to determine within the scope of this project; and
- Flora assessments were conducted during November 2023 (after a below average rainfall season) and October 2025 (after an above average rainy season) – i.e., albeit still during dry seasons. This may affect the presence and identification of annual species, especially grass and herbs, etc.

3.2 Impact Assessment Methodology

The following Impact Assessment Criteria, Determining of Consequence and Significance are used:

An impact is essentially any change to a resource or receptor brought about by the presence of the proposed project component or by the execution of a proposed project related activity. The terminology used to define the nature of an impact is detailed below.

Impact Nature

Term	Definition
Positive (+)	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative (-)	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
Direct impact (D)	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g., between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect impact (I)	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g., in-migration for employment placing a demand on resources).
Cumulative impact (C)	Impacts that act together with other impacts (including those from concurrent or planned future third-party activities) to affect the same resources and/or receptors as the Project.

Assessing Significance

The Knight Piésold impact significance rating system is based on the following equation:

Significance of Environmental/ Social Impact = Consequence x Probability

The consequence of an impact can be derived from the following factors:

Severity / Magnitude – the degree of change brought about in the environment

Reversibility - the ability of the receptor to recover after an impact has occurred

Duration - how long the impact may be prevalent

Spatial Extent - the physical area which could be affected by an impact.

The **severity, reversibility, duration, and spatial extent** are ranked using the criteria indicated below and then the overall consequence is determined by adding up the individual scores and multiplying it by the **overall probability** (the likelihood of such an impact occurring). Once a score has been determined, this is checked against the **significance** descriptions indicated.

Mitigation and Residual Impacts

It is expected that for the identified significant impacts, the project team will work with the client in identifying suitable and practical mitigation measures that are implementable. Mitigation that can be incorporated into the Project design in order to avoid or reduce the negative impacts or enhance the positive impacts will be developed. A description of these mitigation measures will also be included within the Environmental and Social Management Plan (ESMP).

Residual impacts are those impacts which remain once the mitigation measures have been designed and applied. Once the mitigation is applied, each impact is re-evaluated (assuming that the mitigation measure is effectively applied) and any remaining impact is rated once again using the process outlined above. The result is a significance rating for the residual impact.

Severity / magnitude (M)	Reversibility (R)	Duration (D)	Spatial extent (S)	Probability (P)
5 – Very high – The impact causes the characteristics of the receiving environment/ social receptor to be altered by a factor of 80 – 100 %	**5 – Irreversible** – *Environmental* - where natural functions or ecological processes are altered to the extent that it will permanently cease. *Social* - Those affected will not be able to adapt to changes and continue to maintain-pre impact livelihoods.	**5 – Permanent** - Impacts that cause a permanent change in the affected receptor or resource (e.g., removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.	**5 – International** - Impacts that affect internationally important resources such as areas protected by international conventions, international waters etc.	**5 – Definite** - The impact will occur.
4 – High – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 60 – 80 %		**4 – Long term** - impacts that will continue for the life of the Project but ceases when the Project stops operating.	**4 – National** - Impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.	**4 – High probability** – 80% likelihood that the impact will occur
3 – Moderate – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 40 – 60 %	**3 – Recoverable** *Environmental*- where the affected environment is altered but natural functions and ecological processes may continue or recover with human input. *Social*- Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support or intervention.	**3 – Medium term** - Impacts are predicted to be of medium duration (5 – 15 years)	**3 – Regional** - Impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem.	**3 – Medium probability** – 60% likelihood that the impact will occur u
2 – Low – The impact alters the characteristics of the		**2 – Short term** - Impacts are predicted to be of short duration (0 – 5 years)	**2 – Local** - Impacts that affect an area in a radius of 2 km around the site.	**2 – Low probability** - 40% likelihood that the impact will occur

Severity / magnitude (M)	Reversibility (R)	Duration (D)	Spatial extent (S)	Probability (P)
receiving environment/ social receptor by a factor of 20 – 40 %				
1 – Minor – The impact causes very little change to the characteristics of the receiving environment/ social receptor and the alteration is less than 20 %	**1 – Reversible** *Environmental* - The impact affects the environment in such a way that natural functions and ecological processes are able to regenerate naturally. *Social* - People/ communities are able to adapt with relative ease and maintain pre-impact livelihoods.	**1 – Temporary -** Impacts are predicted to intermittent/ occasional over a short period.	**1 – Site only** - Impacts that are limited to the site boundaries.	**1 – Improbable** - 20% likelihood that the impact will occur

Score According to Impact Assessment Matrix	Significance Definitions	Colour Scale Ratings	
		Negative Ratings	Positive Ratings
Between 0 and 29 significance points indicate **Low Significance**	An impact of low significance is one where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value.	**Low**	**Low**
Between 30 and 59 significance points indicate **Moderate Significance**	An impact of moderate significance is one within accepted limits and standards. The impact on the receptor will be noticeable and the normal functioning is altered, but the baseline condition prevails, albeit in a modified state. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is As Low As Reasonably Practicable (ALARP). This does not necessarily mean that "moderate" impacts have to be reduced to "low" impacts, but that moderate impacts are being managed effectively and efficiently to not exceed accepted standards.	**Moderate**	**Moderate**
60 to 100 significance points	An impact of high significance is one where an accepted limit or standard may be exceeded,	**High**	**High**

Score According to Impact Assessment Matrix	Significance Definitions	Colour Scale Ratings	
		Negative Ratings	Positive Ratings
indicate **High Significance**	or large magnitude impacts occur to highly valued/sensitive resource/receptors. An impact with high significance will completely modify the baseline conditions. A goal of the ESIA process is to get to a position where the Project does not have any high negative residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be high residual impacts after all practicable mitigation options have been exhausted (i.e., ALARP has been applied). It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors, such as employment, in coming to a decision on the Project.		

3.3 Methods

3.3.1 Literature review

A comprehensive and intensive literature review (i.e., desktop study) regarding the reptiles, amphibians, mammals, birds, larger trees, and shrubs (>1m in height) and grasses that could potentially occur in the general Noordoewer area (including the EPL3140 project area) was conducted using as many references as manageable. A list of the references consulted can be viewed in the Reference section (Page 129).

3.3.2 Field Surveys

Vertebrate fauna
According to both ToR's, a rapid fieldwork assessment to determine the actual faunal diversity included the following:

- Small mammal transects to determine small mammal diversity in the area
- Assess larger mammal presence in the area
- Reptile and amphibian transects to determine reptile and amphibian diversity in the area
- Bird transects to determine avian diversity in the area
- Tree/shrub transects to determine diversity in the area
- Grass transects to determine diversity in the area

Reptiles
Diurnal reptile transects were conducted along various transects throughout the proposed development area and were not conducted in rigid straight lines but focused on the habitat viewed as most suitable for reptiles. Reptiles observed were either caught by hand or by using an active capture technique called 'reptile noosing' where an extendable fishing rod was fitted with a soft thread noose, positioned over the unsuspecting head of an individual and pulled tight. This technique does not result in the death or injury of the caught specimen. Species caught were identified *in situ*, photographed, and released unharmed at the point of capture.

Amphibians
Amphibians were searched for in areas deemed suitable habitat – e.g., drainage lines, seeps, etc. – with species encountered identified *in situ*.

Mammals
Small mammal trapping was conducted by active trapping using collapsible aluminium Sherman traps baited with peanut butter and oats. Traps were set at 6 sites throughout the area with 9-10 traps placed 20m apart for 2 nights (i.e., potential maximum of 58 captures) during November 2023 and at 3 sites with 7 traps placed 10m apart for 1 night (i.e., potential maximum of 21 captures) in habitats viewed as potentially suitable for small mammals throughout the area and/or potentially affected by the proposed future mining developments.

Assessing larger mammals from the area was conducted by traversing the area on foot and included actual sightings, tracks, scats, and other signs – e.g., burrows, scrapes, carcasses, etc.

Birds
Bird transects (variable lengths, directions, and times) were conducted on foot and by vehicle following permissible tracks throughout the area (when in vehicle) during daylight hours using binoculars to identify and confirm species.

Flora
According to the original Terms of Reference (ToR), fieldwork to determine the actual floral diversity was to include the following:

- Trees and shrubs – species composition
- Grasses – species composition
- Other species

Trees and shrubs
All the trees and shrubs encountered in the proposed development areas were identified whilst conducting the fieldwork in the area – i.e., identification was limited to transect only. Trees and shrubs species composition was quantified. The transect lengths varied according to the terrain and were conducted in the proposed development areas as well as the general surrounding area.

Grasses
All the grasses encountered in the proposed development areas were identified whilst conducting the fieldwork in the area – i.e., identification was limited to transect only. Grass species composition was quantified. The transect lengths varied according to the terrain and were conducted in the proposed development areas as well as the general surrounding area.

Other species
Other species – i.e., bulbs, herbs, etc. – were also identified whenever encountered although not viewed as a comprehensive reflection of occurrence as the focus was on the larger/woody species throughout the area in accordance with the ToR.

During November 2023 the focus of the fieldwork was on the "key target areas" – i.e., Pit Area; Conveyor Belt route; Pipeline route; Transmission Line route; Heap Leach Plant; Process Plant; Haib Substation and Haib River while during October 2025 the focus was on the updated conceptual infrastructure layout (Figure 1).

4 Legislative Context

Various Namibian laws are applicable to the proposed project:

- Soil Conservation Act 76 of 1969 (as amended in SA to March 1978)

The purpose of this Act is "*to consolidate and amend the law relating to the combating and prevention of soil erosion, the conservation, improvement and manner of use of the soil and vegetation and the protection of the water sources in the Republic and the territory of South-West Africa; and to provide for matters incidental thereto*."

- Environmental Assessment Policy for Sustainable Development and Environmental Conservation (1995)

The purpose of the Policy is seen as: informing decision makers and promoting accountability; ensuring that options and alternatives and environmental costs and benefits are considered; striving for a high degree of public participation and involvement of all sectors; incorporating internationally accepted norms and standards; taking into account secondary and cumulative environmental impacts; promoting the user pays principle; and promoting sustainable development. The Policy requires that all listed policies, programmes and projects, whether initiated by Government or the private sector, be subject to an Environmental Impact Assessment (EIA). Policies, programmes and projects requiring an Environmental Assessment (EA), amongst others, include: structure plans (e.g. land-use plans and policies); rezoning applications; establishment of settlements; power generation facilities with an output of 1 megawatt or more; electrical substations and transmission lines having equipment with an operating voltage in excess of 30 000 volts rms phase-to-phase;

afforestation projects; major roads; major pipelines; major canals, aqueducts, river diversions and water transfers; permanent flood control schemes; small scale (formal) water supply schemes; deforestation projects; effluent plants; multinational projects; waste disposal sites; alternate energy programmes; and commercial tourism and recreation facilities (see Appendix B of the Policy).

- Nature Conservation Ordinance (No. 4 of 1975) – Nature Conservation Amendment Act (5 of 1996)

The Nature Conservation Amendment Act 5 of 1996 amends the Nature Conservation Ordinance, 1975, "so as to provide for an economically based system of sustainable management and utilization of game in communal areas; to delete references to representative authorities; and to provide for matters incidental hereto." Section 73. 1) provides: "No person other than the lawful holder of a permit granted by the local authority shall at any time pick ("pick", as defined in Section 1 (xxxviii), includes to cut off, chop off, pick off, take, gather, uproot, damage or destroy) or transport any protected plant: Provided that – (a) the owner a nursery licensed under section 75 may without such permit pick and transport any protected plant cultivated on the premises of such nursery and cause such protected plant to be picked and transported; (b) the owner or lessee of land may on that land without such permit pick the flower of a protected plant for use as a decoration in his home; (c) the owner or lessee of land may without such permit pick a protected plant on that portion of such land – (i) which he needs for cultivated lands, the erection of a building, the construction of a road or airfield or any other development which necessitates the removal of vegetation; or (ii) on which such protected plant has been specially cultivated" (Nature Conservation Ordinance 4 of 1975, Chapter VI INDIGENOUS PLANTS, Picking and transport of protected plants).

- *Forest Act (No. 12 of 2001)*

The Act "provide for the establishment of a Forestry Council and the appointment of certain officials; to consolidate the laws relating to the management and use of forests and forest produce; to provide for the protection of the environment and the control and management of forest fires; to repeal the Preservation of Bees and Honey Proclamation, 1923 (Proclamation No.1 of 1923), Preservation of Trees and Forests Ordinance, 1952 (Ordinance No. 37 of 1952) and the Forest Act, 1968 (Act No. 72 of 1968); and to deal with incidental matters." Section 22. (1) provides: "Unless otherwise authorised by this Act, or by a licence issued under subsection (3), no person shall on any land which is not part of a surveyed erven of a local authority area as defined in section 1 of the Local Authorities Act, 1992 (Act No. 23 of 1992) cut, destroy or remove - (a) vegetation which is on a sand dune or drifting sand or on a gully unless the cutting, destruction or removal is done for the purpose of stabilising the sand or gully; or (b) any living tree, bush or shrub growing within 100 metres of a river, stream or watercourse."

- Environmental Management Act (No. 7 of 2007)

The Environmental Management Act (EMA) gives legislative effect to the Environmental Assessment Policy. The purpose of EMA is to "promote the sustainable management of the environment and the use of natural resources by establishing principles for decision making on matters affecting the environment; to establish the Sustainable Development Advisory Council; to provide for the appointment of the Environmental Commissioner and environmental officers; to provide for a process of assessment and control of activities which may have significant effects on the environment; and to provide for incidental matters." Even though EMA has been promulgated, but not yet implemented, the twelve principles of environmental management (Part II, Section 3 of the Act) should be applied to all projects that may impact on the environment: i) use renewable resources on a sustainable basis for the benefit of present and future generations; ii) involve the community in natural resources management and promote and facilitate the sharing of benefits from the use of resources; iii) promote public participation in decisions affecting the environment and ensure that their

interests, needs and values are taken into account; iv) promote equitable access to all environmental resources and consider the functional integrity of ecological systems so that the sustainability of systems is ensured and that harmful effects are prevented; v) undertake environmental assessments for all projects that may adversely impact on the environment, or the use of natural resources; vi) promote sustainable development in all aspects relating to the environment; vii) protect and respect Namibia's cultural and natural heritage, including its biological diversity, for the benefit of present and future generations; viii) reduce the generation of waste and polluting substances at source by adopting the option that provides the most benefit or causes the least environmental damage, at costs acceptable by society, in the short and long term; ix) promote the reduction, re-use and recycling of waste; x) adopt the "polluter pays principle"; xi) in cases where there is sufficient evidence to conclude that there are threats of serious or irreversible damage to the environment, the lack of full scientific certainty may not be used as an excuse for postponing cost-effective measures to prevent environmental degradation; and xii) prevent damage to the environment; if this is not possible, reduce, limit, or control activities that may cause damage (to the environment).

- Namibia's Second National Biodiversity Strategy and Action Plan (2013-2022)

Namibia's NBSAP2 covers the period 2013-2022, and its vision is for "Namibia's biodiversity to be healthy and resilient to threats, and for the conservation and sustainable use of biodiversity to be key drivers of poverty alleviation and equitable economic growth, particularly in rural areas." The Strategic Goals and Targets of NBSAP2 are:

i. *Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society;*
ii. *Reduce direct pressures on biodiversity and promote the sustainable use of biological resources;*
iii. *Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity;*
iv. *Enhance the benefits to all from biodiversity and ecosystem services; and*
v. *Enhance implementation of NBSAP2 through participatory planning, knowledge management and capacity building.*

Various international legally binding agreements are applicable to the proposed project:

- Convention on Biological Diversity

The Convention on Biological Diversity (CBD) was signed by 150 government leaders at the 1992 Rio Earth Summit and entered into force in December 1993. There are currently 188 Parties to the Agreement. The three objectives of the Convention are: the conservation of biodiversity, the sustainable use of biological resources and the fair and equitable sharing of benefits arising from the use of genetic resources. The principles of the CDB are broad in scope and unlike CITES, the CBD does not contain detailed provisions on implementation. Accordingly, implementation of the CBD depends on the incorporation of the Convention and associated policies and guidelines into the national legislation of Member States. The CBD was signed by Namibia on 12 June 1992 in Rio de Janeiro and ratified it on 18 March 1997. Accordingly, Namibia is obliged to ensure that its domestic legislation conforms to the objectives and obligations of the CBD. Namibia gives effect to the CBD inter alia by implementing the National Biodiversity Strategy and Action Plan and has issued its sixth national report under the CBD for the period 2014-2018. Also of relevance is the Nagoya Protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their utilization to the convention on biological diversity which Namibia has acceded to.

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)

The aim of CITES is to protect certain endangered species from over-exploitation by means of a system of import-export permits. The CITES Convention includes animals and plants

whether dead or alive, and any recognizable parts of derivatives thereof. Appendix I to the Convention covers endangered species, trade in which is to be tightly controlled; Appendix II covers species that may become endangered unless trade is regulated; Appendix III covers species that any party wishes to regulate and requires international cooperation to control trade; and Appendix IV contains model permits. Permits are required for species listed in Appendices I and II stating that export / import will not be detrimental to the survival of the species. The CITES Secretariat is administered by UNEP and is located at Geneva, Switzerland. Namibia joined in 1990 through accession which came into force in 1991. MET is the agency responsible for implementation of CITES.

- *The African Convention on the Conservation of Nature and Natural Resources (revised) 2003:*

Participating and signatory states undertake to adopt the measures necessary to ensure conservation, utilisation and development of soil, water, floral and faunal resources in accordance with scientific principles and with due regard to the best interests of the people (Article II); to take effective measures to conserve and improve the soil and to control erosion and land use (Article IV); and to establish policies to conserve, utilise and develop water resources, prevent pollution and control water use (Article V). Furthermore, the Convention imposes on states the obligation to protect flora and ensure its best utilisation, the management of forests and control of burning, land clearance and overgrazing (Article VI); and to conserve faunal resources and use them wisely, manage populations and habitats, control hunting, capture and fishing, and prohibit the use of poisons, explosives and automatic weapons in hunting (Article VII). States are required to tightly control traffic in trophies, to prevent trade in illegally killed and obtained trophies and to establish and maintain conservation areas (Article X). A list of protected species which enjoy full total protection, and a list of species, which may be taken only with authorisation is part of the Convention. Namibia signed the agreement in 2003.

- *SADC Protocol on Forestry, 2002 (entered into force within SADC on 1 September 2006)*

This Protocol applies to all activities related to development, conservation, sustainable management and utilisation of all types of forests and trees, as well as trade in forest products. Article 4.1 provides the guiding principles to which state parties must cooperate in good faith. The protocol further provides for the tenure and ownership of state-owned forests, national forest policies and programmes for the introduction and implementation of national legal and administrative measures to promote sustainable forest management. Namibia signed the agreement in 2002.

- *SADC Protocol on Wildlife Conservation and Law Enforcement, 1999*

This Protocol aims to establish within the framework of the respective national laws of each State Party, common approaches to the conservation and sustainable use of wildlife resources and to assist with the effective enforcement of laws governing those resources. Each State Party has to ensure the conservation and sustainable use of wildlife resources under its jurisdiction, and that activities within its jurisdiction or control do not cause damage to the wildlife resources of other states or in areas beyond the limits of national jurisdiction. In line with Article 4 of the Protocol, appropriate policy, administrative and legal measures have to be taken to ensure the conservation and sustainable use of wildlife and to enforce national legislation pertaining to wildlife effectively. Namibia signed the agreement in 1999.

- *United Nations Sustainable Development Goals (SDGs) 2015*

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals

(SDGs), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognise that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests. Of specific relevance to ecology is SDG 15: Life on Land which aims to "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss".

5 Project Description

The Haib Copper Project site layout has been designed around critical landform features such as topography, sensitive biodiversity areas, and heritage features. The optimisation has additionally considered the efficiencies required for the mining operation.

It must be noted that this site layout represents the results of preliminary studies, however, it is not final. The final layout will be informed by specialist impact studies and the broader environmental and social impact assessment, as well as ongoing design processes. This finalisation process will also integrate considerations received through the regulatory public consultation process. A summary of the key proposed components is provided:

Open Pit - The Haib deposit straddles the ephemeral Volstruis River and forms the basis for the open pit. The open pit consists of four target areas which will combine to form the larger pit.

The Concentrator Processing Plant - The concentrator processing plant has been laid out to the east of the pit. The Volstruis river valley in which the pit is found flattens to the east as it joins the Haib riverbed. This relatively flat area allows flexibility of the plant layout and an opportunity to minimise earthworks. The Run-of-Mine (ROM) tip pads are located close to the pit edge and are at a similar elevation to the pit rim. The typical processing plant supporting infrastructure comprises a change house, administration facility, workshop, stores, reagents stores, sewerage and water treatment facilities. The final copper and molybdenum concentrate will be dried in a filter press and exported by road.

The Concentrator design is based on a 28 Mtpa facility, executed in a single phase and comprising two 14 Mtpa crushing, milling and flotation circuit modules. The Concentrator will treat higher grade primary sulphide material containing at least 0.275% copper (Cu), for recovery of copper and molybdenum (Mo) minerals and will produce separate copper and molybdenum flotation concentrates (dependent on market conditions and feed grade), which will be trucked to and shipped to international customers.

Heap Leach & Hydrometallurgical Plant - The area in the north-west of the EPL footprint on the flatter plain, as well as the area directly north of the pit have been identified as alternatives currently being assessed for the heap leach and hydrometallurgical plant. Mineralised material will be crushed at the ROM pads and conveyed to the agglomeration plant before being stacked on the Heap Leach pad.

The heap leach, solvent extraction and electrowinning plant is designed with a feed capacity of 7 Mtpa, to process 179 million tonnes (Mt) of low-grade primary sulphide mineralised material containing between 0.175% and 0.275% Cu, as well as small quantities of oxide or secondary sulphide mineralised material over approximately 17 years. Copper cathode produced in this circuit will be exported to the market.

Tailings Disposal - Three (3) Tailings Storage Facility (TSF) options are currently being assessed inclusive of options 3, 4 and 5 -two valley impoundment zoned rockfill dams (options 3 and 5) with an upstream lined face and one raised ring feed structure (option 4).

The TSF options are currently unlined, based on the assumption that the tailings are non-acid generating, non-metal leaching, and the quality of the effluent will be above the effluent standard and waste management guidelines (as per the Namibian Water Quality Standards set out in Annexure 11 (Regulation 67) of the Water Resources Management Regulations 2023). The TSFs will have an underdrainage system and downstream seepage interception trenches/wells to maximise seepage water recovery. The TSF options are designed to Global Industry Standard on Tailings Management (GISTM) published in 2020.

Waste Rock Dumps/Stockpiles - Waste Rock Dumps were designed as close to the pit exits as possible to optimise productivity and minimise waste mining costs or environmental impacts.

Access and Haul Roads - The Project can be accessed from Windhoek or Noordoewer through the B1 National Highway and then via sets of farm roads and tracks developed during the various exploration programmes. Different access road options were investigated during the conceptual design stage, and the access (road) going along the Haib riverbank was rated most favourable in terms of geometrics, gradients, and cut and fill material balance. Based on the capital cost, maintenance costs, ease of construction, dust mitigation, and visual aesthetics, a sealed road option is recommended for the mine access road for use by commercial haulage trucks, buses, and general vehicles. A gravel wearing course and dump rock pavement layer with a dust suppressant is recommended for the haul road section between the open pit and processing stockpiles, as well as to the waste rock dumps to lower dust emission, wear, and damage to the road surface.

Bulk Water Infrastructure - The proposed Project's water demand is 20 million cubic metres per year (Mm^3/yr) of which supply is being investigated from two options, that is from the Orange River only or from an Orange River and Neckartal Dam option. Full abstraction from the Orange River is being pursued under this ESIA process.

Raw water supply from the Orange River assumes seasonal reliability of supply. Off-channel storage facilities will offset the impacts of limited to nil water abstraction during the dry season or drought periods. The proposed system comprises an abstraction weir, intake structure, a low-lift pumping station and two high-lift booster pumping stations, as well as a pipeline to a site reservoir. Two sites for abstraction are under investigation.

Mine Housing - On-site mine Housing accommodation will be used during construction and operation to accommodate 2,500 rotation-based personnel. The mining Housing is to be placed north of the main mining activities on flatter ground near the Project access road and solar photovoltaic (PV) plant. The design includes workers' accommodation, multi-purpose warehouses, gravity-fed water and sewer system, and associated infrastructure services to ensure functionality. The Housing will include a comprehensive internal and bulk infrastructure network covering water supply, wastewater management, internal roads, solid waste disposal, and electrical reticulation. Access to the Housing will be facilitated by a gravel road linked to the planned access road route. Electrical supply will be via a 33 kilovolt (kV) overhead line connected to the main substation, with a dedicated smaller substation near the Housing and internal overhead or underground distribution, including street lighting.

Bulk Power Supply - The power supply concept design includes a hybrid solution combining a solar PV plant (150 MWp (megawatt peak)) and a connection to the regional grid system from the local service provider, the Namibia Power Corporation (NamPower). The system is sized to meet the proposed Project's peak demand that may be up to a maximum of 150 MVA (megavolt-amperes) and annual consumption of 1,123.3 GWh (gigawatt-hour). However, power optimisation studies are still ongoing and expected to provide improvements through introducing efficiencies. The grid supply is recommended to be via a double circuit overhead transmission line (OHTL) configuration for redundancy. The solar PV supply will include either 30% or 100% supply, subject to regulatory approval. Wind energy is a secondary option that was identified.

All infrastructure underwent alternative assessment, which considered designing the site around critical landform features such as topography, sensitive environmental habitats/areas, and heritage features. The process additionally considered the efficiencies required for the mining operation towards identifying an optimal layout. The presented site layout is a result of these considerations.

6. Description of the Receiving Environment

6.1 Vertebrate Fauna

6.1.1 Reptile Diversity

Reptile diversity known and/or expected to occur in the general area, including species confirmed during the fieldwork as well as the authors confirmed records during other studies from the general area, is presented in Table 1.

Approximately 261 species of reptiles are known or expected to occur in Namibia thus supporting approximately 30% of the continent's species diversity (Griffin 1998a). At least 22% or 55 species of Namibian lizards are classified as endemic. The occurrence of reptiles of "conservation concern" includes about 67% of Namibian reptiles (Griffin 1998a). Emergency grazing and large-scale mineral extraction in critical habitats are some of the biggest problems facing reptiles in Namibia (Griffin 1998a).

The overall reptile diversity and endemism in the general area is estimated at between 51-60 and 9-12 species (Mendelsohn *et al.* 2002) or 41-50 and 5-8 species (Jarvis *et al.* 2022), respectively. Griffin (1998a) presents figures of between 11-20 and 5-6 for endemic lizards and snakes, respectively, from the general area. The closest Government protected area – Ai-Ais Richtersveld National Park – has an estimated 74 species of reptiles (Griffin 1998a).

At least 53 species of reptiles are expected to occur in the general area with 28 species being endemic – i.e., 52.8% endemic (All the endemics are furthermore classified as secure). Two species are classified as vulnerable and protected game (*Psammobates tentorius veroxii* and *Varanus niloticus*) while one species is classified as insufficiently known (*Bitis xeropaga*). The IUCN (2022) classifies the Genus *Psammobates (tentorius veroxii)* as near threatened while all the other species are classified as least concern while a few species have not yet been assessed by the IUCN Red List (Table 1). The SARDB (2004) classifies 1 species as rare (*Naya woodi*) and 4 species as peripheral while 4 species are listed as CITES Appendix II species). However, *Naya woodi* is more common in Namibia than South Africa.

The 53 species expected to occur in the general area consist of at least 1 tortoise (100% vulnerable and protected game), 19 snakes (1 Blind snake, 1 Thread snake and 17 typical snakes) of which 8 species (42.1%) are endemic, 12 lizards (7 skinks and 5 Old World lizards) of which 7 species classified as endemic (58.3% endemic), 1 dwarf plated lizard

(endemic), 1 girdled lizard (endemic), 1 flat lizard, 1 monitor lizard, 4 agamas (1 endemic), 1 chameleon and 12 geckos of which 8 are classified as endemic (83.3%).

Snakes (18 species with 8 species being endemic), lizards (12 species with 7 species being endemic) and geckos (12 species with 10 species being endemic) are the most important groups of reptiles expected from the general area. Namibia with approximately 129 species of lizards (Lacertilia) has one of the continents richest lizard fauna (Griffin 1998a). Geckos expected and/or known to occur in the general area have the highest occurrence of endemics (83.3%) of all the reptiles in this area. Griffin (1998a) confirms the importance of the gecko fauna in Namibia.

Tortoises are viewed as the group of reptiles most under threat in Namibia (Griffin 1998a) making *Psammobates tentorius veroxii* probably the most important reptile expected in the area followed by *Varanus niloticus* and *Bitis xeropaga*. Since reptiles are an understudied group of animals, especially in Namibia, it is expected that more species may be located in the general area than presented above.

However, none of the reptiles, especially the important species, are exclusively associated with the Haib Copper Project area.

Table 1. Reptile diversity expected (literature study) and confirmed during the 1st and 2nd rapid site assessments (fieldwork conducted during November 2023 [√[1]] & October 2025 [√[2]]); author's unpublished records (√#) as well as other studies conducted from the general area (See: Cunningham 2010a, Cunningham 2010b, Griffin 1997).

Species: Scientific name	Species: Common name	Species confirmed	Griffin (1997)	Cunningham (2010a)	Cunningham (2010b)	Namibian conservation and legal status	International status		
							IUCN (2025)	SARDB (2004)	CITES
TURTLES AND TERRAPINS									
Psammobates tentorius veroxii	Bushmanland Tent Tortoise	√#				Vulnerable; Protected Game	NT		C2
SNAKES									
Blind Snakes									
Rhinotyphlops schinzi	Schinz's Beaked Blind Snake					Endemic; Secure	LC	P	
Thread Snakes									
Namibiana (Leptotyphlops) occidentalis	Western Thread Snake					Endemic; Secure	LC	P	
Typical Snakes									
Boaedon (Lamprophis) fuliginosus	Brown House Snake					Secure	LC		
Pseudaspis cana	Mole Snake					Secure	LC		
Prosymna bivittata	Two-striped Shovel-snout					Secure	LC		
Prosymna frontalis	South-western Shovel-snout					Endemic; Secure	LC	P	
Dipsina multimaculata	Dwarf Beaked Snake	√#				Endemic; Secure	LC		
Psammophis notostictus	Karoo Sand Snake	√[1]				Secure	LC		
Psammophis leightoni (trinasalis)	Namib Sand Snake	√#				Secure	LC		
Dasypeltis scabra	Common/Rhombic Egg Eater	√#	√			Secure	LC		
Telescopus semiannulatus polystictus	Eastern Tiger Snake					Endemic; Secure	LC		
Telescopus beetzii	Beetz's Tiger Snake					Secure	LC		
Aspidelaps lubricus lubricus	Coral Snake	√#				Secure	LC		
Naja nivea	Cape Cobra	√#	√			Endemic; Secure	LC		
Naya woodi	Black-necked Spitting Cobra	√#				Endemic; Secure		R	
Bitis arietans	Puff Adder	√#				Secure	LC		
Bitis caudalis	Horned Adder	√[1]	√	√	√	Secure	LC		

Species: Scientific name	Species: Common name	Species confirmed	Griffin (1997)	Cunningham (2010a)	Cunningham (2010b)	Namibian conservation and legal status	International status		
							IUCN (2025)	SARDB (2004)	CITES
Bitis cornuta	Many-horned Adder					Secure	LC		
Bitis xeropaga	Desert Mountain Adder					Endemic; Insufficiently Known	LC	P	
LIZARDS									
Skinks									
Acontias lineatus lineatus	Striped Legless Skink	√#				Endemic; Secure	LC		
Scelotes capensis	Western Dwarf Burrowing Skink					Endemic; Secure	LC		
Trachylepis capensis	Cape Skink		√			Secure	LC		
Trachylepis occidentalis	Western Three-striped Skink	√[1]	√		√	Secure	LC		
Trachylepis spilogaster	Kalahari Tree Skink	√#				Endemic; Secure			
Trachylepis sulcata sulcata	Western Rock Skink	√[1]	√	√	√	Secure	LC		
Trachylepis variegata variegata	Variegated Skink		√	√		Secure	LC		
Old World Lizards									
Meroles suborbitalis	Spotted Desert Lizard	√#	√			Endemic; Secure	LC		
Nucras tessellata	Western Sandveld Lizard					Endemic; Secure	LC		
Pedioplanis lineoocellata pulchella	Spotted Sand Lizard		√			Endemic; Secure	LC		
Pedioplanis namaquensis	Namaqua Sand Lizard	√[1]	√	√	√	Secure	LC		
Pedioplanis inornata	Plain Sand Lizard	√[1,2]				Endemic; Secure	LC		
Dwarf Plated Lizard									
Cordylosaurus subtessellatus	Dwarf Plated Lizard	√#	√			Endemic; Secure	LC		
Girdled Lizards									
Karusasaurus (Cordylus) polyzonus	Karoo Girdled Lizard					Endemic; Secure	LC		C2
Flat Lizard									
Platysaurus capensis	Cape Flat Lizard					Secure	LC		
Monitors									
Varanus niloticus	Nile or Water Monitor	√#	√	√	√	Vulnerable; Peripheral; Protected Game	LC		C2
Agama									
Agama aculeata	Ground Agama	√[1,2]				Secure	LC		
Agama anchietae	Anchietae's Agama					Secure	LC		

Species: Scientific name	Species: Common name	Species confirmed	Griffin (1997)	Cunningham (2010a)	Cunningham (2010b)	Namibian conservation and legal status	International status		
							IUCN (2025)	SARDB (2004)	CITES
Agama atra atra	Southern Rock or Knobel's Agama	√#	√	√		Endemic; Secure	LC		
Agama hispida	Southern Spiny Agama					Secure	LC		
Chameleons									
Chamaeleo namaquensis	Namaqua Chameleon					Secure	LC		C2
Geckos									
Chondrodactylus angulifer angulifer	Giant Ground Gecko	√#	√			Endemic; Secure	LC		
Goggia lineata	Striped Dwarf Leaf-toed Gecko					Endemic; Secure	LC		
Lygodactylus bradfieldi	Bradfield's Dwarf Gecko	√#				Endemic; Secure	LC		
Pachydactylus bibronii	Bibron's Thick-toed Gecko		√	√	√	Endemic; Secure	LC		
Pachydactylus turneri	Turner's Thick-toed Gecko	√#				Secure	LC		
Pachydactylus mariquensis latirostris	Marico Thick-toed Gecko					Endemic; Secure	LC		
Pachydactylus haackei	Haacke's Thick-toed Gecko		√			Endemic; Secure	LC		
Pachydactylus punctatus	Speckled Thick-toed Gecko		√		√	Secure	LC		
Pachydactylus rugosus rugosus	Rough Thick-toed Gecko	√#		√		Endemic; Secure	LC		
Pachydactylus serval onscepensis	Western Spotted Thick-toed Gecko		√	√		Endemic; Secure	LC		
Pachydactylus weberi	Weber's Thick-toed Gecko		√			Endemic; Secure	LC		
Ptenopus garrulus maculatus	Common Barking Gecko	√#	√		√	Endemic; Secure	LC		

Namibian conservation and legal status according to the Namibian Conservation Ordinance No 4 of 1975 (Griffin 2003)
"Endemic" includes endemic species to South Africa (Branch 1998)
IUCN (2025) – International Union for the Conservation of Nature and Natural Resources [All species not listed by the IUCN (2025) have not yet been assessed for the IUCN Red List]. NT = Near Threatened; LC = Least Concern
SARDB (2004) – South African Red Data Book; R = Rare; P = Peripheral
CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora C2 = CITES Appendix 2 species.

Source for literature review: Alexander and Marais (2007), Branch (1998), Branch (2008), Bonin *et al.* (2006), Boycott and Bourquin 2000, Broadley (1983), Buys and Buys (1983), Cunningham (2006), Cunningham (2010a), Cunningham (2010b), Griffin (1997), Griffin (1998a), Griffin (2003), Hebbard (n.d.), IUCN (2025), Marais (1992), SARDB (2004), Schleicher (2020), Tolley and Burger (2007).

During November 2023 and October 2025 only 7 and 2 species of reptile were confirmed from the Haib Copper Project area, respectively, which included 2 snakes, 2 skinks, 2 Old World lizards and 1 agama (Table 1 and Figures 2-8). Griffin (1997) confirmed 20 species from the general area while Cunningham (2010a) confirmed 10 species from the Komsberg area (±180-190 km to the east; 1 spp. not included in Table 1) and Cunningham (2010b) confirmed 8 species from the Sendelingsdrift area (±70-80 km to the west). Another 19 species have been confirmed from the general area (mainly on the authors farm 50-60 km to the north) if one includes unpublished records from the author. A total of at least 34 species is confirmed from the general area – i.e., Cunningham (2010a), Cunningham (2010b), Griffin (1997), Cunningham (unpublished records) (Table 1).

Figure 2. *Psammophis notostictus* (Karoo sand snake) roadkill in the TSF4, gravel plain area.

Figure 3. *Bitis caudalis* (horned adder) located in the HLP1 area.

Figure 4. *Trachylepis occidentalis* (western three-striped skink) located in the northern section of the Haib River riparian habitat – i.e., Mine Housing Option 1 area.

Figure 5. *Trachylepis sulcata sulcata* (western rock skink) observed in rocky habitat in the HLP2 area.

Figure 6. *Pedioplanis namaquensis* (Namaqua sand lizard) observed in the Solar PV Plant area, on sandy/gravel terrain.

Figure 7. *Pedioplanis inornata* (plain sand lizard) – endemic – was the most observed reptile throughout the area (rocky and gravel plain habitats) – i.e., HLP1 & 2, TSF5, Water Storage Dam areas, etc.

Figure 8. *Agama aculeata* (ground agama) observed in the HLP2 area and the Haib River.

Large portions of the Haib Copper Project area have been heavily impacted due to various old anthropomorphic activities (e.g., informal farmsteads; transmission line, roads/tracks, old and current mining/prospecting activities, etc.) and none of the unique reptiles are expected to be exclusively associated with this area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on important reptiles potentially occurring in the area.

Open Pit impact
The impact of heavy machinery and blasting operations during excavation activities is expected to be detrimental to reptiles directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature. However, most reptiles known/expected to occur in the area are small lacertid and gecko species which would probably use the pit(s) as part of their habitat and/or rather be attracted to the rocky waste dumps as more suitable habitat.

The impacts of the mining activities are expected to be detrimental to reptiles associated with the affected area/habitat, especially slow moving and/or sedentary species. All vehicle activities (including long hauling) should abide by the speed limits to avoid road mortalities. However, the overall low densities of all reptile species in the mining area would negate the problem.

Concentrator Processing Plant impact
The impact of heavy machinery during excavation and processing activities is expected to be detrimental to reptiles directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Heap Leach & Hydrometallurgical Plant (Options 1 & 2) impact
The impact of heavy machinery during construction and processing activities is expected to be detrimental to reptiles directly associated with the affected area/habitat as well as overall habitat destruction.

HLP Option 1 is flatter and less rocky with less diverse biodiversity than HLP Option 2. HLP Option 1 is the preferred site and expected to have fewer negative impacts on reptiles. This would affect a relatively small area albeit be permanent of nature.

Tailings Disposal – Options 3, 4 & 5 impact
The impact of heavy machinery and associated activities is expected to be detrimental to reptiles directly associated with the affected area/habitat as well as overall habitat destruction.

TSF4 is flatter and less rocky with less diverse biodiversity than TSF3 & 5. TSF3 is in a diverse rocky area while TSF5 is in an unspoilt drainage line with seeps and both are viewed as biodiversity hotspots which are unique in the region. TSF4 is the preferred site and expected to have fewer negative impacts on reptiles.

Waste Rock Dumps/Stockpiles – Options 1 & 3 impact
The impact of heavy machinery and associated activities is expected to be detrimental to reptiles directly associated with the affected area/habitat as well as overall habitat destruction.

Eastern WRD1 & all WRD 3 are in barren sparsely vegetated areas and expected to have few negative impacts on reptiles. Western WRD 1 however is a biodiversity hotspot in the region and development thereof would have higher impact on reptiles.

Access & Haul Roads impact
The impact of heavy machinery during construction activities is expected to be detrimental to reptiles directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

The impact of access route(s) is not expected to be detrimental to reptiles – i.e., would not impede their movement, etc. However, increased traffic would result in road kills, especially

for nocturnal species with nocturnal traffic. Some species are also attracted to roads for thermoregulation purposes (e.g., various snake species) increasing road kills.

Bulk Water Infrastructure – Options 1 & 2 impact
The impact of heavy machinery during excavation of a trench to bury a pipeline is expected to be detrimental to reptiles directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Should the pipeline be buried, an open trench could act as a giant pitfall trap and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench. The impact of above/below ground pipeline infrastructure is not expected to be detrimental to reptiles – i.e., would not impede their movement, etc.

Pipeline Option 2 along the Haib River is significantly shorter than Option 1 from the Noordoewer area making it the preferred option with less overall impact on the environment and associated reptiles.

Water Storage Dam impact
The impact of heavy machinery during construction activities is expected to be detrimental to reptiles directly associated with the affected area/habitat as well as overall habitat destruction. Once operational the water storage dam would attract reptiles (e.g., Varanus niloticus) as it is located relatively close to the Orange River and serve as a new, albeit artificial, reptile habitat.

Mine Housing Options 1 & 2 impact
The impact of heavy machinery during construction activities is expected to be detrimental to reptiles directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Mine Housing Option 2 is located on a flat and open sandy/gravel plain area between small rocky outcrops while Option 1 is located within rocky habitat closer to the Haib River. Option 2 is viewed as the preferred option with less overall impact on the environment and associated reptiles.

Bulk Power Supply impact
Solar PV Plant impact
The impact during construction, are expected to be detrimental to reptiles associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to reptiles – i.e. would not impede their movement, etc.

Transmission line and substation impact
The impact of heavy machinery during excavation of pylon holes is expected to be detrimental to reptiles directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area over a short/limited period.

However, open pylon holes could act as pitfall traps and should not be left open overnight.

The impact of above ground 33kV overhead transmission line (OTL) infrastructure is not expected to be detrimental to reptiles – i.e., would not impede their movement, etc.

Furthermore, none of the unique/important reptile species are exclusively associated with the proposed development area.

6.1.2 Amphibian Diversity

Amphibian diversity known and/or expected to occur in the general area, including species confirmed during the fieldwork as well as the authors confirmed records during other studies from the general area, is presented in Table 2.

Amphibians are declining throughout the world due to various factors of which much has been ascribed to habitat destruction. Basic species lists for various habitats are not always available with Namibia being no exception in this regard while the basic ecology of most species is also unknown. Approximately 4,000 species of amphibians are known worldwide with just over 200 species known from southern Africa and at least 57 species expected to occur in Namibia. Griffin (1998b) puts this figure at 50 recorded species and a final species richness of approximately 65 species, 6 of which are endemic to Namibia. This "low" number of amphibians from Namibia is not only because of the generally marginal desert habitat, but also due to Namibia being under studied and under collected. Most amphibians require water to breed and are therefore associated with the permanent water bodies, mainly in northeast Namibia.

According to Mendelsohn *et al.* (2002), the overall frog diversity in the general area is estimated at between 4-7 species while Jarvis *et al.* (2022) estimates 1-4 species and 1 endemic species, respectively. Griffin (1998b) puts the species richness in the general area at 10 species. The closest Government protected area – Ai-Ais Richtersveld National Park – has an estimated 10 species of amphibians (Griffin 1998b).

According to the literature, at least 11 species of amphibians can occur in suitable habitat in the general area – most notably the perennial Orange River. The area is under represented, with 4 toads, 2 sand frogs and 1 species each for rubber, caco, platana, river and bullfrog known and/or expected (i.e., potentially could be found in the area) to occur in the area. Of these, 1 species is endemic (*Phrynomantis annectens*) (Griffin 1998b) and 1 species classified as near threatened due to habitat loss and development (*Pyxicephalus adspersus*) (Du Preez and Carruthers 2009) – i.e., 18.2% of amphibians of conservation value from the general area. *Pyxicephalus adspersus* is more common in northern Namibia where their numbers are also declining due to overutilization as food by humans (Griffin pers. com.). The IUCN (2022) furthermore indicates their population trend as declining throughout their range. The Karroo toad (*Vandijkophrynus gariepensis*), common platanna (*Xenopus laevis*) and common river frog (*Amietia angolensis*) are however only expected to be associated with open surface water – e.g., Orange River habitat.

The most important species from the area is the endemic *Phrynomantis annectens* although they are widespread in Namibia and not exclusively associated with the Haib Copper Project area. Except for the perennial Orange River, temporary pools in the ephemeral drainage lines flowing southwards into the Orange River (e.g., Haib River) are viewed as potential amphibian habitat in the general area (Figures 9-14).

However, none of the amphibians, especially the important species, are exclusively associated with the Haib Copper Project area.

Table 2. Amphibian diversity expected (literature study) and confirmed during the 1st and 2nd rapid site assessments (fieldwork conducted during November 2023 [√1] & October 2025 [√2]); author's unpublished records (√#) as well as other studies conducted from the general area (See: Cunningham 2010a, Griffin 1997).

Species: Scientific name	Species: Common name	Species confirmed	Griffin (1997)	Cunningham (2010a)	Namibian conservation and legal status	International status: IUCN (2025)
Amientophrynus gutturalis	Guttural Toad				Secure	
Amietophrynus poweri	Western Olive Toad				Secure	LC
Amietophrynus rangeri	Raucous Toad				Secure	LC
Vandijkophrynus gariepensis	Karoo Toad				Rare?	LC
Rubber Frog						
Phrynomantis annectens	Marbled Rubber Frog				Endemic; Secure	LC
Cacos						
Cacosternum boettgeri	Boettger's Caco				Secure	LC
Platannas						
Xenopus laevis	Common Platanna				Secure	LC
River Frogs						
Amietia angolensis	Common River Frog			√	Secure	LC
Bullfrogs						
Pyxicephalus adspersus	Giant Bullfrog				Near Threatened	LC
Sand Frogs						
Tomopterna cryptotis	Tremolo Sand Frog				Secure	LC
Tomopterna tandyi	Tandy's Sand Frog				Secure	LC

Endemic – (Griffin 1998b)
Near threatened – (Du Preez and Carruthers 2009)
IUCN (2025): LC – Least Concern

Source for literature review: Carruthers (2001), Channing (2001), Channing and Griffin (1993), Cunningham (2010a), Du Preez and Carruthers (2009), Griffin (1997), IUCN (2025), Passmore and Carruthers (1995)

During November 2023 and October 2025 no amphibians were identified in the general area during the fieldwork. Although no standing surface water was observed in the various drainage lines throughout the area during November 2023 seeps were observed in the proposed TSF5 area during October 2025 and viewed as potential amphibian habitat (Figures 9-10).

Cunningham (2010a) confirmed 1 species (*Amietia angolensis*) from the Komsberg area (180-190 km to the east) while Griffin (1997) confirmed none from the general area and Cunningham (2010b) confirmed none from the Sendelingsdrift area (70-80 km to the northwest), respectively.

Seeps and rock depressions and other water collections sites in the ephemeral Haib River and its various tributaries serve as amphibian habitat after localised showers. However, the Orange River to the south of the Haib Copper Project site, is the most feasible and important amphibian habitat in the general area.

Figure 9. Active seeps in the TSF5 area are a result of the geology of this important ephemeral drainage line, an eastern tributary of the Haib River.

Figure 10. The water holding capacity of the ephemeral drainage line in the TSF5 area is viewed as important for amphibians.

Figure 11. Rock potholes in the Haib River are potential amphibian habitats.

Figure 12. Pothole and rock depressions in the HLP2/TSF3 are potential amphibian habitat.

Figure 13. The Haib River is an important habitat, albeit temporary, after flooding events, for amphibians.

Figure 14. The perennial Orange River is a linear oasis and the most important habitat for amphibians in an otherwise marginal environment.

Large portions of the Haib Copper Project area have been heavily impacted due to various old anthropomorphic activities (e.g., informal farmsteads; transmission line, roads/tracks, old and current mining/prospecting activities, etc.) and none of the unique amphibians are expected to be exclusively associated with this area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on important amphibians potentially occurring in the area.

Open Pit impact

The impact of heavy machinery and blasting operations during excavation activities is expected to be detrimental to amphibians directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature. However, most amphibians known/expected to occur in the area would probably use the pit(s) as part of their habitat, especially if water would collect/seep into these areas.

Erosion down the steep drill tracks into the Volstruis River (pit area) would result in downstream siltation into the Haib and Orange Rivers. Siltation together with any petrochemical effluents, etc. associated with the drill and mine sites would exacerbate this downstream threat to amphibians.

The impacts of the mining activities are expected to be detrimental to amphibians associated with the affected area/habitat, especially slow moving and/or sedentary species. All vehicle activities (including long hauling) should abide by the speed limits to avoid road mortalities. However, the overall low densities of all amphibian species in the mining area would negate the problem.

Concentrator Processing Plant impact

The impact of heavy machinery during excavation and processing activities is expected to be detrimental to amphibians directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Heap Leach & Hydrometallurgical Plant (Options 1 & 2) impact
The impact of heavy machinery during construction and processing activities is expected to be detrimental to amphibians directly associated with the affected area/habitat as well as overall habitat destruction.

HLP Option 1 is flatter and less rocky with less diverse biodiversity than HLP Option 2. Furthermore, HLP Option 2 has pothole depressions (albeit currently dry) which potentially could serve as amphibian habitat. HLP Option 1 is the preferred site and expected to have fewer negative impacts on amphibians. This would affect a relatively small area albeit be permanent of nature.

Tailings Disposal – Options 3, 4 & 5 impact
The impact of heavy machinery and associated activities is expected to be detrimental to amphibians directly associated with the affected area/habitat as well as overall habitat destruction.

TSF4 is flatter and less rocky with fewer pothole depressions than TSF3 & 5. TSF3 is in a diverse rocky area while TSF5 is in an unspoilt drainage line with active seeps (Figures 9-10) and both are viewed as biodiversity hotspots with unique features in the landscape . TSF4 is the preferred site and expected to have fewer negative impacts on amphibians.

Waste Rock Dumps/Stockpiles – Options 1 & 3 impact
The impact of heavy machinery and associated activities is expected to be detrimental to amphibians directly associated with the affected area/habitat as well as overall habitat destruction.

Eastern portion of WRD1 & all of WRD 3 are in barren sparsely vegetated areas with limited pothole depressions and expected to have few negative impacts on amphibians. These areas are not deemed suitable habitat for amphibians and impacts would be negligible.

Access & Haul Roads impact
The impact of heavy machinery during construction activities is expected to be detrimental to amphibians directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

The impact of access route(s) is not expected to be detrimental to amphibians – i.e., would not impede their movement, etc. Erosion along the access route(s) would result in downstream siltation into the Orange River. Siltation together with any petrochemical effluents, etc. associated with these routes would exacerbate this downstream threat to amphibians.

Bulk Water Infrastructure – Options 1 & 2 impact
Pipeline
The impact of heavy machinery during excavation of a trench to bury a pipeline is expected to be detrimental to amphibians directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Should the pipeline be buried, an open trench could act as a giant pitfall trap and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench. The impact of above/below ground pipeline infrastructure is not expected to be detrimental to amphibians – i.e., would not impede their movement, etc.

Pipeline Option 2 along the Haib River is significantly shorter than Option 1 from the Noordoewer area making it the preferred option with less overall impact on the environment and associated amphibians.

Erosion and siltation together with any petrochemical effluents, etc. associated with the pipeline operations would exacerbate this downstream threat to amphibians and the siltation into the Orange River.

Water Storage Dam impact
The impact of heavy machinery during construction activities is expected to be detrimental to amphibians directly associated with the affected area/habitat as well as overall habitat destruction. Once operational the water storage dam would attract amphibians as it is located relatively close to the Orange River and serve as a new, albeit artificial, amphibian habitat.

Mine Housing Options 1 & 2 impact
The impact of heavy machinery during construction activities is expected to be detrimental to amphibians directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Mine Housing Option 2 is located on a flat and open sandy/gravel plain area between small rocky outcrops while Option 1 is located within rocky habitat closer to the Haib River. Option 2 is viewed as the preferred option with less overall impact on the environment and associated amphibians. These areas are not deemed suitable habitat for amphibians and impacts would be negligible.

Bulk Power Supply impact
Solar PV Plant impact
The impact during construction, are expected to be detrimental to amphibians associated with the affected area/habitat. This would affect a relatively small area over a short/limited period of time.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to amphibians – i.e. would not impede their movement, etc. This area is not deemed suitable habitat for amphibians and impacts would be negligible.

Transmission line and substation impact
The impact of heavy machinery during excavation of pylon holes is expected to be detrimental to amphibians directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area over a short/limited period of time.

However, open pylon holes could act as pitfall traps and should not be left open overnight.

The impact of above ground 33kV overhead transmission line (OTL) infrastructure is not expected to be detrimental to amphibians – i.e., would not impede their movement, etc.

Furthermore, none of the unique/important amphibian species are exclusively associated with the proposed development area.

6.1.3 Mammal Diversity

Mammal diversity known and/or expected to occur in the general area, including species confirmed during the fieldwork as well as the authors confirmed records during other studies from the general area, is presented in Table 3.

Namibia is well endowed with mammal diversity with at least 250 species occurring in the country. These include the well-known big and hairy as well as a legion of smaller and lesser-known species. Currently 14 mammal species are considered endemic to Namibia of which 11 species are rodents and small carnivores of which very little is known. Most endemic mammals are associated with the Namib and escarpment with 60% of these rock-dwelling (Griffin 1998c). According to Griffin (1998c) the endemic mammal fauna is best characterized by the endemic rodent family *Petromuridae* (Dassie rat) and the rodent genera *Gerbillurus* and *Petromyscus*.

Overall terrestrial diversity and endemism – all species – is classified as "low" in the far south of Namibia (Mendelsohn *et al.* 2002). The overall diversity (1-2 species) and abundance of large herbivorous mammals is "low" in the general area with springbok and oryx having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall abundance and diversity of large carnivorous mammals is also "low" (1 species) in the general area with leopard having the highest density of the larger species (Mendelsohn *et al.* 2002). The overall mammal diversity in the general area is estimated at between 61-75 species with 5-6 species being endemic to the area (Mendelsohn *et al.* 2002) while Jarvis et al. (2022) indicates 7-8 endemic species from the area. Griffin (1998c) also puts the species richness distribution of endemics also between 5-6 species in the general area. The closest Government protected area – Ai-Ais Richtersveld National Park – has an estimated 76 species of mammals (Griffin 1998c).

According to the literature at least 64 species of mammals are known and/or expected to occur in the general area of which 6 species (9.4%) are classified as endemic. The Namibian legislation classifies 3 species as rare (Angolan wing-gland bat, black-footed cat and Cape grey mongoose), 3 species as indeterminate, 6 species as vulnerable, 2 species as specially protected game, 3 species as protected game, 5 species as insufficiently known, 3 species as huntable game, 5 species as problem animals, 7 species as peripheral, 1 species as a migrant, 2 species not listed and 1 species as invasive alien. At least 28.2% (18 species) of the mammalian fauna that occur or are expected to occur in general area are represented by rats and mice of which 4 species (22.2%) are endemic. This is followed by carnivores with 26.6% (17 species) of which 2 species (11.8%) are viewed as rare and 6 species as vulnerable (35.3%) and bats with 17.2% (11 species) with 1 species (9.1%) viewed as rare and endemic.

The IUCN (2025) classifies 3 species as vulnerable (*Panthera pardus*, *Felis nigripes*, *Equus zebra hartmannae*) and 3 species as near threatened (*Eidolon helvum*, *Parahyaena (Hyaena) brunnea*, *Aonyx capensis*) while the SARDB (2004) classifies 1 species as endangered, 1 species as vulnerable and 5 species as near threatened and 3 species as data deficient and CITES lists 2 species as Appendix 1 and 5 species as Appendix 2. The House Mouse (*Mus musculus*) is viewed as an invasive alien species to the area. *Mus musculus* are generally known as casual pests and not viewed as problematic although they are known carriers of "plague" and can cause economic losses (Picker and Griffiths 2011). Habitat alteration and overutilization are the two primary processes threatening most mammals (Griffin 1998c) with species probably underrepresented in Table 3 for the general area being the bats and rodents, as these groups have not been well documented from the arid southern part of Namibia.

The most important species from the general area are those classified as vulnerable (*Panthera pardus*, *Felis nigripes*, *Equus zebra hartmannae*) and near threatened (*Eidolon helvum*, *Parahyaena (Hyaena) brunnea*, *Aonyx capensis*) by the IUCN (2025) as well as species classified as rare under Namibian legislation (*Cistugo seabrae*, *Felis nigripes*, *Galerella pulverulenta*).

Table 3. Mammal diversity expected (literature study) and confirmed during the 1st and 2nd rapid site assessments (fieldwork conducted during November 2023 [√1] & October 2025 [√2]); author's unpublished records (√#) as well as other studies conducted from the general area (See: Cunningham 2010a, Cunningham 2010b, Griffin 1997).

Species: Scientific name	Species: Common name	Species confirmed	Griffin (1997)	Cunningham (2010a)	Cunningham (2010b)	Red List – Namibia (carnivores)	Namibian conservation and legal status	International status		
								IUCN (2025)	SARDB (2004)	CITES
Elephant Shrews										
Macroscelides proboscideus	Round-eared Elephant-shrew						Secure	LC		
Elephantulus rupestris	Western Rock Elephant-shrew	√#					Secure	LC		
Elephantulus intufi	Bushveld Elephant-shrew						Secure	LC	DD	
Aardvark										
Orycteropus afer	Aardvark	√2;√#					Secure; Protected Game	LC		
Shrews										
Crocidura cyanea	Reddish-grey Musk Shrew						Secure	LC	DD	
Hyrax										
Procavia capensis	Rock Hyrax	√1,2	√	√			Secure; Problem animal	LC		
Bats										
Eidolon helvum	African Straw-coloured Fruit Bat						Secure; Migrant	NT		
Rhinolophus darlingi	Darling's Horseshoe Bat						Secure; Peripheral	LC	NT	
Nycteris grandis	Large Slit-faced Bat						Not Listed	LC		
Nycteris thebaica	Egyptian Slit-faced Bat	√#	√				Secure	LC		
Tadarida aegyptiaca	Egyptian Free-tailed Bat	√#					Secure	LC		
Miniopterus natalensis	Natal Long-fingered Bat						Secure	LC	NT	
Cistugo seabrae	Angolan Wing-gland Bat						Endemic; Insufficiently Known; Rare?	LC	V	
Eptesicus hottentotus	Long-tailed Serotine Bat				√		Secure	LC		
Neoromicia (Pipistrellus) capensis	Cape Serotine Bat						Secure	LC		
Pipistrellus reuppellii	Rüppell's Pipistelle						Insufficiently Known; Peripheral			
Scotophilus leucogaster	White-bellied House Bat						Not Listed	LC		
Hares and Rabbits										

Species: Scientific name	Species: Common name	Species confirmed	Griffin (1997)	Cunningham (2010a)	Cunningham (2010b)	Red List – Namibia (carnivores)	Namibian conservation and legal status	International status		
								IUCN (2025)	SARDB (2004)	CITES
Lepus capensis	Cape Hare	√[1,2]	√	√	√		Secure	LC		
Pronolagus rupestris	Smith's Red Rock Rabbit	√#	√				Secure	LC		
Rodents										
Porcupine										
Hystrix africaeaustralis	Cape Porcupine	√[1,2]	√	√	√		Secure	LC		
Rats and Mice										
Petromys typicus	Dassie Rat	√[1,2]	√	√			Endemic; Secure		NT	
Pedetes capensis	Springhare	√#					Secure	LC		
Xerus inaurus	South African Ground Squirrel	√#		√			Secure			
Rhabdomys pumilio	Four-striped Grass Mouse	√#	√				Secure	LC		
Thallomys paedulcus	Acacia Rat						Secure	LC		
Thallomys nigricauda	Black-tailed Tree Rat						Secure	LC		
Aethomys namaquensis	Namaqua Rock Mouse	√[2];√#	√				Secure	LC		
Parotomys brantsii	Brant's Whistling Rat		√				Secure	LC		
Parotomys littledalei	Littledale's Whistling Rat						Secure	LC	NT	
Desmodillus auricularis	Cape Short-tailed Gerbil	√#	√				Secure	LC		
Gerbillurus paeba	Hairy-footed Gerbil	√#	√				Endemic; Insufficiently Known	LC		
Gerbillurus vallinus	Brush-tailed Hairy-footed Gerbil	√#	√	√			Endemic; Secure	LC		
Tatera leucogaster	Bushveld Gerbil	√[1]		√			Secure	LC	DD	
Tatera brantsii	Highveld Gerbil						Secure	LC		
Saccostomus Housingestris	Pouched Mouse						Secure	LC		
Malacothrix typica	Gerbil Mouse						Secure	LC		
Petromyscus collinus	Pygmy Rock Mouse	√[1]	√	√			Endemic; Secure	LC		
Mus musculus	House Mouse						Invasive alien	LC		
Primates										
Papio ursinus	Chacma Baboon	√[1,2]	√	√	√		Secure; Problem Animal	LC		C2
Clorocebus (Cercopihecus) pygerythrus	Vervet Monkey	√#	√				Secure	LC		C2
Carnivores										

Species: Scientific name	Species: Common name	Species confirmed	Griffin (1997)	Cunningham (2010a)	Cunningham (2010b)	Red List – Namibia (carnivores)	Namibian conservation and legal status	International status		
								IUCN (2025)	SARDB (2004)	CITES
Proteles cristatus	Aardwolf	√#	√				Insufficiently Known; (Vulnerable?); Peripheral	LC		
Parahyaena (Hyaena) brunnea	Brown Hyena	√#				NT	Insufficiently Known; (Vulnerable?); Peripheral	NT	NT	
Panthera pardus	Leopard	√#				V	Secure?; Peripheral; Protected Game	V		C1
Caracal caracal	Caracal	√#					Secure; Problem Animal	LC		C2
Felis lybica	African Wild Cat	√[1]			√		Vulnerable			C2
Felis nigripes	Black-footed Cat	√#				V	Indeterminate; Rare	V		C1
Genetta genetta	Small Spotted Genet	√#					Secure	LC		
Suricata suricatta	Suricate						Secure	LC		
Cynictis penicillata	Yellow Mongoose	√#					Secure	LC		
Galerella sanguinea	Slender Mongoose	√#	√	√			Secure	LC		
Galerella pulverulenta	Cape Grey Mongoose	√#					Indeterminate (rare)			
Atilax paludinosus	Marsh Mongoose						Indeterminate			
Otocyon megalotis	Bat-eared Fox	√#					Vulnerable?; Peripheral	LC		
Vulpes chama	Cape Fox	√[2];√#					Vulnerable?	LC		
Canis mesomelas	Black-backed Jackal	√[1,2]		√	√		Secure; Problem Animal	LC		
Aonyx capensis	African Clawless Otter	√#	√	√	√	NT	Vulnerable?; Peripheral; Protected Game	NT		C2
Ictonyx striatus	Striped Polecat	√#					Secure	LC		
Equidae										
Equus zebra hartmannae	Hartman's Mountain Zebra	√#					Endemic; Secure; Specially Protected Game	V	E	C2
Antelopes										
Tragelaphus strepsiceros	Greater Kudu	√[1,2]		√			Secure; Huntable Game	LC		
Oryx gazella	Gemsbok	√#			√		Secure; Huntable Game	LC		
Sylvicapra grimmia	Common Duiker						Secure	LC		
Antidorcas marsupialis	Springbok	√[2]'√#			√		Secure; Huntable Game	LC		
Raphicerus Housingestris	Steenbok	√[1,2]		√			Secure; Protected Game	LC		

Species: Scientific name	Species: Common name	Species confirmed	Griffin (1997)	Cunningham (2010a)	Cunningham (2010b)	Red List – Namibia (carnivores)	Namibian conservation and legal status	International status		
								IUCN (2025)	SARDB (2004)	CITES
Oreotragus oreotragus	Klipspringer	√[1,2]	√	√			Secure; Specially Protected Game	LC		

SARDB (2004): E – Endangered, V – Vulnerable, NT – Near Threatened, DD – Data Deficient
IUCN (2025): V – Vulnerable, NT – Near Threatened. All other species not listed are viewed as "Least Concern" by IUCN (2025)
CITES: CITES Appendix 1/2 species
*Monadjem *et al.* (2010)
Red List – Namibia (carnivores): V – Vulnerable, NT – Near Threatened. All other species are classified as LC – Least Concern (NCE, LCMAN, MEFT 2022)

Source for literature review: Cunningham (2010a), Cunningham (2010b), De Graaff (1981), Estes (1995), Frost (2014), Griffin (1997), Griffin and Coetzee (2005), IUCN (2025), Joubert and Mostert (1975), Monadjem *et al.* (2010), NCE, LCMAN, MEFT (2022), Picker and Griffiths (2011), SARDB (2004), Skinner and Smithers (1990), Skinner and Chimimba (2005), Stander and Hanssen (2003) and Taylor (2000)

These species are either associated with the Orange River (e.g., *Aonyx capensis*) and/or only pass through the area occasionally and not necessarily permanently associated with the proposed development sites (e.g., *Panthera pardus*, *Parahyaena (Hyaena) brunnea*, etc.).

However, none of the mammals, especially the important species, are exclusively associated with the Haib Copper Project area.

During November 2023 and October 2025 only 12 and 13 species were confirmed from the Haib Copper Project area, respectively, with a total of 16 species for both surveys. These include aardvark, hyrax, Cape hare, porcupine, dassie rat, bushveld gerbil, pygmy rock mouse, Namaqua rock mouse, baboon, African wild cat, black-backed jackal, Cape fox, kudu, springbok, steenbok and klipspringer (Table 3 and Figures 15-23). Griffin (1997) confirmed 20 species from the general area (including *Hipposideros caffer* not included in Table 3) while Cunningham (2010a) confirmed 15 species from the Komsberg area (180-190 km to the east) and Cunningham (2010b) confirmed 9 species from the Sendelingsdrift area (70-80 km to the northwest). Another 29 species have been confirmed from the general area (mainly on a farm 50-60 km to the north) if one includes unpublished records from the author. A total of at least 43 species is confirmed from the general area – i.e., Cunningham (2010a), Cunningham (2010b), Griffin (1997), Cunningham (unpublished records) – See Table 3.

During November 2023 a total of 58 Sherman small mammal traps (Figure 15a,b) were set for 2 nights at 6 sites throughout the area (Table 4). This resulted in 3 captures of 2 species – *Tatera leucogaster, Petromyscus collinus* – i.e., 5.2% capture success (Figures 16-17).

During October 2025 a total of 21 small mammal traps were set for 1 night at 3 sites throughout the area (Table 4). This resulted in 1 capture of 1 species – *Aethomys namaquensis* – i.e., 4.8% capture success (Figure 18).

Table 4. Small mammals trap sites during November 2023 and October 2025.

	Number	Traps	Area	Habitat	Coordinates	Captures	Species	Season
Nov-23	1	10	Rocky plateau	Rocky	S28°40'29.7"; E17°51'37.7"	1	*Tatera leucogaster*	Summer
	2	10	Hills	Rocky	S28°39'44.4"; E17°49'19.9"	1	*Petromyscus collinus*	Summer
	3	9	Gravel plains	Gravel plains	S28°38'31.47"; E17°48'00.6"	0		Summer
	4	10	Haib River & mountains	Riparian vegetation & Rocky	S28°38'17.0"; E17°52'51.0"	0		Summer
	5	10	Haib River & mountains	Riparian vegetation & Rocky	S28°38'03.9"; E17°51'37.9"	1	*Petromyscus collinus*	Summer
	6	9	Haib River & mountains	Riparian vegetation & Rocky	S28°37'22.0"; E17°50'41.3"	0		Summer
Oct-25								
	1	7	Gravel plains	Gravel plains	S28°56'57.0"; E17°51'04.0"	0		Spring
	2	7	Rocky outcrop	Rocky	S28°36'38.0"; E17°49'55.0"	1	*Aethomys namaquensis*	Spring
	3	7	Gravel plains	Gravel plains	S28°36'25.0"; E17°47'30.0"	0		Spring

Figure 15a,b (top & bottom). Sherman collapsible small mammal traps were baited; placed in different habitats and used to trap rodents.

Figure 16. *Tatera leucogaster* (bushveld gerbil) was captured on the rocky plateau area between the pit and plant areas.

Figure 17. *Petromyscus collinus* (pygmy rock mouse) associated with rocky terrain.

Figure 18. *Aethomys namaquensis* (Namaqua rock mouse) captured in a rocky outcrop in the Mine Housing Option 2 area.

Figure 19. Typical *Petromys typicus* (dassie rat) – endemic – latrine in suitable rocky terrain.

Figure 20. Cape porcupine (*Hystrix africaeaustralis*) faeces confirm its presence in the area.

Figure 21. *Tragelaphus strepsiceros* (greater kudu) – huntable game – encountered in the Haib River. Griffin (1997) indicates that this species was probably locally extinct in the area.

Figure 22. *Raphicerus Housingestris* (steenbok) – protected game – observed in the Haib River.

Figure 23. *Oreotragus oreotragus* (klipspringer) – specially protected game – associated with rocky terrain.

Large portions of the Haib Copper Project area have been heavily impacted due to various old anthropomorphic activities (e.g., informal farmsteads; transmission line, roads/tracks, old and current mining/prospecting activities, etc.) and none of the unique mammals are expected to be exclusively associated with this area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on important mammals potentially occurring in the area.

Open Pit impact
The impact of heavy machinery and blasting operations during excavation activities is expected to be detrimental to mammals directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

The impacts of the open pit(s) are expected to be detrimental to mammals associated with the affected area/habitat and/or could act as pitfall traps. However, most larger mammals known/expected to occur in the area would avoid the active mining areas and/or be deterred by the waste rock dump sites around the pits, while the smaller mammals would probably use the pit(s) as part of their habitat and/or rather be attracted to the rocky waste dumps as more suitable habitat. Filling up of the pits after mining and/or sloping the pits would negate the pitfall problem.

The impacts of the mining activities are expected to be detrimental to mammals associated with the affected area/habitat although larger mammals known/expected to occur in the area would avoid the active mining areas. All vehicle activities (including long hauling) should abide by the speed limits to avoid road mortalities. Furthermore, larger mammals are very adaptable to disturbances, range over vast areas, and are attracted to areas with grazing after localised rainfall events (i.e., mostly avoid disturbed areas) while the overall low densities of all mammal species in the mining area would negate the problem.

Concentrator Processing Plant impact
The impact of heavy machinery during excavation and processing activities is expected to be detrimental to mammals directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Heap Leach & Hydrometallurgical Plant (Options 1 & 2) impact
The impact of heavy machinery during construction and processing activities is expected to be detrimental to mammals directly associated with the affected area/habitat as well as overall habitat destruction.

HLP Option 1 is flatter and less rocky with less diverse biodiversity than HLP Option 2. HLP Option 1 is the preferred site and expected to have fewer negative impacts on mammals. This would affect a relatively small area albeit be permanent of nature.

Tailings Disposal – Options 3, 4 & 5 impact
The impact of heavy machinery and associated activities is expected to be detrimental to mammals directly associated with the affected area/habitat as well as overall habitat destruction.

TSF4 is flatter and less rocky with less diverse biodiversity than TSF3 & 5. TSF3 is in a diverse rocky area while TSF5 is in an unspoilt drainage line with seeps and both are viewed as biodiversity hotspots with unique features in the landscape. TSF4 is the preferred site and expected to have fewer negative impacts on mammals.

Waste Rock Dumps/Stockpiles – Options 1 & 3 impact
The impact of heavy machinery and associated activities is expected to be detrimental to mammals directly associated with the affected area/habitat as well as overall habitat destruction.

Eastern portion of WRD1 and entire WRD 3 are in barren sparsely vegetated areas and expected to have few negative impacts on mammals. Western portion of WRD 1 overlaps with the plateau area which represents a biodiversity hotspot and unique biodiversity in the landscape.

Access & Haul Roads impact

The impact of heavy machinery during construction activities is expected to be detrimental to mammals directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

The impact of access route(s) is not expected to be detrimental to mammals – i.e., would not impede their movement, etc. However, increased traffic would result in road kills, especially for nocturnal species with nocturnal traffic. Some species are also attracted to roads for thermoregulation purposes (e.g., various small mammals) increasing road kills. However, track discipline should be maintained (e.g., minimise speed (e.g., 40km/h), no off-road driving, limited nocturnal driving, etc.), speed humps and vehicle calming devices should be incorporated along the route. This should act as mitigation measure for important, especially nocturnal, mammals.

A tarmac access route would result in less dust pollution and make installing the speed humps and vehicle calming devices, etc. easier than a gravel route. However, a tarmac access route would attract certain mammals (e.g., carnivores, etc.) to it for foraging purposes resulting in potentially more mortalities. This could be negated by limiting nocturnal vehicle activity along this route.

Bulk Water Infrastructure – Options 1 & 2 impact

The impact of heavy machinery during excavation of a trench to bury a pipeline is expected to be detrimental to mammals directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Should the pipeline be buried, an open trench could act as a giant pitfall trap and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench.

Height

A detailed study on the effects of an aboveground pipeline infrastructure on vertebrate fauna was conducted by Cunningham et al. (2015) on a 40km section from the Swakopmund Base Station to the Langer Heinrich Mine junction. Heights, crossing points and species affected were assessed. It was determined that most springbok crossed the pipeline with heights between 40-70cm (91.1%) with the greatest number crossing at 50-60cm (44%) while gemsbok crossed with difficulty (e.g., individuals only) at 60cm. This indicates that a pipeline height of >70cm is an effective barrier to most springbok and >60cm for gemsbok while anything >80cm is a total barrier (e.g., only 0.4% of springbok crossings were above 80cm) (Cunningham et al. 2015). Although springbok have been observed crossing cattle fences of 1.5m when pressed, often with fatalities, most avoid this height (Pers. obs.). Mountain zebra is expected to be similarly negatively affected while kudu, a typical jumping species, is not affected.

The effect of aboveground pipeline infrastructure >80cm is expected to be detrimental to most ungulates – i.e., would impede their movement, etc.

Crossing Points

Ungulate activity is associated with the availability of vegetation, especially along ephemeral drainage lines. Most pipeline crossing attempts were made in the vicinity of vegetated drainage lines (Cunningham et al. 2015).

Raised – earth covered – crossing points, 30m in width were not used by ungulates while buried sections did not impede movements at all (Cunningham et al. 2015).

Pipeline infrastructure >80cm in height would be viewed as an effective barrier to most ungulates while belowground crossing points would be best situated at drainage lines.

To prevent the pipeline serving as a barrier to ungulates, it would be recommended to bury the pipeline along the entire route.

Pipeline Option 2 along the Haib River is significantly shorter than Option 1 from the Noordoewer area making it the preferred option with less overall impact on the environment and associated mammals.

Water Storage Dam impact
The impact of heavy machinery during construction activities is expected to be detrimental to mammals directly associated with the affected area/habitat as well as overall habitat destruction. Once operational the water storage dam would attract mammals and serve as a new, albeit artificial, water point with associated habitat.

Mine Housing Options 1 & 2 impact
The impact of heavy machinery during construction activities is expected to be detrimental to mammals directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Mine Housing Option 2 is located on a flat and open sandy/gravel plain area between small rocky outcrops while Option 1 is located within rocky habitat closer to the Haib River. Option 2 is viewed as the preferred option with less overall impact on the environment and associated mammals.

Bulk Power Supply impact
Solar PV Plant impact
The impact during construction, are expected to be detrimental to mammals associated with the affected area/habitat. This would affect a relatively small area over a short/limited period.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to mammals – i.e. would not impede their movement, etc.

Transmission line and substation impact
The impact of heavy machinery during excavation of pylon holes is expected to be detrimental to mammals directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area over a short/limited period.

However, open pylon holes could act as pitfall traps and should not be left open overnight.

The impact of above ground 33kV overhead transmission line (OTL) infrastructure is not expected to be detrimental to mammals – i.e., would not impede their movement, etc. However, species potentially causing problems include baboon and monkeys although their impacts can be mitigated by insulating jumper downleads on pole-mounted transformers and insulating bushings with bushing covers. Substation outages are occasionally caused by small spotted genet throughout Namibia and preventative measures should be employed to prevent these (e.g., install adequate squirrel guard and electrostatic animal guard technologies, etc.). Electric fencing can be effective to prevent baboon/monkey/genet for gaining access to substation infrastructures if no large trees close by (Van Rooyen 2003).

Furthermore, none of the unique/important mammal species are exclusively associated with the proposed development area.

6.1.4 Avian Diversity

Bird diversity known and/or expected to occur in the general area, including species confirmed during the fieldwork as well as the authors confirmed records during other studies from the general area, is presented in Table 5.

Although Namibia's avifauna is comparatively sparse compared to the high rainfall equatorial areas elsewhere in Africa, approximately 658 species have already been recorded with a diverse and unique group of arid endemics (Brown *et al.* 1998, Maclean 1985). Fourteen species of birds are endemic or near endemic to Namibia with most Namibian endemics occurring in the savannas (30%) of which ten species occur in a north-south belt of dry savannah in central Namibia (Brown *et al.* 1998).

Bird diversity is viewed as "low" in the general area with between 81-110 species estimated although none of these are viewed as endemic species (Mendelsohn *et al.* 2000). Simmons (1998a) also supports the lack of endemic species in the area as well as a "low" ranking for southern African endemics and red data birds, respectively. Furthermore, the general area is also not classified as an Important Birding Area (IBA) in Namibia (Simmons 1998b) with the closest such site being the globally important Tsau //Khaeb (Sperrgebiet) National Park approximately 130 km to the northwest. However, the Orange River habitat to the south is an important site for birds in the general area.

At least 153 species of terrestrial ["breeding residents"] birds occur and/or could occur in the general area at any time (Hockey *et al.* 2006, Maclean 1985, Tarboton 2001). All the aquatic (i.e., Orange River species – e.g., aquatic spp.), extralimital breeders and migrant species have been excluded here. Only 1 – rosy-faced lovebird – of the 14 Namibian endemics are expected to occur in the general area (7.1% of all Namibian endemic species or 0.7% of all the species expected to occur in the area).

Fifty-six (36.6% of all the birds expected) species have a southern African conservation rating with 24 species classified as endemic (42.9% of southern African endemics or 15.7% of all the birds expected) and 32 species classified as near endemic (57.1% of southern African endemics or 20.9% of all the birds expected) (Hockey *et al.* 2006).

Simmons *et al.* (2015) classifies 7 species as endangered (Ludwig's bustard, white-backed vulture, black harrier, tawny eagle, booted eagle, martial eagle, black stork), 3 species as vulnerable (African fish eagle, lappet-faced vulture, secretarybird) and 5 species as near threatened (Cape eagle owl, kori bustard, Verreaux's eagle, peregrine falcon, marabou stork) from Namibia.

The IUCN (2025) classifies 1 species as critically endangered (white-backed vulture), 5 species as endangered (black harrier, martial eagle, secretarybird, Ludwig's bustard and lappet-faced vulture), 1 species as vulnerable (tawny eagle) and 1 species as near threatened (kori bustard).

Many species expected to occur in the general area have marginal distributions in Namibia and are mainly found in South Africa – e.g., Kimberley pipit. Other species such as the black harrier – vulnerable – migrate to Namibia although their main breeding grounds are known from South Africa. As very little ringing/recording occurs in the far southern Namibia, little is known about the distribution and ecology of many species from the general area with many more species expected to occur.

Table 5. Avian diversity expected (literature study) and confirmed during the 1st and 2nd rapid site assessments (fieldwork conducted during November 2023 [√[1]] & October 2025 [√[2]]); author's unpublished records (√#) as well as other studies conducted from the general area (See: Cunningham 2010a, [3]Cunningham 2016a, [4]Cunningham and Thomson 2016, Simmons 1997).

Species: Scientific name	Species: Common name	Species confirmed	Simmons (1997)	Cunningham (2010a)	Namibian conservation and legal status	International Status	
						Southern Africa	IUCN
Struthio camelus	Common Ostrich						
Pternistis capensis	Cape Spurfowl		√	√		End	
Coturnix coturnix	Common Quail						
Numida meleagris	Helmeted Guineafowl						
Dendropicos fuscescens	Cardinal Woodpecker			√			
Tricholaema leucomelas	Acacia Pied Barbet	√#	√	√		N-end	
Trachyphonus vaillantii	Crested Barbet						
Upupa africana	African Hoopoe			√			
Rhinopomastus cyanomelas	Common Scimitarbill	√#					
Merops hirundineus	Swallow-tailed Bee-eater	√#	√	√			
Merops apiaster	European Bee-eater						
Colius colius	White-backed Mousebird	√#	√	√		End	
Urocolius indicus	Red-faced Mousebird	√#					
Chrysococcyx caprius	Diderick Cuckoo		√				
Agapornis roseicollis	Rosy-faced Lovebird			√	End	N-end	
Cypsiurus parvus	African Palm Swift	√#					
Tachymarptis melba	Alpine Swift	√#					
Apus bradfieldi	Bradfield's Swift	√[1,2]	√			N-end	
Apus affinis	Little Swift	√#	√				
Apus caffer	White-rumped Swift						
Tyto alba	Barn Owl	√#					
Bubu capensis	Cape Eagle Owl	√#	√		NT		
Bubo africanus	Spotted Eagle Owl		√	√			
Caprimulgus tristigma	Freckled Nightjar	√#	√				
Caprimulgus rufigena	Rufous-cheeked Nightjar			√			
Columba livia	Rock Dove		√				
Columba guinea	Speckled Pigeon	√[2];√#		√			

Species: Scientific name	Species: Common name	Species confirmed	Simmons (1997)	Cunningham (2010a)	Namibian conservation and legal status	International Status	
						Southern Africa	IUCN
Streptopelia capicola	Cape Turtle Dove	√[1,2]	√				
Streptopelia senegalensis	Laughing Dove	√[2];√#	√	√			
Streptopelia semitorquata	Red-eyed Dove		√	√			
Oena capensis	Namaqua Dove	√[1,2]	√	√			
Neotis ludwigii	Ludwig's Bustard	√[1,2]	√		E	N-end	E
Ardeotis kori	Kori Bustard	√#			NT		NT
Afrotis afraoides	Northern Black Korhaan	√#				End	
Eupodotis vigorsii	Karoo Korhaan	√[1]				End	
Pterocles namaqua	Namaqua Sandgrouse	√[1,2]	√			N-end	
Pterocles bicinctus	Double-banded Sandgrouse			√		N-end	
Burhinus capensis	Spotted Thick-knee	√#					
Charadrius tricollaris	Three-banded Plover						
Vanellus armatus	Blacksmith Lapwing		√	√			
Vanellus coronatus	Crowned Lapwing						
Rhinoptilus africanus	Double-banded Courser	√#					
Cursorius rufus	Burchell's Courser	√[1,2]	√			N-end	
Pandion haliaetus	Osprey						
Elanus caeruleus	Black-shouldered Kite		√	√			
Haliaeetus vocifer	African Fish Eagle		√	√	V		
Gyps africanus	White-backed Vulture	√#			E		CR
Aegypius tracheliotos	Lappet-faced Vulture	√#			V		E
Circaetus pectoralis	Black-chested Snake-Eagle	√#	√				
Circus maurus	Black Harrier	√#			E	End	E
Polyboroides typus	African Harrier-hawk						
Melierax canorus	Southern Pale Chanting Goshawk	√[1]	√	√		N-end	
Melierax gabar	Gabar Goshawk						
Buteo rufofuscus	Jackal Buzzard	√#	√			End	
Aquila rapax	Tawny Eagle				E		V
Aquila verreauxii	Verreaux's Eagle	√#	√	√	NT		
Aquila pennatus	Booted Eagle	√[1]	√		E		
Polemaetus bellicosus	Martial Eagle	√#			E		E

Species: Scientific name	Species: Common name	Species confirmed	Simmons (1997)	Cunningham (2010a)	Namibian conservation and legal status	International Status	
						Southern Africa	IUCN
Sagittarius serpentarius	Secretarybird	√#			V		E
Polihierax semitorquatus	Pygmy Falcon	√#		√			
Falco rupicolus	Rock Kestrel	√[1]	√	√			
Falco rupicoloides	Greater Kestrel		√				
Falco chicquera	Red-necked Falcon						
Falco biarmicus	Lanner Falcon	√#	√				
Falco peregrinus	Peregrine Falcon		√		NT		
Scopus umbretta	Hamerkop		√				
Ciconia nigra	Black Stork		√		E		
Leptoptilos crumeniferus	Marabou Stork				NT		
Dicrurus adsimilis	Fork-tailed Drongo						
Nilaus afer	Brubru		√				
Telophorus zeylonus	Bokmakierie	√#	√			N-end	
Batis pririt	Pririt Batis	√#	√	√		N-end	
Corvus capensis	Cape Crow	√[2]		√			
Corvus albus	Pied Crow	√[1,2]	√				
Lanius collaris	Common Fiscal	√#	√	√			
Anthoscopus minutes	Cape Penduline Tit					N-end	
Parus afer	Grey Tit					End	
Riparia paludicola	Brown-throated Martin		√	√			
Hirundu albigularis	White-throated Swallow						
Hirundo dimidiata	Pearl-breasted Swallow						
Hirundo cucullata	Greater Striped Swallow			√			
Hirundo fuligula	Rock Martin	√[1,2]	√	√			
Pycnonotus nigricans	African Red-eyed Bulbul	√#	√	√		N-end	
Stenostira scita	Fairy Flycatcher					End	
Sylvietta rufescens	Long-billed Crombec	√#	√	√			
Eremomela icteropygialis	Yellow-bellied Eremomela		√				
Eremomela gregalis	Karoo Eremomela	√[1]					
Acrocephalus baeticatus	African Reed Warbler		√				
Acrocephalus gracilirostris	Lesser Swamp-Warbler						
Parisoma layardi	Layard's Tit-Babbler					End	

Species: Scientific name	Species: Common name	Species confirmed	Simmons (1997)	Cunningham (2010a)	Namibian conservation and legal status	International Status	
						Southern Africa	IUCN
Parisoma subcaeruleum	Chestnut-vented Tit-Babbler			√		N-end	
Zosterops pallidus	Orange River White-eye	√#	√	√		End	
Cisticola subruficapilla	Grey-backed Cisticola		√			N-end	
Cisticola juncidis	Zitting Cisticola						
Prinia flavicans	Black-chested Prinia	√#	√	√			
Prinea maculosa	Karoo Prinia					End	
Phragmacia substriata	Namaqua Warbler					End	
Malcorus pectoralis	Rufous-eared Warbler					End	
Euryptila subcinnamommea	Cinnamon-breasted Warbler		√			End	
Mirafra apiata	Cape Clapper Lark					End	
Mirafra sabota	Sabota Lark	√#	√				
Calendulauda africanoides	Fawn-coloured Lark	√#				N-end	
Chersomanes albofasciata	Spike-heeled Lark	√#				N-end	
Certhilauda subcoronata	Karoo Long-billed Lark	√[1,2]	√			End	
Eremopterix australis	Black-eared Sparrowlark	√#	√			End	
Eremopterix verticalis	Grey-backed Sparrowlark	√[2];√#	√			N-end	
Calandrella cinerea	Red-capped Lark	√#	√				
Alauda starki	Stark's Lark	√#				N-end	
Monticola brevipes	Short-toed Rock Thrush						
Turdus smithi	Karoo Thrush					End	
Bradornis infuscatus	Chat Flycatcher	√#	√	√		N-end	
Muscicapa striata	Spotted Flycatcher						
Cossypha caffra	Cape Robin-Chat		√	√			
Cercotrichas coryphoeus	Karoo Scrub-Robin	√#		√		End	
Oenanthe monticola	Mountain Wheatear	√[1,2]	√	√		N-end	
Oenanthe pileata	Capped Wheatear	√#	√				
Cercomela sinuata	Sickle-winged Chat					End	
Cercomela schlegelii	Karoo Chat	√#				N-end	
Cercomela tractrac	Tractrac Chat	√[2];√#	√			N-end	
Cercomela familiaris	Familiar Chat	√[1,2]	√	√			
Myrmecocichla formicivora	Ant-eating Chat	√#	√			End	
Onychognathus nabouroup	Pale-winged Starling	√[1,2]	√	√		N-end	

Species: Scientific name	Species: Common name	Species confirmed	Simmons (1997)	Cunningham (2010a)	Namibian conservation and legal status	International Status	
						Southern Africa	IUCN
Lamprotornis nitens	Cape Glossy Starling		√				
Creatophora cinerea	Wattled Starling	√#					
Sturnus vulgaris	Common Starling	√[3]			Alien		
Nectarinia famosa	Malachite Sunbird	√[4]					
Cinnyris chalybeus	Southern Double-collared Sunbird	√[4]					
Cinnyris fuscus	Dusky Sunbird	√[1,2]	√	√		N-end	
Sporopipes squamifrons	Scaly-feathered Finch	√#				N-end	
Plocepasser mahali	White-browed Sparrow-Weaver	√#					
Philetairus socius	Sociable Weaver	√[1]	√	√		End	
Ploceus velatus	Southern Masked-Weaver	√#	√	√			
Quelea quelea	Red-billed Quelea	√#					
Euplectes orix	Southern Red Bishop		√				
Amadina erythrocephala	Red-headed Finch	√#				N-end	
Estrilda astrild	Common Waxbill	√#	√	√			
Lagonostica senegala	Red-billed Firefinch						
Vidua macroura	Pin-tailed Whydah		√				
Passer domesticus	House Sparrow		√	√			
Passer motitensis	Great Sparrow					N-end	
Passer melanurus	Cape Sparrow	√[1,2]	√			N-end	
Passer griseus	Southern Grey-headed Sparrow						
Motacilla capensis	Cape Wagtail	√#	√	√			
Motacilla aguimp	African Pied Wagtail		√	√			
Anthus cinnamomeus	African Pipit						
Anthus similes	Long-billed Pipit						
Anthus pseudosimilis	Kimberley Pipit					End	
Serinus alario	Black-headed Canary		√			End	
Crithagra atrogulariis	Black-throated Canary						
Serinus flaviventris	Yellow Canary	√[2];√#	√			N-end	
Serinus albogularis	White-throated Canary	√[1]	√	√		N-end	
Emberiza impetuani	Lark-like Bunting	√[1,2]	√			N-end	
Emberiza capensis	Cape Bunting	√#	√			N-end	

This table excludes migratory birds (e.g., Petrel, Albatross, Skua, etc.), aquatic species (e.g., ducks, herons, kingfishers, etc.) and species breeding extralimital (e.g., stints, sandpipers, etc.) and rather focuses on birds that are breeding residents or can be found in the area during any time of the year. This would imply that many more birds (e.g., Palaearctic migrants) could occur in the area depending on "favourable" environmental conditions.
Namibian status: E – Endangered, V- Vulnerable, NT – Near Threatened (Simmons *et al.* 2015)
Southern African status: Hockey *et al.* (2006)
IUCN (2025): CE – Critically Endangered, E – Endangered, V- Vulnerable, NT – Near Threatened. All other species not listed are viewed as "Least Concern" by IUCN (2025)

Source for literature review: Brown *et al.* (1998), Cunningham (2010a), Cunningham (2016a), Cunningham (2016b), Cunningham and Thomson (2016), Cunningham (2018), Cunningham (2019), Cunningham *et al.* (2019), Cunningham (2020), Cunningham (2021a), Cunningham (2021b), Cunningham and Cunningham (2021), Cunningham (2023), Cunningham and Cunningham (2023), Hockey *et al.* (2006), IUCN (2025), Komen (n.d.), Little and Crowe (2011), Maclean (1985), Peacock (2015), Simmons *et al.* (1997), Simmons *et al.* (2015), Tarboton (2001)

The most important species expected to occur in the general area are the one endemic – rosy-faced lovebird – although it is common and widespread throughout much of Namibia, and the birds classified as critically endangered (white-backed vulture), endangered (black harrier, martial eagle, secretarybird, Ludwig's bustard and lappet-faced vulture), vulnerable (tawny eagle) and near threatened (kori bustard) by the IUCN (2025) as well as those classified by Simmons *et al.* (2015) from Namibia as endangered (Ludwig's bustard, white-backed vulture, black harrier, tawny eagle, booted eagle, martial eagle, black stork), vulnerable (African fish eagle, lappet-faced vulture, secretarybird) and near threatened (Cape eagle owl, kori bustard, Verreaux's eagle, peregrine falcon, marabou stork). At least 1-4 Namibian Red Data Bird species are known/expected to occur in the general area (Figure 24).

However, none of the birds, especially the important species, are exclusively associated with the Haib Copper Project area.

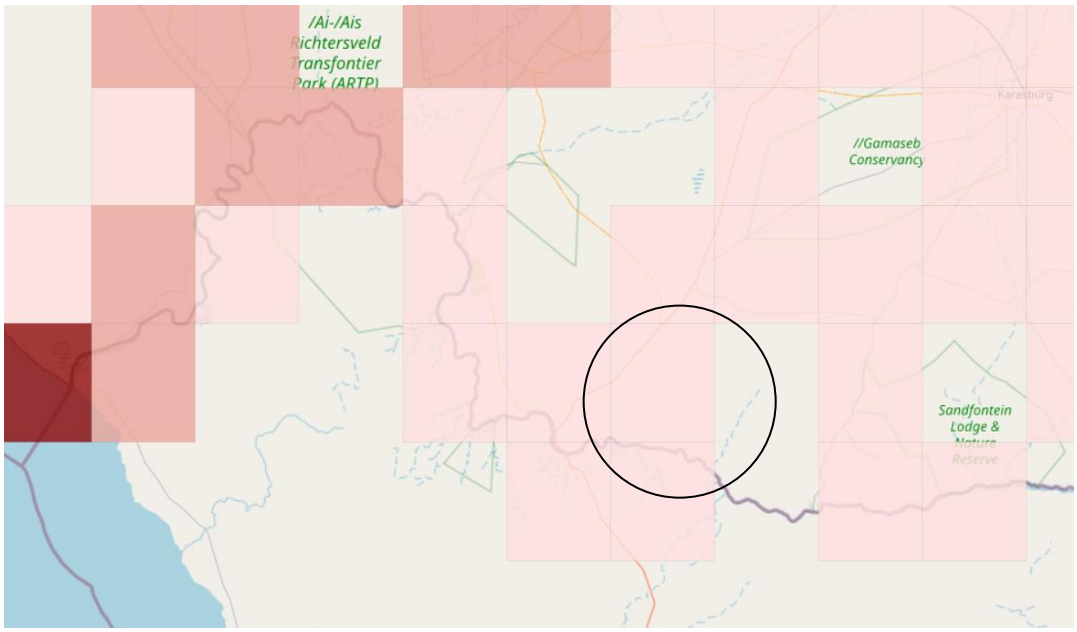

Figure 24. Between 1-4 Namibia Red Data Bird species are known/expected to occur in the general area (Source: www,the-eis.com) (See black circle).

During November 2023 and October 2025 only 22 and 21 species of birds were confirmed (i.e., observed) to occur in the general area (Figures 25-27) with the most important species observed being Ludwig's bustard (endangered) on the gravel plain areas and probable booted eagle (endangered) nest on cliffs in the upper Haib River area. A total of 31 species of birds were confirmed when combining November 2023 and October 2025 observations (Table 5). These low numbers indicate the overall marginal habitat and dry conditions. At least 114 species of birds are confirmed from the general area – i.e., Cunningham (2016a), Cunningham (2016b), Cunningham and Thomson (2016), Cunningham (2018), Cunningham (2019), Cunningham *et al.* (2019), Cunningham (2020), Cunningham (2021a), Cunningham 2021b), Cunningham and Cunningham (2021), Cunningham (2023), Cunningham and Cunningham (2023), Cunningham (unpublished records) – See Table 5.

Simmons *et al.* (1997) confirmed 94 species from the general area of which 53 species were associated with Karoo environments and 70 species associated with the Orange River habitat. Another 8 species were confirmed using SABAP (South African Bird Atlas Project) records from the general area (Simmons *et al.* 1997). Not all the species identified by Simmons *et al.* (1997) are included in Table 5 as the typical Orange River associated aquatic species were excluded. Cunningham (2010a) confirmed 59 species Komsberg area (180-190 km to the east) (not all included in Table 5).

Figure 25. A booted eagle (endangered) nest site on cliffs in the upper Haib River area (See arrow).

Figure 26. Karoo korhaan observed on gravel plains habitat.

Figure 27. Ludwig's bustard (*Neotis ludwigii*) – endangered (IUCN 2025) – mortality associated with the existing 132kV OTL in the Mine Housing Option 1 area.

Large portions of the Haib Copper Project area have been heavily impacted due to various old anthropomorphic activities (e.g., informal farmsteads; transmission line, roads/tracks, old and current mining/prospecting activities, etc.) and none of the unique birds are expected to be exclusively associated with this area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on important birds potentially occurring in the area.

Open Pit impact
The impact of heavy machinery and blasting operations during excavation activities is expected to be detrimental to birds directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

The impacts of the mining activities are expected to be detrimental to birds associated with the affected area/habitat although larger birds known/expected to occur in the area would avoid the active mining areas. All vehicle activities (including long hauling) should abide by the speed limits to avoid road mortalities. Furthermore, most birds are very adaptable to disturbances, range over vast areas, and are attracted to areas with grazing after localised rainfall events (i.e., mostly avoid disturbed areas).

Concentrator Processing Plant impact
The impact of heavy machinery during excavation and processing activities is expected to be detrimental to birds directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Heap Leach & Hydrometallurgical Plant (Options 1 & 2) impact
The impact of heavy machinery during construction and processing activities is expected to be detrimental to birds directly associated with the affected area/habitat as well as overall habitat destruction.

HLP Option 1 is flatter and less rocky with less diverse biodiversity than HLP Option 2. HLP Option 1 is the preferred site and expected to have fewer negative impacts on birds. This would affect a relatively small area albeit be permanent of nature.

Tailings Disposal – Options 3, 4 & 5 impact
The impact of heavy machinery and associated activities is expected to be detrimental to birds directly associated with the affected area/habitat as well as overall habitat destruction.

TSF4 is flatter and less rocky with less diverse biodiversity than TSF3 & 5. TSF3 is in a diverse rocky area while TSF5 is in an unspoilt drainage line with seeps and both are viewed as biodiversity hotspots with unique features in the landscape. TSF4 is the preferred site and expected to have fewer negative impacts on birds.

Waste Rock Dumps/Stockpiles – Options 1 & 3 impact
The impact of heavy machinery and associated activities is expected to be detrimental to birds directly associated with the affected area/habitat as well as overall habitat destruction.

The Eastern portion of WRD1 and entire WRD 3 are in barren sparsely vegetated areas and expected to have few negative impacts on birds.

Access & Haul Roads impact
The impact of heavy machinery during construction activities is expected to be detrimental to birds directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature during the construction and operational phases.

The impact of access route(s) is not expected to be detrimental to birds – i.e., would not impede their movement, etc. However, increased traffic would result in road kills, especially for nocturnal species with nocturnal traffic. However, track discipline should be maintained (e.g., minimise speed (e.g., 40km/h), no off-road driving, limited nocturnal driving, etc.), speed humps and vehicle calming devices should be incorporated along the route. This should act as mitigation measure for important, especially nocturnal, birds.

A tarmac access route would result in less dust pollution and make installing the speed humps and vehicle calming devices, etc. easier than a gravel route. However, a tarmac access route would attract certain birds (e.g., crows, smaller raptors, owls, etc.) to it for foraging purposes resulting in potentially more mortalities. This could be negated by limiting nocturnal vehicle activity along this route.

Bulk Water Infrastructure – Options 1 & 2 impact
The impact of heavy machinery during excavation of a trench to bury a pipeline is expected to be detrimental to birds directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Should the pipeline be buried, an open trench could act as a giant pitfall trap and should not be left open overnight and/or have regular exists along its route, especially at the two ends of the trench.

Height
A detailed study on the effects of an aboveground pipeline infrastructure on avifauna was conducted by Cunningham et al. (2015) on a 40km section from the Swakopmund Base Station to the Langer Heinrich Mine junction. Heights; crossing points and species affected were assessed. It was determined that ostrich did not cross the pipeline at all and viewed it as an effective barrier. Other birds were not adversely affected by the pipeline infrastructure.

Crossing Points
Ostrich activity is correlated to the availability of vegetation, especially vegetated drainage lines in the Namib.

Raised – earth covered – crossing points, 30m in width were not used by ostrich while buried sections did not impede movements at all (Cunningham et al. 2015).

The effect of aboveground pipeline infrastructure is expected to be detrimental to ostrich – i.e., would impede their movement, etc.

To prevent the pipeline serving as a barrier to ostrich, it would be recommended to bury the pipeline along the entire route.

Pipeline Option 2 along the Haib River is significantly shorter than Option 1 from the Noordoewer area making it the preferred option with less overall impact on the environment and associated birds.

Water Storage Dam impact
The impact of heavy machinery during construction activities is expected to be detrimental to birds directly associated with the affected area/habitat as well as overall habitat destruction. Once operational the water storage dam would attract various birds, especially aquatic species (e.g., ducks, herons, etc.), and serve as a new, albeit artificial, water body with associated habitat.

Mine Housing Options 1 & 2 impact
The impact of heavy machinery during construction activities is expected to be detrimental to birds directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Mine Housing Option 2 is located on a flat and open sandy/gravel plain area between small rocky outcrops while Option 1 is located within rocky habitat closer to the Haib River. Option 2 is viewed as the preferred option with less overall impact on the environment and associated birds.

Bulk Power Supply impact
Solar PV Plant impact
The impact during construction, are expected to be detrimental to birds, especially ground nesting species associated with the affected area/habitat. This would affect a relatively small area over a short/limited period.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to birds – i.e. would not impede their movement, etc. Other problems such as "reflective surfaces" and "mirror collisions", etc. are not applicable – i.e., does not pose the same avifaunal impact as CSP (Concentrated Solar Power) (Jenkins et al. 2017, Smit n.d.). However, the collision mortality impacts of birds with PV panels may be underestimated (Jenkins et al. 2017) and ongoing long-term monitoring is viewed as imperative to determine local bird mortalities.

Transmission line and substation impact
The impact of heavy machinery during excavation of pylon holes is expected to be detrimental to birds directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area over a short/limited period.

However, open pylon holes could act as pitfall traps and should not be left open overnight.

None of the unique/important species are exclusively associated with the proposed development area, although the effect of aboveground transmission line infrastructure is expected to be detrimental to certain birds – e.g., "pylon sensitive species". Existing transmission line infrastructures, include a 22kV (Khurub-Noordoewer), 66kV (Khurub-Ausenkehr) and 132kV (e.g., Haib-Khurub) overhead lines in the general area.

Furthermore, none of the unique/important species are exclusively associated with the proposed development area.

A new substation and 33kV overhead transmission line network is proposed between various mine infrastructures (See Figure 28).

Birds expected to be negatively affected (i.e., collision and/or electrocution) by the transmission line developments include:

- *Birds flying at pylon height – e.g., bustards, swifts, sandgrouse, ravens, raptors, and aquatic and marine species.*
- *Birds with nocturnal transients – e.g., Palaearctic migrants and wetland birds (i.e., coastal area).*
- *Birds following certain geological and/or landscape features (e.g., rivers; mountain ranges, etc.) whilst foraging and/or migrating – e.g., aquatic/marine species and raptors.*
- *Birds attracted to the area during rainfall events – e.g., bustards – and temporary water sources in ephemeral rivers/drainage lines – e.g., aquatic/marine species.*

Pylon sensitive species

Pylon sensitive bird species (See Scott and Scott n.d.) known/expected to occur in the general area include:

- *African fish eagle;*
- *Black stork;*
- *Booted eagle;*
- *Cape eagle owl;*
- *Kori bustard;*
- *Lappet-faced vulture;*
- *Ludwig's bustard;*
- *Marabou stork;*
- *Martial eagle;*
- *Peregrine falcon;*
- *Tawny eagle;*
- *Verreaux's eagle; and*
- *White-backed vulture.*

Other potential transmission line issues related to birds would be species that typically nest on such structures.

Nest induced faulting caused by birds (See Scott and Scott n.d.) includes:

- *Cape crow;*
- *Pied crow;*
- *Sociable weaver;*
- *Eagles – large; and*
- *Vultures.*

[Dummy poles, placed adjacent problem areas, could be used to attract nesting birds]

Factors influencing collision risk

The following factors influence the collision risk for birds (See: Van Rooyen 2003):

- *Voltage levels – i.e., correlation between physical size of bird and collision risk;*
- *Body size and flight behaviour – i.e., birds with a heavy body size and small wing surface are more prone to collisions;*
- *Flight height and habitat use – i.e., short distance, low altitude, frequency of overhead structures;*
- *Age (i.e., young birds more prone to collisions);*
- *Resident versus migratory birds (i.e., movement into unfamiliar terrain increases collisions);*
- *Weather (i.e., inclement weather increases collisions);*
- *Time of day (i.e., nocturnal movement increases collisions);*
- *Land use (i.e., cultivated areas attract birds); and*
- *Topography (i.e., mountains/rivers/shorelines act as corridors).*

Bird streamers often affect 33kV OTL's at night when big bird species roost on the pylon infrastructures (Van Rooyen 2003).

As many of the "pylon sensitive" bird species occur in the general area, it is recommended that BFD's (Bird Flight Diverters – e.g., coils, flappers, etc.) are installed along the entire 33kV transmission line network to minimise/prevent bird mortalities (See Figures 28-29).

It is recommended that the new 33kV transmission line network should be aligning in parallel (and as close as technically feasible) to the existing 132kV OTL (where coinciding – See Figure 28) with staggered pylon towers so that each tower is aligned with the mid-span of the neighbouring line, thus potentially making it more visible and prevent bird collisions as most collisions occur near the middle of a section of a span (87%) and fewer closer to the pylons (Pallett et al. 2022).

The OTL should follow the access routes and not along the ridges to minimise bird mortalities and facilitate maintenance and bird mortality monitoring (See Figure 28; white lines).

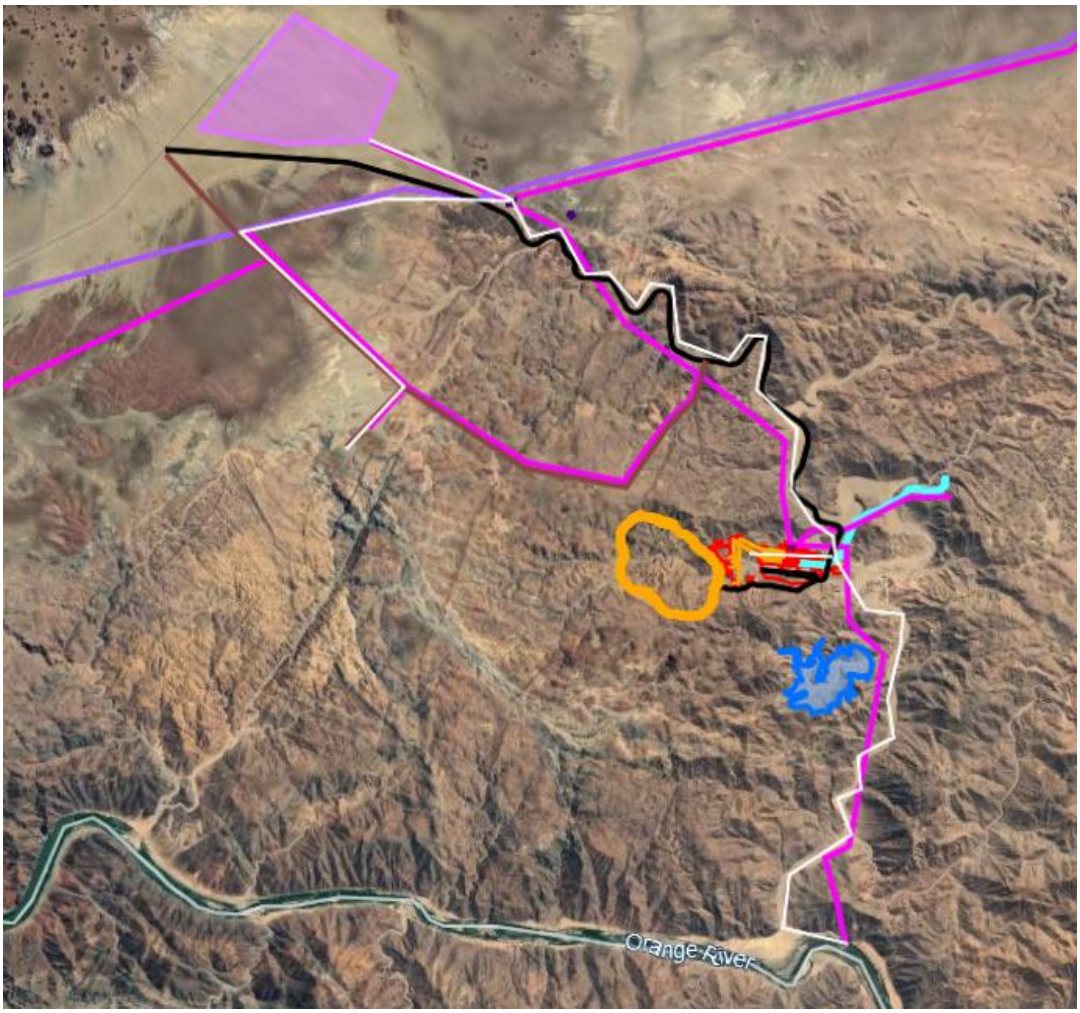

Figure 28. The proposed new 33KV overhead transmission line network is indicated in pink while the existing 132kV OTL route is indicated in purple. The proposed new solar PV site (light purple); access routes (brown & black); mine pit (orange); storage dam (blue) and plant (red) are also included. The white lines indicate the alternative 33kV OTL "shortest route" options. Bird flight diverters should be installed along the entire 33kV OTL route. A staggered pylon tower layout should be followed where the 33kV line runs parallel to the existing 132kV OTL (©Knight Piésold Consulting).

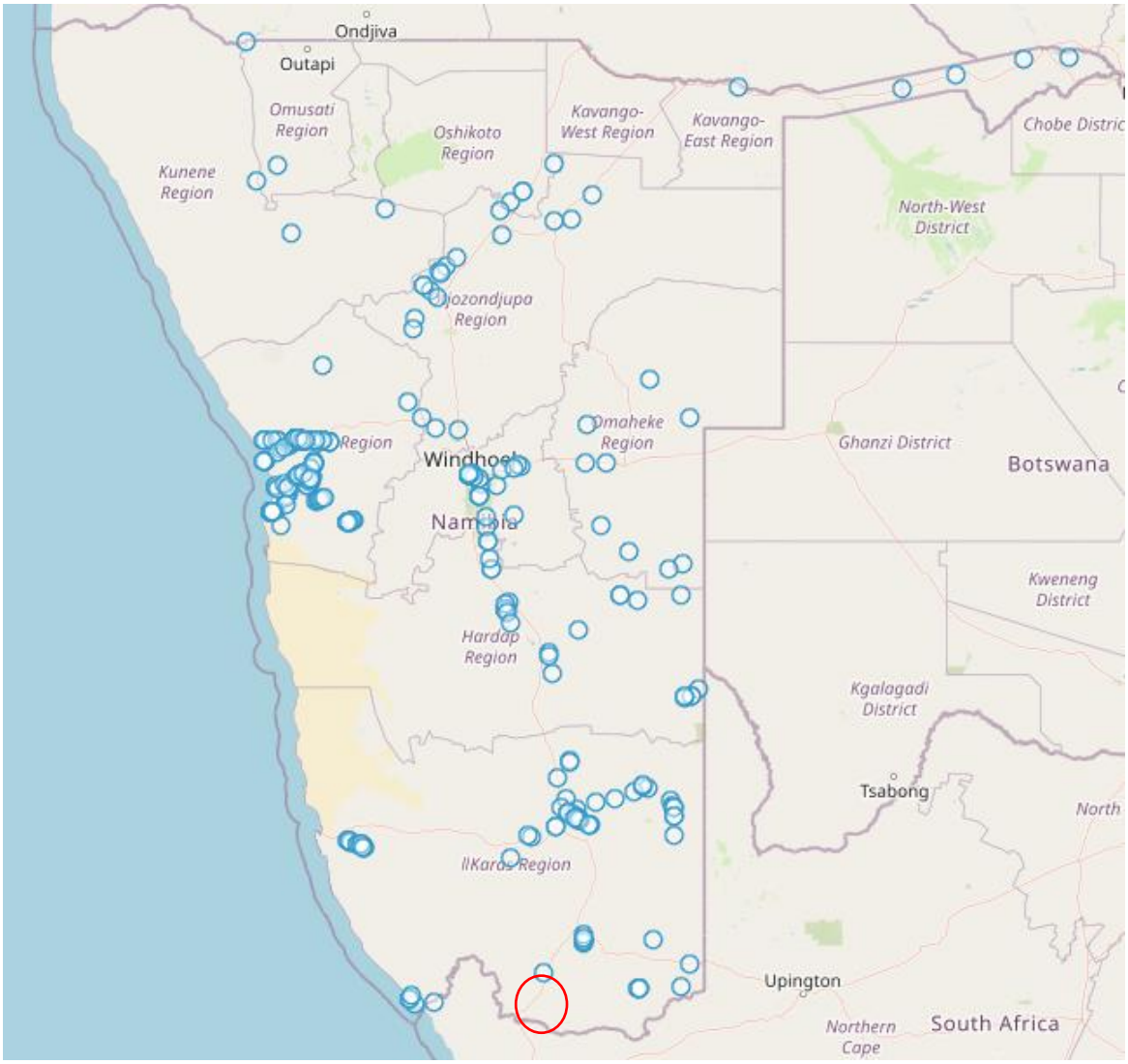

Figure 29a. Known bird mortalities caused by power lines throughout Namibia (March 2021) are indicated by blue circles. The general Noordoewer area – indicated by a red circle – although not currently a known "hotspot" BIRD collision risk area, is located between such sites to the west and east as well as near the Orange River, and new overhead transmission line(s) undoubtedly would increase bird collisions risks, etc. (Source: www.the-eis.com).

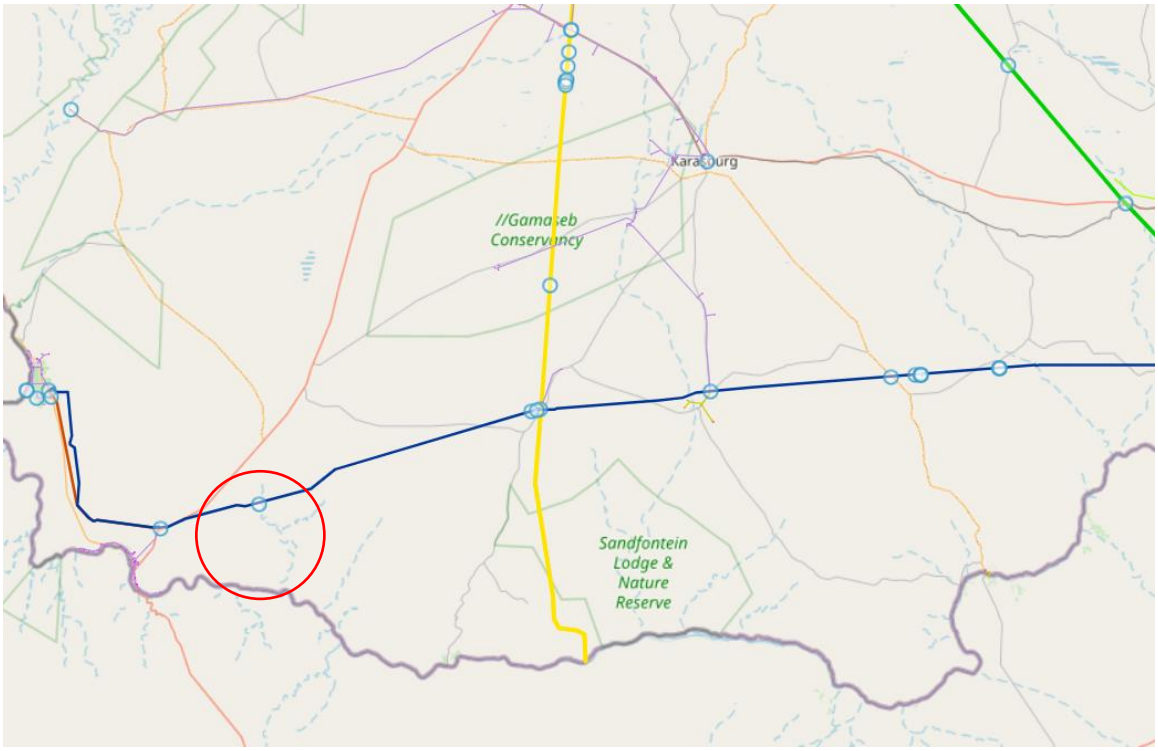

Figure 29b. Updated map for the general project area (red circle) indicating bird mortalities caused by power lines (blue circles). The blue circle located within the general Project atrea is a Ludwig's bustard killed along the existing 132kV OTL in the vicinity of the Mine Housing Option 1 – confirmed during this study (Source: www.the-eis.com).

6.2 Flora

6.2.1 Tree and Shrub Diversity

Tree and shrub diversity known and/or expected to occur in the general area, including species confirmed during the fieldwork as well as the authors confirmed records during other studies from the general area, is presented in Table 6.

According to Mannheimer and Curtis (2018) at least 56 species of larger trees and shrubs (>1m in height) are known and/or expected to occur in the general area.

Of the 54 larger tree/shrub species known/expected from the general area, 30 (55.6%) species have some kind of protected status (including endemic and near endemic). One species (1.9%) is classified as rare (*Ozoroa namaquensis*), 19 species protected by the Forest Act No. 12 of 2001 (35.2%), 2 species (3.7%) protected by the Nature Conservation Ordinance No. 4 of 1975 and 17 species are classified as near endemic (31.5%). The IUCN (2025) classifies 1 species as endangered (*Commiphora buruxa*) and 1 species as vulnerable (*(Aloidendron dichotomum) Aloe dichotoma*). All other species are classified as least concern or not yet been assessed by the IUCN Red List (See Table 6).

However, none of the larger trees and shrubs (>1m in height), especially the important species, are exclusively associated with the Haib Copper Project area.

Although at least 54 larger species of trees and shrubs (>1m in height) are known and/or expected to occur in the general area only 7, 20 and 17 species were identified in the following habitats – gravel plains, drainage lines and rocky areas during the November 2023 surveys – throughout the proposed project area, respectively. A total of 32 species of larger trees and shrubs (>1m in height) were identified throughout the area (See Table 6).

Table 6. Tree and shrub diversity (>1m in height) expected (literature study) and confirmed during the rapid assessment (√) conducted during November 2023 including author's confirmed records from other studies conducted from the general area (See: Cunningham 2010a, Cunningham 2013). The trees and shrubs known, and/or expected to occur in the general area (derived from Mannheimer and Curtis 2018).

Species: Scientific name	Habitats			Cunningham (2010a)	Cunningham (2013)	Namibian conservation and legal status	International status	
	Gravel plains	Drainage lines	Rocky areas				IUCN (2025)	CITES
Acacia erioloba		√		√	√	Protected (F)		
Acacia karroo		√		√	√			
Adenolobus garipensis		√	√	√	√			
(Aloidendron dichotomum) Aloe dichotoma	√		√	√	√	N-end; protected (F); Protected (NC)	V	C2
Berkheya chamaepeuce		√						
Boscia albitrunca		√	√	√	√	Protected (F)		
Boscia foetida	√	√		√	√	Protected (F)		
Cadaba aphylla	√			√	√			
Carissa haematocarpa								
Ceraria fruticulosa			√			N-end		
Portulacaria (Ceraria) namaquensis			√	√		N-end		
Commiphora capensis						N-end; Protected (F)		
Commiphora cervifolia					√	N-end; Protected (F)		
Commiphora gracilifrondosa			√	√		N-end; Protected (F)		
Commiphora namaensis			√			N-end; Protected (F)		
Commiphora buruxa							E	
Diospyros lycioides								
Diospyros ramulosa								
Ehretia alba		√						
Euclea pseudebenus		√		√	√	Protected (F)		
Euphorbia gregaria			√	√	√	N-end		C2
Euphorbia virosa			√	√	√			C2
Ficus cordata					√	Protected (F)		
Gaillonia crocyllis								
Gymnosporia linearis								
Gymnosporia senegalensis								
Jatropha orangeana								
Lycium bosciifolium	√			√	√			

Species: Scientific name	Habitats			Cunningham (2010a)	Cunningham (2013)	Namibian conservation and legal status	International status	
	Gravel plains	Drainage lines	Rocky areas				IUCN (2025)	CITES
Lycium horridum								
Maerua gilgii				√	√	N-end		
Maerua schinzii		√	√			Protected (F)		
Montinia caryophyllacea		√						
Nymania capensis		√	√					
Ozoroa concolor						N-end; Protected (F)		
Ozoroa dispar					√			
Ozoroa namaensis						N-end		
Ozoroa namaquensis						Rare; N-end; Protected (F)		
Pachypodium namaquanum						N-end; Protected (F); Protected (NC)		
Pappea capensis		√		√	√	Protected (F)		
Parkinsonia africana	√		√	√	√			
Phaeoptilum spinosum		√			√			
Rhigozum trichotomum			√	√	√			
Salsola spp.	√	√	√					
Salix mucronata subsp. *capensis*					√	Protected (F)		
Schotia afra				√	√	Protected (F)		
Searsia burchellii					√			
Searsia lancea						Protected (F)		
Searsia pendulina				√	√			
Searsia populifolia		√		√		N-end		
Searsia tenuinervis								
Sisyndite spartea	√	√		√	√	N-end		
Tamarix usneoides		√		√	√	Protected (F)		
Ziziphus mucronata		√		√	√	Protected (F)		
Zygophyllum cretaceum		√	√			N-end		
Zygophyllum prismatocarpum		√	√			N-end		
Zygophyllum rigidum			√		√	N-end		
Total:	**7**	**20**	**17**	**23 (25)[1]**	**27(28)[2]**			

Endemic and Near-endemic – (Mannheimer and Curtis 2018)
F – Forest Act No. 12 of 2001
NC – Nature Conservation Ordinance No. 4 of 1975

C2 – CITES Appendix 2 species
IUCN (2025): V – Vulnerable. All other species not listed are viewed as “Least Concern” or not yet been assessed by the IUCN Red List.
Rare – (Loots 2005)
[1] – Also: *Acacia mellifera, Commiphora glandulosa* (Cunningham 2010a)
[2] – Also: *Acacia mellifera* (Cunningham 2013)
Source for literature review: Coats Palgrave (1983), Cunningham (2010a), Cunningham (2013), Curtis and Mannheimer (2005), IUCN (2025), Loots (2005), Mannheimer and Curtis (2009), Mannheimer and Curtis (2018), Rothmann (2004), Steyn (2003), Van Wyk and Van Wyk (1997)

[Although African species of Acacia have undergone a name change and grouped into two distinct genera – i.e., Vachellia and Senegalia – which are clearly separated based on several morphological, anatomical & biochemical attributes (e.g., Vachellia has capitate inflorescences (round, head-like flowers) and spinescent stipules (thorns) while Senegalia has spicate inflorescences (flowers in spikes) and the stipules are non-spinescent), the International Code of Nomenclature for algae, fungi, and plants is not prescriptive and the author remains referring to Acacia throughout]

A total of at least 42 species is confirmed from the general area if one includes species identified by Cunningham (2010a [25 spp.], 2013 [28 spp.]) – See Table 6.

During November 2023 the flora was assessed for various habitats throughout the general development area.

The most important protected species (including endemic/near endemic, etc.) are viewed as:

Gravel Plain habitat:
- *(Aloidendron dichotomum) Aloe dichotoma*

Drainage Line habitat:
- *Acacia erioloba*, *Boscia albitrunca*, *Euclea pseudebenus*, *Maerua schinzii*, *Pappea capensis*, *Tamarix usneoides* and *Ziziphus mucronata*

Rocky Area habitat:
- *(Aloidendron dichotomum) Aloe dichotoma, Boscia albitrunca*, *Ceraria fruticulosa*, *Portulacaria (Ceraria) namaquensis*, *Commiphora gracilifrondosa*, *Commiphora namaensis* and *Maerua schinzii*

Gravel Plain habitat:
Ten species of larger trees and shrubs were encountered along various transects totalling 1,000m in the gravel plain habitat throughout the area. *Salsola* spp. (48%) and *Calicorema capitata* (37%) were the most dominant species observed during the fieldwork in this habitat (Figure 30-31). Protected species (and other important species) (*(Aloidendron dichotomum) Aloe dichotoma*, *Hoodia gordonii*, *Sarcocaulon flavescens*) account for only 8% of the species in this habitat, occur widespread throughout Namibia and not exclusively associated with the project area. All three these species can be successfully transplanted and relocated. Permits would also be required to remove these species.

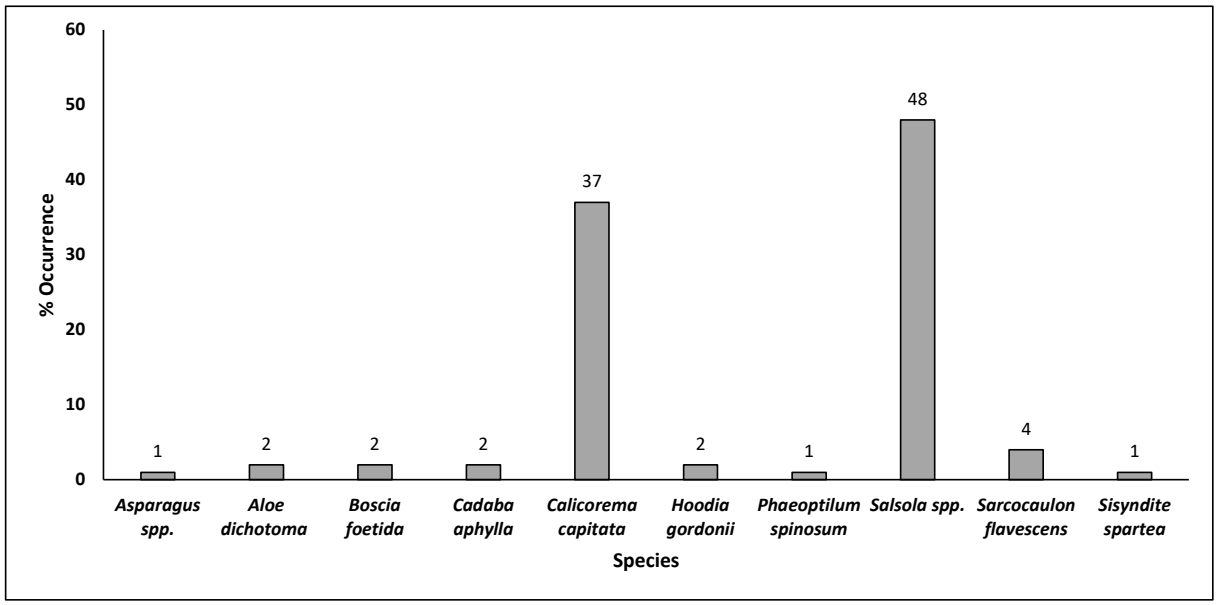

Figure 30. Tree and shrub species composition along various transects (total length – 1,000m @ 10m intervals) in the gravel habitat (N=100 points) during November 2023. Includes all woody species and not only species >1m in height.

Figure 31. Gravel plain habitat dominated by low shrubs and *Stipagrostis brevivolia* tufts.

Rocky Area habitat:

Sixteen species of larger trees and shrubs were encountered along various transects totalling 1,000m in the rocky area habitat. *Ruschia divaricata* (25%) and *Portulacaria* (*Ceraria) namaquensis* (24%) and *Euphorbia gregaria* (21%) were the most dominant species observed during the fieldwork in this habitat (Figure 32-33). Protected species (and other important species) (*(Aloidendron dichotomum) Aloe dichotoma, Boscia albitrunca*, *Ceraria fruticulosa*, *Portulacaria (Ceraria) namaquensis*, *Commiphora gracilifrondosa*, *Commiphora namaensis*, *Euphorbia gregaria*, *Ruschia divaricata* and *Tylecodon rubrovenosus*) account for 87% of the species in this habitat (i.e., are dominant in this habitat), occur widespread throughout Namibia and not exclusively associated with the project area. Except for *Boscia albitrunca* all these species can be successfully transplanted and relocated. Permits would also be required to remove these species.

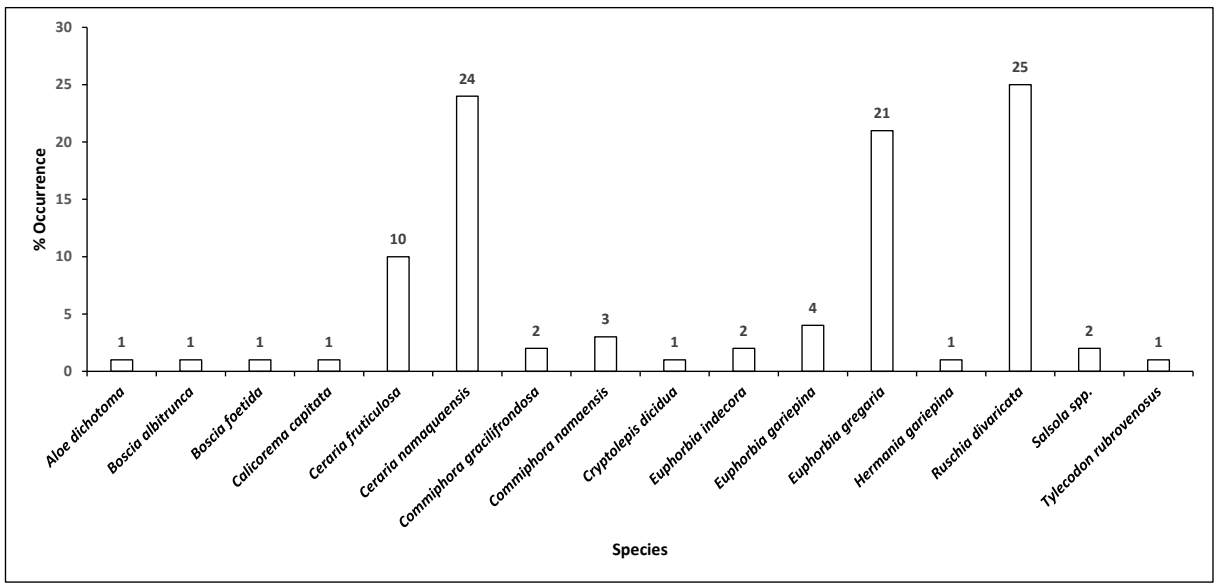

Figure 32. Tree and shrub species composition along various transects (total length – 1,000m @ 10m intervals) in the river habitat (N=100 points) during November 2023.

Figure 33. Rocky habitat – often well vegetated by a variety of unique and/or protected tree/shrub species (see a dense stand of *Portulacaria (Ceraria) namaquensis* – near endemic – above).

Drainage Line habitat:

Trees

Eleven species of larger trees were encountered along a transect totalling 20,000m (20km) in the Haib River habitat. This large ephemeral drainage line is indicative of larger tree/shrub species present throughout the area. *Maerua schinzii* (32% & 40%), *Tamarix usneiodes* (30% & 27%) and *Euclea pseudebenus* (15% & 10%) were the most dominant species observed during the fieldwork in this habitat (Figures 34 & 36). Protected species – *Acacia erioloba*, *Boscia albitrunca*, *Commiphora namaensis*, *Euclea pseudebenus*, *Maerua schinzii*, *Tamarix usneiodes*) – account for 77% & 84% in this habitat (i.e., are dominant in this habitat). These species are widespread throughout Namibia and not exclusively associated with the project area. However, as protected species are dominant and the Haib River is a sensitive habitat, all unnecessary activities should be avoided in this habitat as far as possible. Track discipline should be enforced along the river bed and no harvesting of firewood should be permitted. *Prosopis* spp. (mesquite) – invasive alien – is more numerous closer to the Haib River mouth area. Permits would also be required to remove these species.

Shrubs

Four species of larger shrubs were encountered along a transect totalling 20,000m (20km) in the Haib River habitat. This large ephemeral drainage line is indicative of larger tree/shrub species present throughout the area. *Sisyndite spartea* (35% & 49%) and *Calicorema capitata* (42% & 22%) were the most dominant species observed during the fieldwork in this habitat (Figure 35). *Sisyndite spartea* becomes more dominant as one travels northwards away from the Orange River while *Calicorema capitata* is more dominant in the lower reaches of the Haib River.

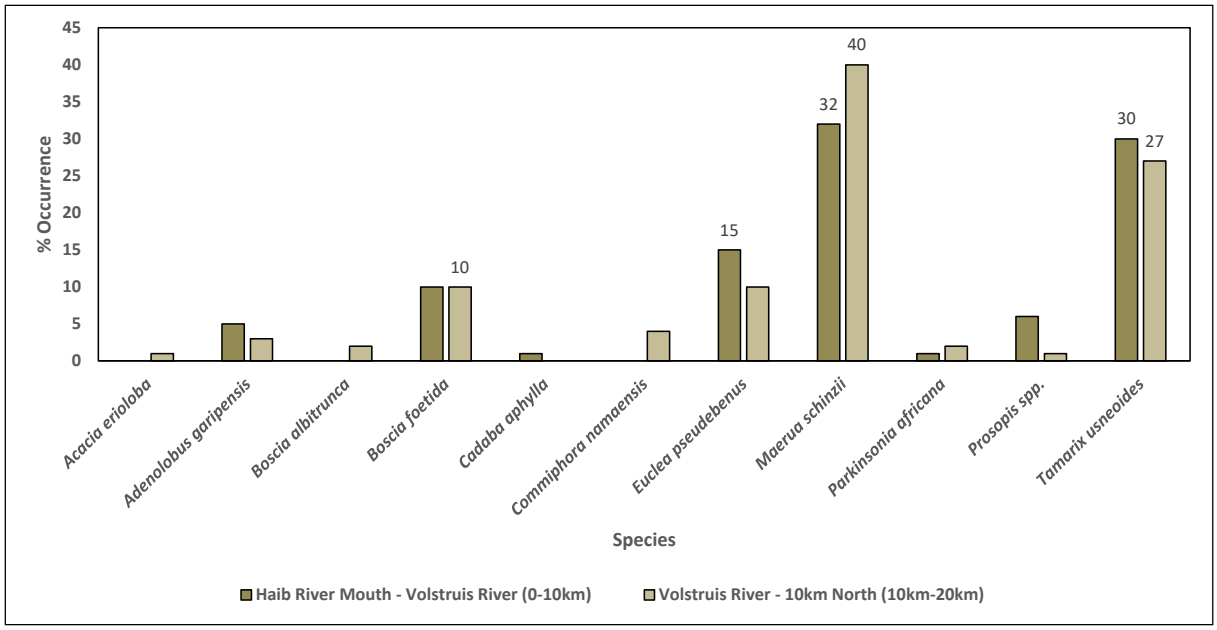

Figure 34. Tree species composition along a transects (total length – 20,000m @ 100m intervals) in the Haib River habitat (N=200 points). The transect starts at the Haib River mouth and moves northwards with 2 sections – i.e., Haib River mouth to Volstruis River (0-10km) & Volstruis River northwards for 10km (10-20km).

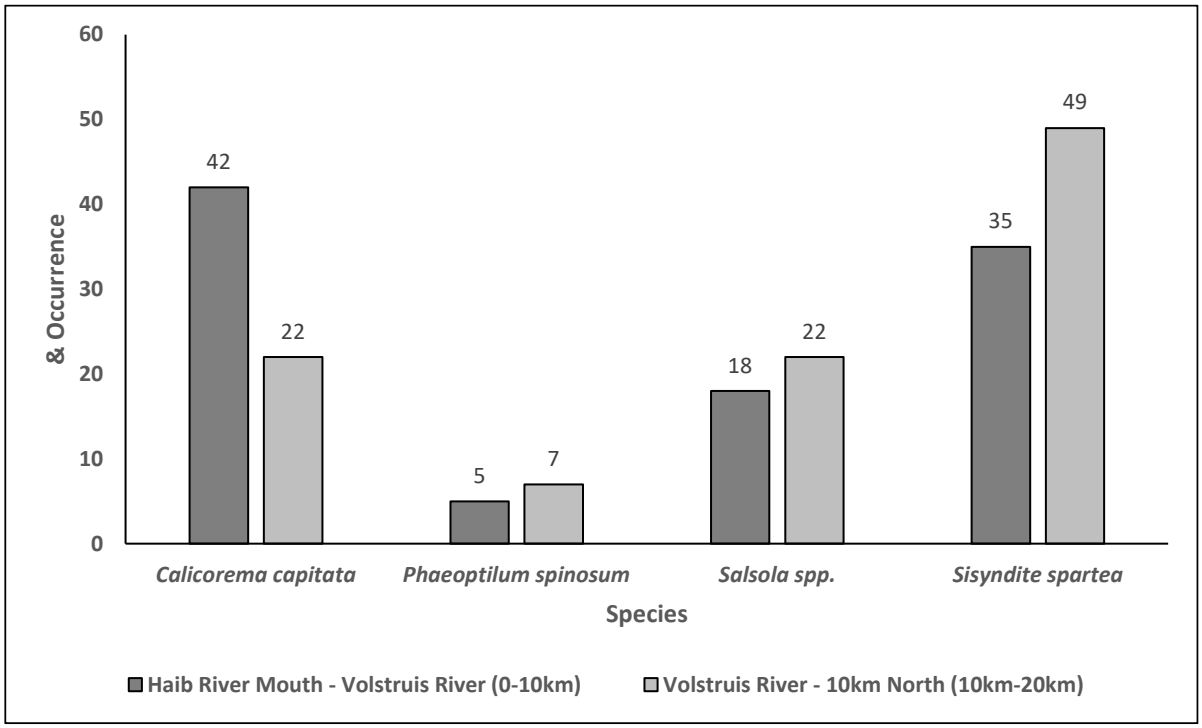

Figure 35. Shrub species composition along a transects (total length – 20,000m @ 100m intervals) in the Haib River habitat (N=200 points) during November 2023. The transect starts at the Haib River mouth and moves northwards with 2 sections – i.e., Haib River mouth to Volstruis River (0-10km) & Volstruis River northwards for 10km (10-20km).

Figure 36. Drainage line habitat – Haib River – with a high density of large and mostly protected tree species (See Figure 28).

The protected and/or unique species larger trees/shrubs identified during the fieldwork throughout the Haib River habitat occur widespread throughout Namibia and not limited to the project area. However, unique habitats such as the Haib River and other larger ephemeral drainage lines (especially the pipeline drainage line) have larger tree specimens which often serve as habitat for a variety of species – e.g., raptor breeding sites, bark and cavity dwelling species (bats, birds and reptiles), etc. – and stabilise riverbanks. The importance of these larger ephemeral drainage lines is supported by initial environmental studies conducted in the area by Burke (1997), Griffin (1997) and Simmons *et al.* (1997).

Rocky areas (e.g., mountains, outcrops, hills, ridges, etc.), especially the higher elevations, have a higher diversity of species including unique species – e.g., *Ceraria* spp., *Commiphora* spp., *Ruschia spp.*, *Tylecodon* spp., etc. The importance of these rocky habitats is supported by initial environmental studies conducted in the area by Burke (1997), Griffin (1997) and Simmons *et al.* (1997). However, many species (e.g., *Tylecodon* spp., etc.) are relatively easily to transplant/relocate and could be relocated to other similar habitats rather than just destroying them.

Developments and especially irreparable destruction of these habitats and associated unique flora species should be avoided as far as possible in an already marginal environment where the importance of these habitats increases for all vertebrates (Figures 37-42).

Figure 37. *Aloidendron dichotomum* (*Aloe dichotoma*) – near endemic; protected F/NC & vulnerable by IUCN (2025) mainly associated with rocky areas and/or small drainage lines.

Figure 38. *Commiphora namaensis* (Nama corkwood) – near endemic; Protected F –are common throughout the rocky areas.

Figure 39. *Euclea pseudebenus* (false ebony) – protected F – limited to ephemeral drainage lines throughout area.

Figure 40. *Maerua schinzii* (ringwood) – protected F – associated with drainage lines, especially the Haib River riparian habitat, and rocky areas.

Figure 41. *Pappea capensis* (jacket plum) – protected F – observed along the pipeline drainage line.

Figure 42. *Tamarix usneoides* (wild tamarisk) – protected F – common along the lower reaches of the Haib River.

During October 2025 the flora was assessed for various sites according to the conceptual infrastructure layout and compared in Table 7 below:

Table 7. Tree and shrub diversity (>1m in height) expected (literature study) and confirmed at various conceptual infrastructure layout sites during October 2025 (√). The trees and shrubs known, and/or expected to occur in the general area (derived from Mannheimer and Curtis 2018).

Species: Scientific name	Solar PV Plant	Mine Housing Option 1	Mine Housing Option 2	HLP 1	HLP 2	TSF3	TSF4	TSF5	Water Storage Dam	Namibian conservation and legal status	International status	
											IUCN (2025)	CITES
Acacia erioloba										Protected (F)		
Acacia karroo												
Adenolobus garipensis	√	√			√	√	√	√	√			
(Aloidendron dichotomum) Aloe dichotoma	√			√	√	√				N-end; protected (F); Protected (NC)	V	C2
Berkheya chamaepeuce												
Boscia albitrunca					√	√		√		Protected (F)		
Boscia foetida	√	√		√	√	√	√	√	√	Protected (F)		
Cadaba aphylla	√		√					√				
Carissa haematocarpa												
Ceraria fruticulosa					√	√				N-end		
Portulacaria (Ceraria) namaquensis					√	√				N-end		
Commiphora capensis										N-end; Protected (F)		
Commiphora cervifolia					√	√				N-end; Protected (F)		
Commiphora gracilifrondosa										N-end; Protected (F)		
Commiphora namaensis					√	√		√	√	N-end; Protected (F)		
Commiphora buruxa											E	
Diospyros lycioides												
Diospyros ramulosa												
Ehretia alba												
Euclea pseudebenus									√	Protected (F)		
Euphorbia dregeana	√				√	√				N-end		C2
Euphorbia virosa												C2
Ficus cordata										Protected (F)		
Gaillonia crocyllis												
Gymnosporia linearis												
Gymnosporia senegalensis												
Jatropha orangeana												

Species: Scientific name	Solar PV Plant	Mine Housing Option 1	Mine Housing Option 2	HLP 1	HLP 2	TSF3	TSF4	TSF5	Water Storage Dam	Namibian conservation and legal status	International status	
											IUCN (2025)	CITES
Lycium bosciifolium							√	√				
Lycium horridum												
Maerua gilgii										N-end		
Maerua schinzii					√	√		√	√	Protected (F)		
Montinia caryophyllacea					√	√						
Nymania capensis												
Ozoroa concolor										N-end; Protected (F)		
Ozoroa dispar												
Ozoroa namaensis	√		√							N-end		
Ozoroa namaquensis										Rare; N-end; Protected (F)		
Pachypodium namaquanum										N-end; Protected (F); Protected (NC)		
Pappea capensis										Protected (F)		
Parkinsonia africana		√					√					
Phaeoptilum spinosum	√		√	√				√				
Rhigozum trichotomum					√	√						
Salsola spp.	√	√	√	√			√					
Salix mucronata subsp. *capensis*										Protected (F)		
Schotia afra										Protected (F)		
Searsia burchellii												
Searsia lancea										Protected (F)		
Searsia pendulina												
Searsia populifolia					√	√		√				
Searsia tenuinervis												
Sisyndite spartea		√	√	√	√	√	√	√	√	N-end		
Tamarix usneoides								√		Protected (F)		
Ziziphus mucronata										Protected (F)		
Zygophyllum cretaceum										N-end		
Zygophyllum prismatocarpum		√			√	√		√		N-end		
Zygophyllum rigidum							√			N-end		
Total:	**8(12)**	**6(7)**	**5(7)**	**5(7)**	**15(17)**	**15(17)**	**7(11)**	**12(13)**	**6(9)**			

Endemic and Near-endemic – (Mannheimer and Curtis 2018)

F – Forest Act No. 12 of 2001
NC – Nature Conservation Ordinance No. 4 of 1975
C2 – CITES Appendix 2 species
IUCN (2025): V – Vulnerable. All other species not listed are viewed as “Least Concern” or not yet been assessed by the IUCN Red List.
Rare – (Loots 2005)
Parentheses indicate other shrubs also confirmed at each site.

Source for literature review: Coats Palgrave (1983), Curtis and Mannheimer (2005), IUCN (2025), Loots (2005), Mannheimer and Curtis (2009), Mannheimer and Curtis (2018), Rothmann (2004), Steyn (2003), Van Wyk and Van Wyk (1997)

[Although African species of Acacia have undergone a name change and grouped into two distinct genera – i.e., Vachellia and Senegalia – which are clearly separated based on several morphological, anatomical & biochemical attributes (e.g., Vachellia has capitate inflorescences (round, head-like flowers) and spinescent stipules (thorns) while Senegalia has spicate inflorescences (flowers in spikes) and the stipules are non-spinescent), the International Code of Nomenclature for algae, fungi, and plants is not prescriptive and the author remains referring to Acacia throughout]

Solar PV Plant

A total of 8 trees/shrubs (>1m in height) were identified in the proposed Solar PV Plant area, located on gravel plain habitat (See Table 7; Figure 1). Four other shrub species, not included in table 7, were also identified and include *Euphorbia lignosa* (N-end), *Hoodia gordonii* (protected NC), *Larryleachia marlothii* (N-end; protected NC) and *Sarcocaulon flavescens* (N-end) (Figures 43-45). The most important species are viewed as *Aloidendron dichotomum* (*Aloe dichotoma*) – near endemic; protected F/NC & vulnerable by IUCN (2025) – and *Hoodia gordonii* (protected NC), *Larryleachia marlothii* (N-end; protected NC) and *Sarcocaulon flavescens* (N-end).

Eight species of larger trees and shrubs were encountered along various transects totalling 500m in the Solar PV Plant area. *Salsola* spp. (68%) and *Phaeoptilum spinosum* (12%) were the most dominant species observed during the fieldwork (Figure 46). Important species (protected, etc.) include *Aloidendron dichotomum* (*Aloe dichotoma*), *Hoodia gordonii* and *Larryleachia marlothii* although account for only 8% of the species confirmed in this area, occur widespread throughout Namibia and not exclusively associated with the project area. All three these species can be successfully transplanted and relocated. Permits would also be required to remove these species.

Figure 43. Scattered *Aloidendron dichotomum* (*Aloe dichotoma*) – near endemic; protected F/NC & vulnerable by IUCN (2025) – individuals identified in this proposed development area.

Figure 44. *Hoodia gordonii* – protected NC – identified throughout this site.

Figure 45. *Larryleachia marlothii* – N-end; protected NC – grow beneath *Stipagrostis brevifolia* grasses and are uncommon in the area.

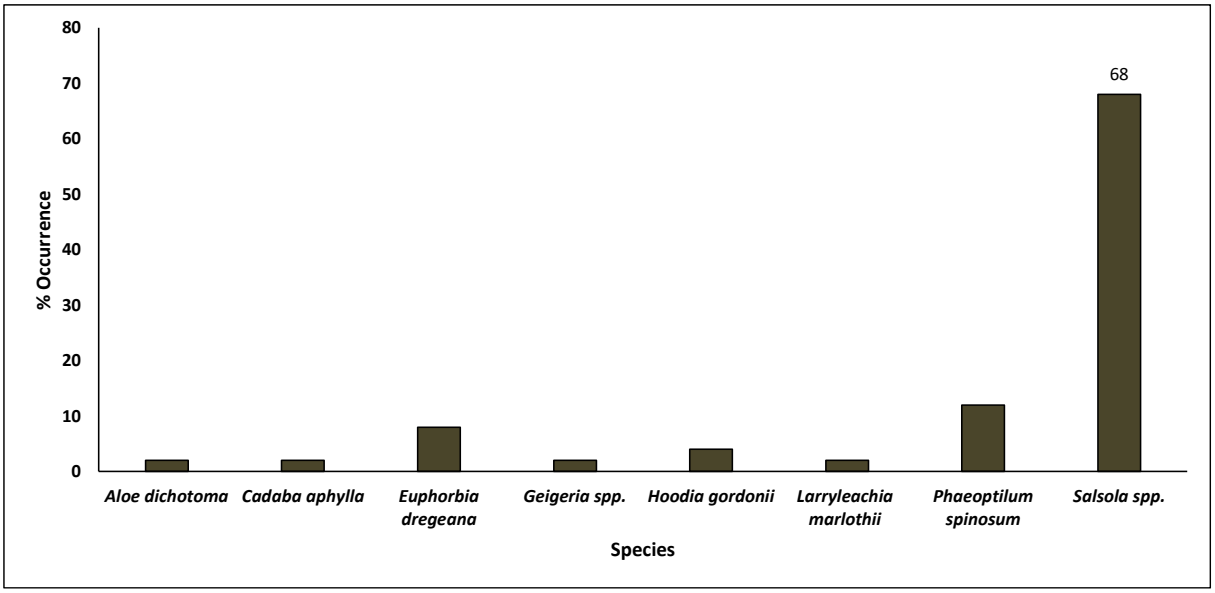

Figure 46. Tree and shrub species composition along various transects (total length – 500m @ 10m intervals) in the Solar PV Plant area (N=50 points) during October 2025. Includes all woody species and not only species >1m in height.

Mine Housing Options 1 & 2

A total of 6 and 5 trees/shrubs (>1m in height) were identified in the proposed Mine Housing Options 1 & 2 areas, respectively. Option 1 is in rocky hill habitat while Option 2 is located on gravel plain habitat (See Table 7; Figure 1). One and 2 other shrub species, not included in Table 7, were also identified at each site and include *Calicorema capitata* and *Sarcocaulon flavescens* (N-end) (Figures 47-49). The most important species are viewed as *Sarcocaulon flavescens* (N-end).

Four and 7 species of larger trees and shrubs were encountered along various transects totalling 500m in the Mine Housing Options 1 & 2 areas, respectively. *Calicorema capitata* (66% Vs 36%) and *Sisyndite spartea* (12% Vs 22%) were the most dominant species observed during the fieldwork (Figure 50). None of the species are particularly important (i.e., protected, etc.), occur widespread throughout Namibia and not exclusively associated with the project area.

Figure 47. *Sarcocaulon flavescens* – N-end – confirmed on rocky outcrop in the Mine Housing Option 2 area.

Figure 48. Mine Housing Option 1 is in a rocky habitat and viewed as potentially more important ecologically and diverse than Option 2 (See Figure 49 below).

Figure 49. Mine Housing Option 2 is in a sparsely vegetated gravel plain habitat and viewed as less important ecologically and diverse than Option 2 (See Figure 48 above).

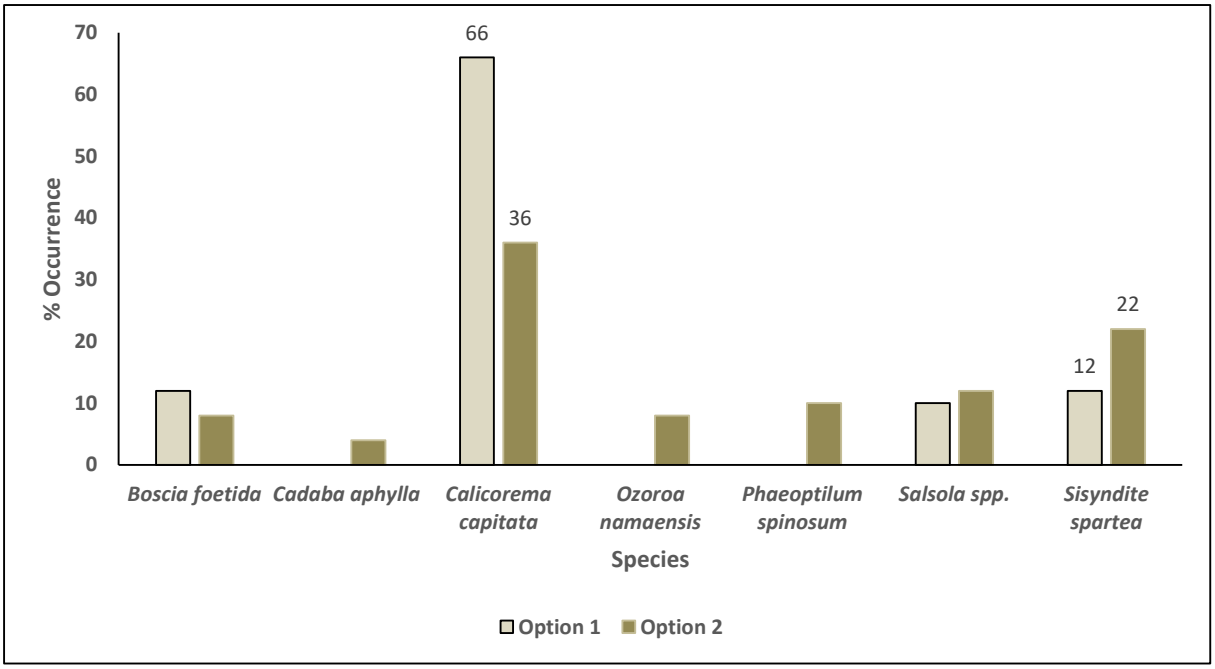

Figure 50. Tree and shrub species composition along various transects (total length – 500m @ 10m intervals) in the Mine Housing Options 1 & 2 areas (N=50 points) during October 2025. Includes all woody species and not only species >1m in height.

HLP Options 1 & 2

A total of 5 and 15 trees/shrubs (>1m in height) were identified in the proposed Heap Leach Pad Options 1 & 2 areas, respectively. Option 1 is in gravel plain habitat while Option 2 is located on rocky habitat (See Table 7; Figure 1). Two other shrub species, not included in Table 7, were also identified at each site and include *Calicorema capitata* and *Hoodia gordonii* (protected NC) at HLP1 and *Euphorbia lignosa* (N-end) and *E. indecora* at HLP2

(Figures 51-54). The most important species are viewed as *Aloidendron dichotomum* (*Aloe dichotoma*) – near endemic; protected F/NC & vulnerable by IUCN (2025) – and *Hoodia gordonii* (protected NC), *Ceraria fruticulosa* (N-end), *Portulacaria (Ceraria) namaquensis* (N-end), *Commiphora cervifolia* (N-end; protected F), *Commiphora namaensis* (N-end; protected F) and *Maerua schinzii* (protected F).

Five and 14 species of larger trees and shrubs were encountered along various transects totalling 500m in the Heap Leach Pad Options 1 & 2 areas, respectively. *Calicorema capitata* (50%) and *Salsola* spp. (44%) were the most dominant species observed in the HLP1 are while *Portulacaria (Ceraria) namaquensis* (34%) and *Ceraria fruticulosa* (14%) were dominant in the HLP2 area (Figure 55). Important species (protected, etc.) include *Aloidendron dichotomum* (*Aloe dichotoma*), *Boscia albitrunca*, *Ceraria fruticulosa*, *Commiphora cervifolia*, *C. namaensis*, *Maerua schinzii* and *Portulacaria (Ceraria) namaquensis* and although account for only 2% in the HLP1 area this makes up 62% in the HLP2 area indicating the importance of the HLP2 area. Although these species occur widespread throughout Namibia and not exclusively associated with the project area, the HLP2 area is diverse floristically with rocky habitat important to a variety of vertebrate species as well and should be avoided. Permits would also be required to remove these species.

Figure 51. Gravel plain habitat dominated by small shrubs (mainly *Calicorema capitata* & *Salsola* spp.) and grasses in the HLP1 area.

Figure 52. A few *Aloidendron dichotomum* (*Aloe dichotoma*) – near endemic; protected F/NC & vulnerable by IUCN (2025) – are viewed as the most important larger tree/shrub in the HLP1 area.

Figure 53. Rocky habitat dominated by a variety of unique tree/shrub species such as *Ceraria fruticulosa* (N-end) and *Portulacaria (Ceraria) namaquensis* (N-end) in the HLP2 area

Figure 54. *Portulacaria (Ceraria) namaquensis* (N-end) – left – and *Maerua schinzii* (protected F) – right – are some of the important larger tree/shrubs species in the HLP2 area.

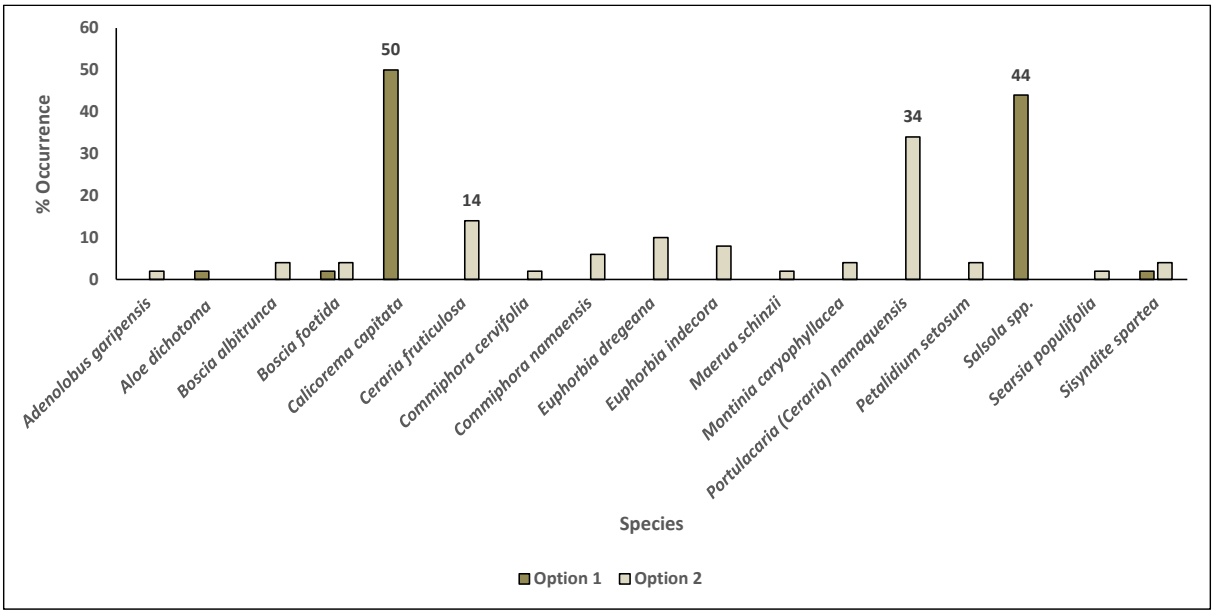

Figure 55. Tree and shrub species composition along various transects (total length – 500m @ 10m intervals) in the Heap Leach Pad Options 1 & 2 areas (N=50 points) during October 2025. Includes all woody species and not only species >1m in height.

TSF Options 3-5

A total of 15, 7 and 12 trees/shrubs (>1m in height) were identified in the proposed Tailings Storage Facilities Options 3-5 areas, respectively. Option 3 and 5 are in rocky habitats while Option 4 is in a gravel plain habitat (See Table 7; Figure 1). Two, 4 and 1 other shrub species, not included in Table 7, were also identified at each site, respectively, and include *Euphorbia lignosa* (N-end) and *E. indecora* (TSF3); *Calicorema capitata*, *Hermania stricta*, *Microloma calycinum*, *Sarcaucolon flavescens* (N-end) (TSF4) and *Calicorema capitata* (TSF5) (Figures 51-54; 56-57). The most important species are viewed as *Aloidendron*

dichotomum (*Aloe dichotoma*) – near endemic; protected F/NC & vulnerable by IUCN (2025) – and *Ceraria fruticulosa* (N-end), *Portulacaria (Ceraria) namaquensis* (N-end), *Commiphora cervifolia* (N-end; protected F), *Commiphora namaensis* (N-end; protected F) and *Maerua schinzii* (protected F) (TSF3); *Sarcocaulon flavescens* (N-end) (TSF4) and *Boscia albitrunca* (protected F), *Commiphora namaensis* (N-end; protected F), *Maerua schinzii* (protected F) and *Tamarix usneoides* (protected F) (TSF5).

Fourteen, 6 and 9 species of larger trees and shrubs were encountered along various transects totalling 500m in the TSF Options 3-5 areas, respectively. The most dominant species were *Portulacaria (Ceraria) namaquensis* (34%) and *Ceraria fruticulosa* (14%) (TSF3); *Salsola* spp. (68%) and *Calicorema capitata* (14%) (TSF4) and Sisyendite spartea (44%) and *Phaeoptilum spinosum* (20%) (TSF5) (Figure 58). Important species (protected, etc.) include *Aloidendron dichotomum* (*Aloe dichotoma*), *Boscia albitrunca*, *Ceraria fruticulosa*, *Commiphora cervifolia*, *C. namaensis*, *Maerua schinzii* and *Portulacaria (Ceraria) namaquensis* (TSF3); *Sarcaucolon flavescens* (TSF4) and *Maerua schinzii* & *Tamarix usneoides* (TSF5) and account for 62% (TSF3); 4% (TSF4) and 20% (TSF5) areas, respectively. This shows the importance of the TSF3 and TSF5 areas floristically compared to the TSF4 site. Although these species confirmed occur widespread throughout Namibia and not exclusively associated with the project area, the TSF3 & TSF5 areas are diverse floristically with rocky habitat and seeps important to a variety of vertebrate species as well and should be avoided. Permits would also be required to remove these species.

Figure 56. The rocky habitat with important seeps in the TSF5 area.

Figure 57. *Tamarix usneoides* – protected F – indicate shallow surface water where located.

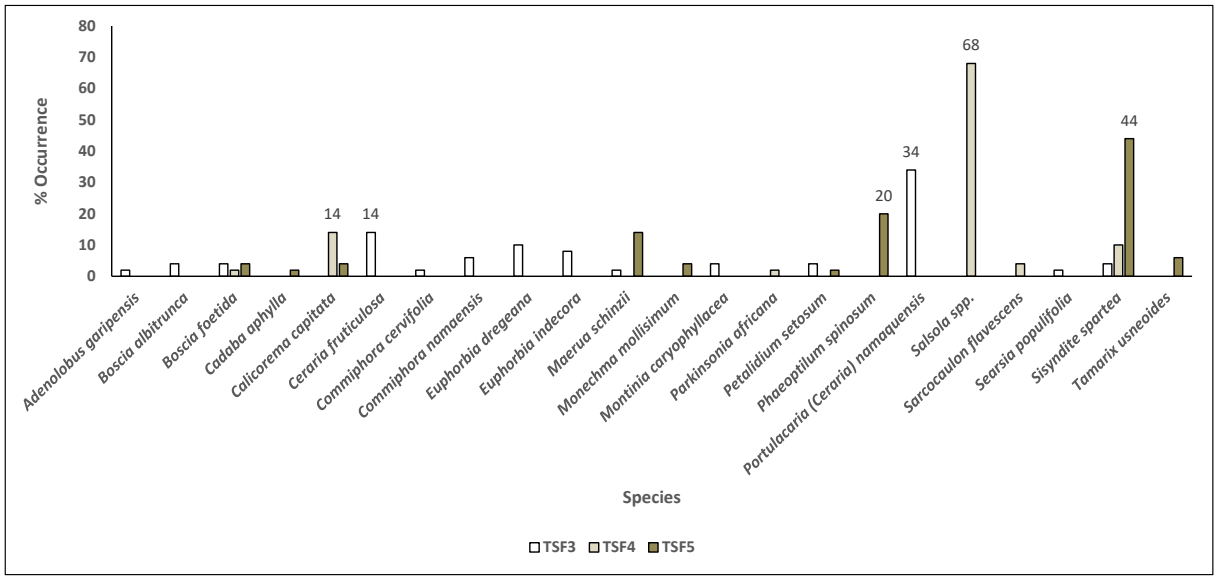

Figure 58. Tree and shrub species composition along various transects (total length – 500m @ 10m intervals) in the TSF Options 3-5 areas (N=50 points) during October 2025. Includes all woody species and not only species >1m in height.

Water Storage Dam

A total of 6 trees/shrubs (>1m in height) were identified in the proposed Water Storage Dam area, located in a rocky drainage line habitat (See Table 7; Figure 1). Three other shrub species, not included in table 7, were also identified and include *Calicorema capitata*, *Monechma mollisimum* and *Petalidium setosum* (Figures 59-60). The most important species are viewed as *Commiphora namaensis* (N-end; protected F), *Euclea pseudebenus* (protected F) and *Maerua schinzii* (protected F).

Eight species of larger trees and shrubs were encountered along various transects totalling 500m in the Water Storage Dam area. *Calicorema capitata* (44%) and *Petalidium setosum*

(18%) were the most dominant species observed during the fieldwork (Figure 61). Important species (protected, etc.) include *Commiphora namaensis*, *Euclea pseudebenus* and *Maerua schinzii* although account for only 12% of the species confirmed in this area, occur widespread throughout Namibia and not exclusively associated with the project area. Some species (i.e., *Commiphora namaensis*) can be successfully transplanted and relocated. Permits would also be required to remove these species.

Figure 59. The proposed Water Storage Dam area.

Figure 60. *Euclea pseudebenus* – protected F – individuals occur at the mouth of the proposed drainage line to be dammed where it enters the Haib River.

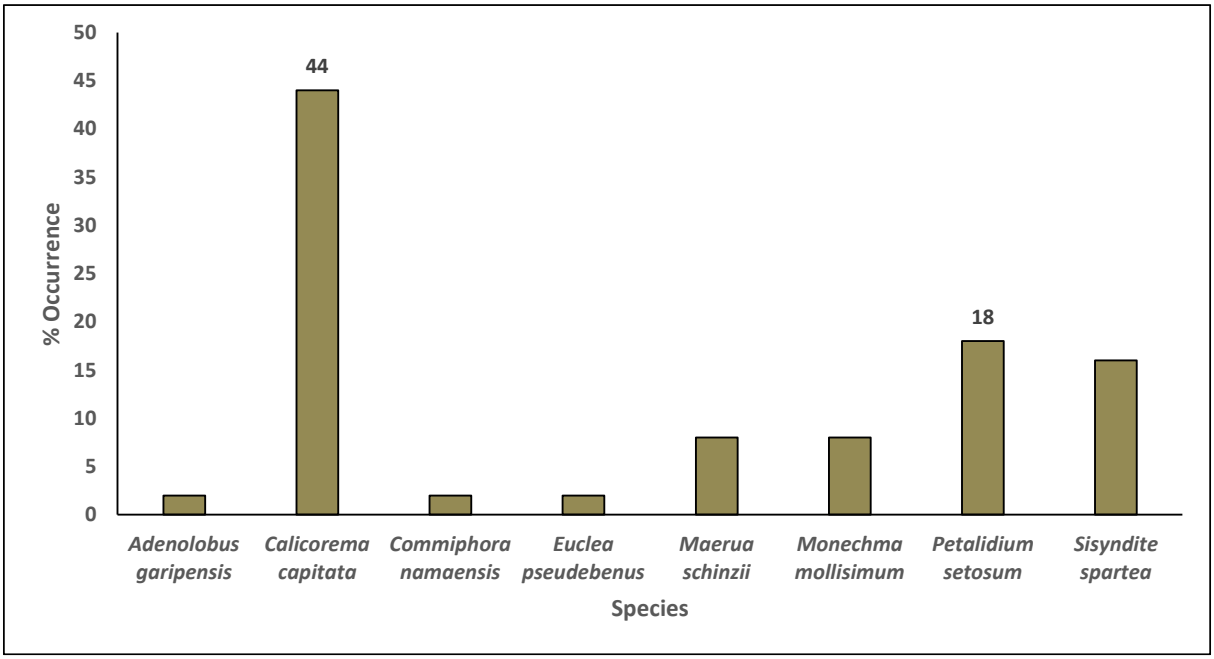

Figure 61. Tree and shrub species composition along various transects (total length – 500m @ 10m intervals) in the Water Storage Dam area (N=50 points) during October 2025. Includes all woody species and not only species >1m in height.

Large portions of the Haib Copper Project area have been heavily impacted due to various old anthropomorphic activities (e.g., informal farmsteads; transmission line, roads/tracks, old and current mining/prospecting activities, etc.) and none of the unique larger trees/shrubs (>1m in height) are expected to be exclusively associated with this area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on important trees/shrubs potentially occurring in the area.

Open Pit impact
The impact of heavy machinery and blasting operations during excavation activities is expected to be detrimental to larger trees/shrubs directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

The impacts of the mining activities are expected to be detrimental to larger trees/shrubs if track discipline is not maintained throughout and offroad driving goes unchecked.

Concentrator Processing Plant impact
The impact of heavy machinery during excavation and processing activities is expected to be detrimental to larger trees/shrubs directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Heap Leach & Hydrometallurgical Plant (Options 1 & 2) impact
The impact of heavy machinery during construction and processing activities is expected to be detrimental to larger trees/shrubs directly associated with the affected area/habitat as well as overall habitat destruction.

HLP Option 1 is flatter and less rocky with less diverse biodiversity than HLP Option 2. HLP Option 1 is the preferred site and expected to have fewer negative impacts on larger trees/shrubs. This would affect a relatively small area albeit be permanent of nature.

Tailings Disposal – Options 3, 4 & 5 impact
The impact of heavy machinery and associated activities is expected to be detrimental to larger trees/shrubs directly associated with the affected area/habitat as well as overall habitat destruction.

TSF4 is flatter and less rocky with less diverse biodiversity than TSF3 & 5. TSF3 is in a diverse rocky area and diverse floristically while TSF5 is in an unspoilt drainage line with seeps and viewed as the most important site. TSF4 is the preferred site and expected to have fewer negative impacts on larger trees/shrubs.

Waste Rock Dumps/Stockpiles – Options 1 & 3 impact
The impact of heavy machinery and associated activities is expected to be detrimental to larger trees/shrubs directly associated with the affected area/habitat as well as overall habitat destruction.

WRD1 & 3 are in barren sparsely vegetated areas and expected to have few negative impacts on larger trees/shrubs. However, the western portions of the proposed WRD1 would impact the important rocky habitat with unique flora and should be move eastwards to avoid this area. The WRD3 is the preferred site.

Access & Haul Roads impact
The impact of heavy machinery during construction activities is expected to be detrimental to trees/shrubs directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

However, track discipline should be maintained (e.g., minimise speed (e.g., 40km/h), no off-road driving, limited nocturnal driving, etc.), speed humps and vehicle calming devices should be incorporated along the route. This should act as mitigation measure for important, especially nocturnal, vertebrate fauna and minimise dust pollution issues.

A tarmac access route would result in less dust pollution and make installing the speed humps and vehicle calming devices, etc. easier than a gravel route.

Bulk Water Infrastructure – Options 1 & 2 impact
The impact of heavy machinery during excavation of a trench to bury a pipeline is expected to be detrimental to larger trees/shrubs directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Pipeline Option 2 along the Haib River is significantly shorter than Option 1 from the Noordoewer area making it the preferred option with less overall impact on the environment and associated larger trees/shrubs.

The pipeline should follow the edge of the Haib River and alignment negotiated beforehand to avoid the larger protected tree/shrub species associated with this ephemeral river (e.g., Acacia erioloba, Euclea pseudebenus, Ziziphus mucronata, etc.).

Water Storage Dam impact
The impact of heavy machinery during construction activities is expected to be detrimental to larger trees/shrubs directly associated with the affected area/habitat as well as overall habitat destruction.

Once operational the water storage dam would serve as a new, albeit artificial, habitat with some species expected to colonise the edges and seepage areas (i.e., below barrier wall, etc.) and would include Tamarix usneoides as well as *reeds, sedges, herbs, etc.*

Mine Housing Options 1 & 2 impact
The impact of heavy machinery during construction activities is expected to be detrimental to larger trees/shrubs directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area albeit be permanent of nature.

Mine Housing Option 2 is located on a flat and open sandy/gravel plain area between small rocky outcrops while Option 1 is located within rocky habitat closer to the Haib River. Option 2 is viewed as the preferred option with less overall impact on the environment and associated larger trees/shrubs.

Bulk Power Supply impact
Solar PV Plant impact
The impact during construction, are expected to be detrimental to larger trees/shrubs associated with the affected area/habitat. This would affect a relatively small area over a short/limited period.

The impact of aboveground PV plant infrastructure is not expected to be detrimental to larger trees/shrubs.

Transmission line and substation impact
The impact of heavy machinery during excavation of pylon holes is expected to be detrimental to larger trees/shrubs directly associated with the affected area/habitat as well as overall habitat destruction. This would affect a relatively small area over a short/limited period.

The OTL should follow the access roads & pipeline route to avoid disturbing additional areas.

Furthermore, none of the unique/important larger trees/shrubs species are exclusively associated with the proposed development area.

6.2.2 Grass Diversity

Grass diversity known and/or expected to occur in the general area, including species confirmed during the fieldwork as well as the authors confirmed records during other studies from the general area, is presented in Table 8.

Up to 49 grasses are expected in the general area, none of which are viewed as endemic or particularly unique. *Stipagrostis* (8 species) and *Eragrostis* (11 species) species are the dominant grasses expected to occur in the general area.

A total of 9 grass species were observed in the different habitats throughout the area ranging from 3 species in the rocky areas to 8 species in the ephemeral drainage lines (Table 7). According to Cunningham (2010a) and Cunningham (2013), between 12 and 13 grass species were observed in similar habitats further to the east (Onseepkans and Komsberg areas), respectively.

During November 2023 the grass was assessed for various habitats throughout the general development area (Table 8).

Gravel Plain habitat:
The dominant grass species associated with the gravel plain areas is the perennial, large tuft forming, *Stipagrostis brevifolia* in an otherwise very dry and barren habitat. The low grass diversity is due to the rapid site assessment being conducted during the dry season after a long period of below average rainfall. More species are expected to occur throughout the area after rainfall episodes, albeit at low densities and biomass (Figure 62).

Table 8. Grass diversity expected (literature study) and confirmed during the rapid assessment (√) including author's confirmed records from other studies conducted from the general area (See: Cunningham 2010a, Cunningham 2013). The grasses known, and/or expected to occur in the general area are derived from [1]Müller (1984), [2]Van Oudtshoorn (2012) and [3]Müller (2007).

Species: Scientific name	Habitats			Cunningham (2010a)	Cunningham (2013)	Namibian conservation and legal status	Ecological Status	Grazing Value
	Gravel plains	Drainage lines	Rocky areas					
[3]*Anthephora pubescens*							Decreaser	High
[1]*Anthephora ramosa*							Decreaser	High
[2,3]*Aristida adscensionis*							Increaser 2	Low
[2,3]*Aristida congesta*							Increaser 2	Low
[2,]*Aristida meridionalis*							Increaser 3	Low
[1,3]*Brachiaria glomerata*							?	Average
[2]*Cenchrus ciliaris*		√		√	√		Decreaser	High
[2]*Centropodia glauca*				√	√		Decreaser	High
[2,3]*Chloris virgata*							Increaser 2	Average
[2]*Cynodon dactylon*		√			√		Increaser 2	High
[2]*Dactyloctenium aegyptium*							Increaser 2	Average
[2]*Dichanthium annulatum*					√		Decreaser	High
[2]*Digitaria eriantha*							Decreaser	High
[1,2,3]*Enneapogon cenchroides*				√	√		Increaser 2	Average
[1,2,3]*Enneapogon desvauxii*			√				Intermediate	Average
[1,2,3]*Enneapogon scaber*		√		√	√		?	Low
[2]*Eragrostis bicolor*							?	Low
[3]*Eragrostis brizantha*							Increaser 2	Average
[3]*Eragrostis cylindriflora*				√			Increaser 2	Low
[2]*Eragrostis echinochloidea*							Increaser 2	Average
[3]*Eragrostis homomalla*							?	?
[2,3]*Eragrostis lehmanniana*							Increaser 2	Average
[2]*Eragrostis nindensis*					√		Increaser 2	Average
[3]*Eragrostis porosa*							Increaser 2	Low
[2,3]*Eragrostis rotifer*							?	Average
[2,3]*Eragrostis trichophora*							Increaser 2	Average
[2]*Eragrostis viscosa*							Increaser 2	Low
[2]*Fingerhuthia africana*							Decreaser	Average
[2,3]*Melinis repens*							Increaser 2	Low

Species: Scientific name	Habitats			Cunningham (2010a)	Cunningham (2013)	Namibian conservation and legal status	Ecological Status	Grazing Value
	Gravel plains	Drainage lines	Rocky areas					
[1,3]*Odyssea paucinervis*							?	Low
[2]*Oropetium capense*							Increaser 2	Low
[1,3]*Panicum arbusculum*							Decreaser	High
[2]*Phragmites australis*					√		Decreaser	Low
[2]*Polypogon monspeliensis*							Introduced	Average
[1]*Rhynchelytrum villosum*							Increaser 2	Average
[1,2,3]*Schmidtia kalahariensis*				√			Increaser 2	Low
[2]*Schmidtia pappophoroides*							Decreaser	High
[2]*Setaria verticillata*				√			Increaser 2	Average
[2]*Sorghum bicolor*							?	High
[1]*Stipagrostis anomala*							?	Low
[1]*Stipagrostis brevifolia*	√	√					Decreaser	High
[1,2,3]*Stipagrostis ciliata*	√	√		√	√		Decreaser	High
[1,3]*Stipagrostis fastigiata*							?	High
[3]*Stipagrostis hochstetteriana*							Decreaser	High
[2]*Stipagrostis namaquensis*		√		√	√		?	Average
[2]*Stipagrostis obtusa*	√	√	√	√	√		Decreaser	High
[2,3]*Stipagrostis uniplumis*	√	√	√	√	√		Increaser 2	Average
[2,3]*Tragus berteronianus*							Increaser 2	Low
[3]*Triraphis ramosissima*				√	√		?	High
Total:	**4**	**8**	**3**	**12**	**13**			

? – not classified in literature, but often similar to other species within the genus.
Source for literature review: Müller (1984), Müller (2007), Van Oudtshoorn (2012)

Drainage lines:
Due to the ephemeral drainage lines being mostly devoid of grasses no survey was conducted in this habitat. Grasses observed were limited to patches of *Stipagrostis namaquensis* in the larger drainage lines – e.g., Haib River.

Rocky areas:
The dominant grass species associated with the rocky areas is *Stipagrostis uniplumis* in an otherwise very dry habitat. The low grass diversity is due to the rapid site assessment being conducted during the dry season after a long period of below average rainfall. More species are expected to occur throughout the area after rainfall episodes, albeit at low densities and biomass (Figure 62).

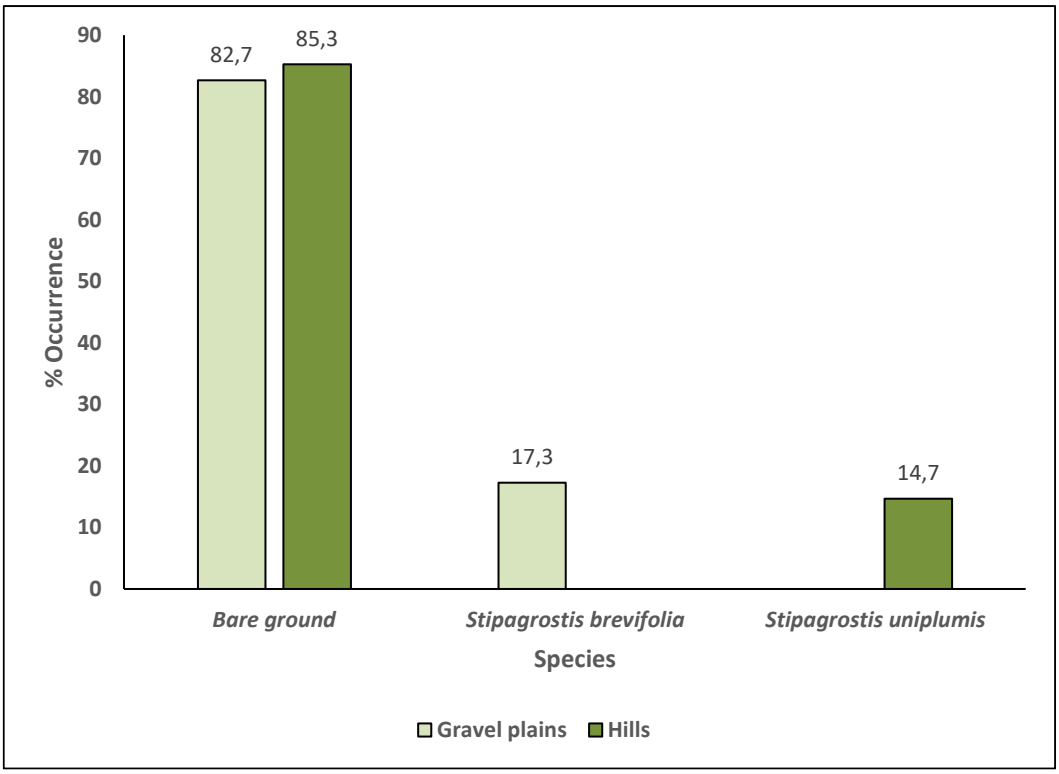

Figure 62. Grass species composition along various transects in various habitats (150m each – i.e., data points @ 1m intervals).

During October 2025 the grass was assessed for various sites according to the conceptual infrastructure layout and compared in Table 9 below:

Table 9. Grass diversity expected (literature study) and confirmed at various conceptual infrastructure layout sites during October 2025 (√). The grasses known, and/or expected to occur in the general area are derived from [1]Müller (1984), [2]Van Oudtshoorn (2012) and [3]Müller (2007).

Species: Scientific name	Solar PV Plant	Mine Housing Option 1	Mine Housing Option 2	HLP1	HLP2	TSF3	TSF4	TSF5	Water Storage Dam	Namibian conservation and legal status	Ecological Status	Grazing Value
[3]*Anthephora pubescens*											Decreaser	High
[1]*Anthephora ramosa*											Decreaser	High
[2,3]*Aristida adscensionis*					√	√					Increaser 2	Low
[2,3]*Aristida congesta*											Increaser 2	Low
[2,]*Aristida meridionalis*											Increaser 3	Low
[1,3]*Brachiaria glomerata*											?	Average
[2]*Cenchrus ciliaris*											Decreaser	High
[2]*Centropodia glauca*											Decreaser	High
[2,3]*Chloris virgata*											Increaser 2	Average
[2]*Cynodon dactylon*											Increaser 2	High
[2]*Dactyloctenium aegyptium*											Increaser 2	Average
[2]*Dichanthium annulatum*											Decreaser	High
[2]*Digitaria eriantha*											Decreaser	High
[1,2,3]*Enneapogon cenchroides*		√					√				Increaser 2	Average
[1,2,3]*Enneapogon desvauxii*											Intermediate	Average
[1,2,3]*Enneapogon scaber*		√	√	√	√	√		√	√		?	Low
[2]*Eragrostis bicolor*											?	Low
[3]*Eragrostis brizantha*											Increaser 2	Average
[3]*Eragrostis cylindriflora*											Increaser 2	Low
[2]*Eragrostis echinochloidea*											Increaser 2	Average
[3]*Eragrostis homomalla*											?	?
[2,3]*Eragrostis lehmanniana*											Increaser 2	Average
[2]*Eragrostis nindensis*											Increaser 2	Average
[3]*Eragrostis porosa*											Increaser 2	Low
[2,3]*Eragrostis rotifer*											?	Average
[2,3]*Eragrostis trichophora*											Increaser 2	Average
[2]*Eragrostis viscosa*											Increaser 2	Low
[2]*Fingerhuthia africana*											Decreaser	Average
[2,3]*Melinis repens*											Increaser 2	Low

Species: Scientific name	Solar PV Plant	Mine Housing Option 1	Mine Housing Option 2	HLP1	HLP2	TSF3	TSF4	TSF5	Water Storage Dam	Namibian conservation and legal status	Ecological Status	Grazing Value
[1,3]*Odyssea paucinervis*											?	Low
[2]*Oropetium capense*											Increaser 2	Low
[1,3]*Panicum arbusculum*											Decreaser	High
[2]*Phragmites australis*											Decreaser	Low
[2]*Polypogon monspeliensis*											Introduced	Average
[1]*Rhynchelytrum villosum*											Increaser 2	Average
[1,2,3]*Schmidtia kalahariensis*											Increaser 2	Low
[2]*Schmidtia pappophoroides*											Decreaser	High
[2]*Setaria verticillata*											Increaser 2	Average
[2]*Sorghum bicolor*											?	High
[1]*Stipagrostis anomala*											?	Low
[1]*Stipagrostis brevifolia*	√	√	√	√			√				Decreaser	High
[1,2,3]*Stipagrostis ciliata*	√	√	√	√			√	√			Decreaser	High
[1,3]*Stipagrostis fastigiata*											?	High
[3]*Stipagrostis hochstetteriana*											Decreaser	High
[2]*Stipagrostis namaquensis*							√				?	Average
[2]*Stipagrostis obtusa*	√	√	√	√				√			Decreaser	High
[2,3]*Stipagrostis uniplumis*	√	√	√	√	√	√		√	√		Increaser 2	Average
[2,3]*Tragus berteronianus*											Increaser 2	Low
[3]*Triraphis ramosissima*											?	High
Total:	**4**	**6**	**5**	**5**	**3**	**3**	**4**	**4**	**2**			

? – not classified in literature, but often similar to other species within the genus.
Source for literature review: Müller (1984), Müller (2007), Van Oudtshoorn (2012)

A total of between 2 and 6 grass species were identified at the various proposed conceptual infrastructure layout sites (See Table 9; Figure 1). This low number is probably due to the dry season survey conducted during October 2025 in an area with low diversity dominated by *Stipagrostis* species. Other than their ecological role none of the grass species are viewed as important.

Seven grasses (including bare ground & herbs) were encountered along various transects totalling 150m throughout the proposed infrastructure layout sites. Herbs were dominant at 4 of the 9 sites while *Enneapogon scaber* was dominant at 2 sites; *Stipagrostis ciliata* at 2 sites and *S. obtusa* at 1 site as recorded during the fieldwork (Figure 63).

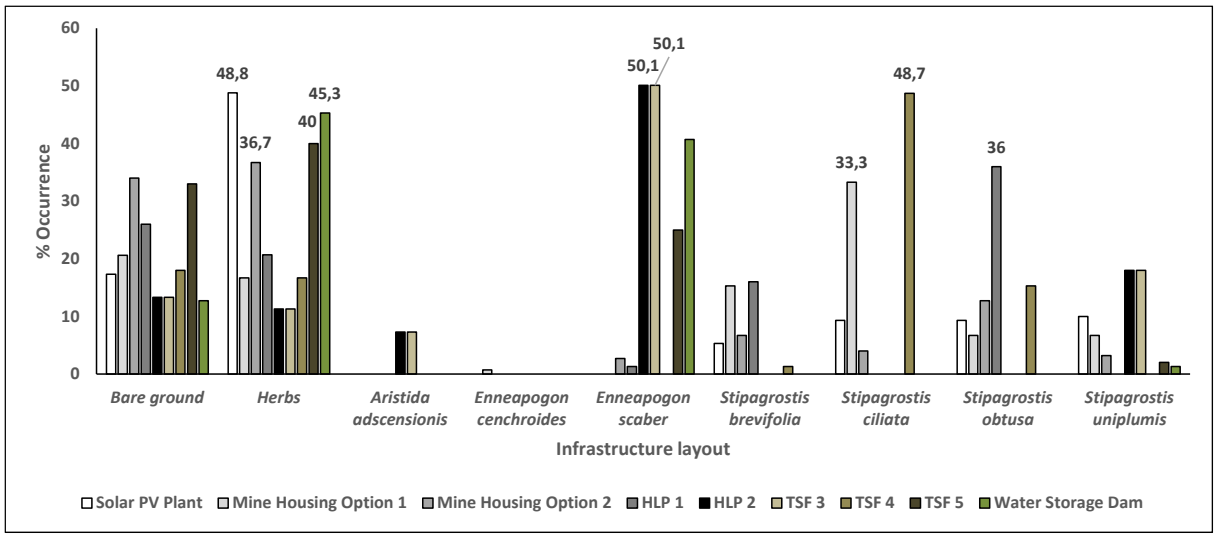

Figure 63. Grass species composition along various transects at the various Infrastructure Layout sites (150m each – i.e., data points @ 1m intervals).

Large portions of the Haib Copper Project area have been heavily impacted due to various old anthropomorphic activities (e.g., informal farmsteads; transmission line, roads/tracks, old and current mining/prospecting activities, etc.) and none of the unique grasses are expected to be exclusively associated with this area. The proposed mitigations – See Section 4 – are expected to minimise the overall effect on important grasses potentially occurring in the area.

Development impact
The various developments are not expected to adversely affect the grass species composition and biomass, which are rainfall driven, throughout the area.

6.2.3 Other Species

Other species observed during November 2023 in various habitats throughout the proposed development area included the following herbs, succulents, etc. (Table 10). This list is not comprehensive – i.e., many more species are known and/or expected to occur in the area – as this survey was conducted during the dry season after/during a period of drought with many species being rainfall driven.

A total of 55 "other" species – i.e., herbs, succulents, small woody spp., etc. – were identified in the various habitats throughout the general area (Table 10). The overall dry conditions resulted in fewer species than expected with most species associated with the rocky (33 species) and ephemeral drainage line (24 species) habitats. The most important species are viewed as *Aloe gariepensis*, *Hoodia gordonii*, *Ruschia divaricata*, *Sarcaucolon crassicaule*, *S. flavescens*, *Stroeberia gigas* and *Tylecodon rubrovenosus*. Most of these important species are associated with the rocky area habitats, especially areas at highest elevations.

Table 10. Other species – succulents, small woody spp., etc. – confirmed in various habitats during November 2023 throughout the area.

	Habitat			Status
Species	**Gravel plains**	**Drainage lines**	**Rocky areas**	
Abutilon pycnodon		√	√	
Acanthopsis disperma		√	√	
Aloe gariepensis			√	NC
Aptosimum spinescens	√	√	√	
Asparagus spp.		√	√	
Berkheya chamaepeuce		√		
Blepharis furcata	√		√	Near endemic
Brownhanthus arenosus	√		√	Near endemic
Calicorema capitata	√	√		
Chascanum garipense	√	√		
Cleome foliosa		√		
Codon royenii		√		
Codon schenckii		√		
Cryptolepis decidua			√	
Cyperus marginatus		√		
Dicoma capensis			√	
Dyerophytum africanum		√		
Eriocephalus spp.	√		√	
Euphorbia indecora			√	
Forsskaolea candida	√		√	
Foveolina dichotoma	√			
Geigeria spp.		√		
Gisekia africana		√		
Helichrysum gariepinum		√	√	Near endemic
Helichrysum obtusum		√		
Heliophila trifurca			√	Near endemic
Hermania gariepina	√			
Hermania stricta		√	√	
Hoodia gordonii	√			NC
Hypertelis salsoloides			√	
Jamesbrittenia maxii			√	
Kissenia capensis		√		
Limeum aethiopicum			√	
Mesembryanthemum barklyi	√	√	√	
Microloma calycinum			√	Near endemic
Monechma mollisimum	√	√	√	Near endemic
Monsonia ignorata		√		
Petalidium setosum		√		Near endemic
Pteronia cylindracea			√	
Rogeria longiflora		√	√	
Rushia divaricata			√	NC
Salsola kali			√	Alien
Sarcocaulon crassicaule			√	NC

	Habitat			Status
Species	**Gravel plains**	**Drainage lines**	**Rocky areas**	
Sarcocaulon flavescens	√			NC; near endemic
Senecio piptocoma	√			
Stroeberia gigas			√	Near endemic
Sutera tristis	√		√	
Tephrosia dregeana		√		
Tetragonia reduplicata	√			
Trichodesma africanum			√	
Tylecodon rubrovenosus			√	NC
Zygophyllum decumbens			√	
Zygophyllum longicapsulare			√	
Zygophyllum rigidum			√	Near endemic
Zygophyllum simplex	√			
Total:	**16**	**24**	**33**	

NC – Protected under the Nature Conservation Ordinance No 4 of 1975.
Near endemic – Mannheimer *et al.* (2008)

During October 2025 after an above average rainfall season between 15 and 23 other species were confirmed at the proposed infrastructure layout sites (Table 11).

Most of these other species were associated with the rocky habitats such as HLP2, TSF3 and TSF 5 areas.

Table 11. Other species – succulents, small woody spp., etc. – confirmed in the proposed infrastructure layout areas during October 2025.

	Infrastructure layouts									Status
Species	**Solar PV Plant**	**Mine Housing Option 1**	**Mine Housing Option 2**	**HLP 1**	**HLP 2**	**TSF 3**	**TSF 4**	**TSF 5**	**Water Storage Dam**	
Abutilon pycnodon					√	√		√		
Acanthopsis disperma	√	√	√		√	√	√		√	
Aptosimum spinescens	√		√							
Asparagus spp.	√		√	√			√			
Barleria rigida								√		
Blepharis furcata	√	√		√			√			Near endemic
Calicorema capitata		√	√	√			√	√	√	
Chascanum garipense	√						√			
Cleome foliosa								√	√	
Cleome oxyphylla								√		
Codon royenii								√	√	
Crotelaria spp.							√			
Cyperus marginatus								√		
Didelta carnosa					√	√				
Dyerophytum africanum	√	√	√					√		
Eriocephalus spp.		√	√		√	√		√		
Euphorbia phylloclada	√	√	√	√			√	√	√	
Felicia hirsuta				√	√	√	√	√	√	
Forsskaolea candida		√	√		√	√		√	√	
Galenia africana					√	√				
Geigeria spp.	√				√	√				
Gisekia africana	√	√	√	√	√	√			√	
Helichrysum gariepinum	√		√	√			√		√	Near endemic
Helichrysum obtusum					√	√				
Hermania gariepina	√		√	√	√	√				
Hermania stricta			√		√	√		√		

Hoodia gordonii	√				√					NC
Indogophera merxmuelleri						√	√	√	√	Endemic
Indogophera spp.		√			√			√		
Jamesbrittenia primuliflora								√		
Kissenia capensis	√		√		√	√	√			
Mesembryanthemum barklyi		√	√			√	√			
Mesumbryanthemum hypertrophicum								√	√	Near endemic
Microloma calycinum						√	√			Near endemic
Mollugo spp.					√			√	√	
Monechma mollisimum		√						√	√	Near endemic
Monsonia ignorata	√	√	√	√						
Ocimum americanum						√	√		√	√	
Petalidium setosum						√	√		√		Near endemic
Pteronia cylindracea			√							
Rogeria longiflora			√			√	√		√	√	
Sarcocaulon flavescens	√		√					√			NC; near endemic
Sesamum capense	√	√						√		
Sesuvium sesuvioides								√			Near endemic
Tapinanthus oleifolius					√					
Tephrosia dregeana		√	√							
Tetragonia reduplicata						√	√			
Tribulus terrestris								√		
Trichodesma africanum			√			√	√		√	√
Tripteris microcarpa	√	√	√	√	√	√	√	√	√	
Zygophyllum decumbens			√							
Zygophyllum prismatocarpum	√									
Total:	**18**	**15**	**22**	**15**	**22**	**22**	**18**	**23**	**16**	

Invasive alien species

During November 2023 various invasive alien species were recorded throughout the general area in various habitats (Table 12). No invasive alien species were recorded at the proposed infrastructure layout sites during October 2025.

Invasive alien species confirmed from the general area were associated with and/or spread from various old farming activities, old mine infrastructures and along the ephemeral drainage lines and Orange River and include:

- *Argemone ochroleuca* (Mexican poppy)
- *Datura innoxia* (thorn apple spp.)
- *Opuntia* spp. (prickly pear spp.)
- *Nicotiana glauca* (wild tobacco)
- *Prosopis* spp. (mesquite spp.)
- *Salsola kali* (tumbleweed)

Some of these above-mentioned species have already started invading the area, especially along the ephemeral drainage lines – i.e., Haib River and perennial Orange River – and rocky areas in the vicinity of the old mine infrastructures and should be eradicated where/when encountered (Figures 64-68).

Furthermore, mine and associated infrastructure related soil disturbances could favour some of the invasive alien species (e.g., *Datura* spp. increase in disturbed areas) and/or increase their range throughout the area.

Table 12. Invasive alien species confirmed in various habitats throughout the general area.

Species	Gravel plains	Drainage lines	Rocky areas	Status
Argemone ochroleuca		√		Invasive alien spp.
Datura inoxia		√		Invasive alien spp.
Opuntia spp.			√	Invasive alien spp.
Nicotiana glauca		√		Invasive alien spp.
Prosopis spp.	√	√		Invasive alien spp.
Salsola kali		√		Invasive alien spp.

Figure 64. *Argemone ochroleuca* (Mexican poppy) observed in the lower reaches of the Haib River and along the Orange River.

Figure 65. *Datura innoxia* (thorn apple spp.) observed along the Orange River.

Figure 66. *Cylindropuntia fulgida* (cactus spp.) spreading throughout the area and expected to become a major problem in the rocky areas in future.

Figure 67. *Nicotiana glauca* (wild tobacco) observed in the lower reaches of the Haib River and along the Orange River.

Figure 68. *Prosopis* spp. (mesquite spp.) adjacent old farm infrastructures at the mouth of the Volstruis River east of the Pit area.

Development impact
The various developments are expected to adversely affect "other" important plant species (i.e., herbs, succulents, etc.) although much of these are rainfall driven, throughout the area.

The plateau area northwest west of the Pit and in the proposed HLP2 and TSF3 areas, is an especially sensitive habitat for succulents (e.g., Ruschia, Stroeberia, Tylecodon, etc.). Destruction of this important habitat should be avoided, and alternatives should be considered – i.e., HLP1 and TSF4. The TSF5 area is also viewed as an important habitat due to the seeps recorded in this drainage line and should be avoided with the TSF4 the proposed alternative.

Mine and associated infrastructure related soil disturbances could favour some of the invasive alien species (e.g., Datura spp. increase in disturbed areas) and/or increase their range throughout the area. All invasive alien species should be eradicated throughout the project area to avoid mining activities further exacerbating this potential threat.

Furthermore, none of the unique/important species are exclusively associated with the proposed development area.

6.3 Important Species

Reptiles
Tortoises are viewed as the group of reptiles most under threat in Namibia (Griffin 1998a) making *Psammobates tentorius veroxii* probably the most important reptile expected in the area followed by *Varanus niloticus* and *Bitis xeropaga*. Tortoises, snakes and monitor lizards are routinely killed for food or as perceived threats.

Amphibians
The most important species from the area is the endemic *Phrynomantis annectens* although they are widespread in Namibia and not exclusively associated with the Haib Copper Project area. Except for the perennial Orange River, temporary pools in the ephemeral drainage

lines flowing southwards into the Orange River (e.g., Haib River & drainage line in the TSF5 area) are viewed as potential amphibian habitat in the general area. Because there is little open permanent surface water in the area (excluding the Orange River), amphibians are not viewed as very important in the general area.

Mammals
The most important species from the general area are those classified as vulnerable (*Panthera pardus*, *Felis nigripes*, *Equus zebra hartmannae*) and near threatened (*Eidolon helvum*, *Parahyaena (Hyaena) brunnea*, *Aonyx capensis*) by the IUCN (2025) as well as species classified as rare under Namibian legislation (*Cistugo seabrae*, *Felis nigripes*, *Galerella pulverulenta*). However, these species are either associated with the Orange River (e.g., *Aonyx capensis*) and/or only pass through the area occasionally and not necessarily permanently associated with the proposed development sites (e.g., *Panthera pardus*, *Parahyaena (Hyaena) brunnea*, etc.).

Birds
The most important species expected to occur in the general area are the one endemic – rosy-faced lovebird – although it is common and widespread throughout much of Namibia, and the birds classified as critically endangered (white-backed vulture), endangered (black harrier, martial eagle, secretarybird, Ludwig's bustard and lappet-faced vulture), vulnerable (tawny eagle) and near threatened (kori bustard) by the IUCN (2025) as well as those classified by Simmons *et al.* (2015) from Namibia as endangered (Ludwig's bustard, white-backed vulture, black harrier, tawny eagle, booted eagle, martial eagle, black stork), vulnerable (African fish eagle, lappet-faced vulture, secretarybird) and near threatened (Cape eagle owl, kori bustard, Verreaux's eagle, peregrine falcon, marabou stork).

Flora
Trees/shrubs
The most important species in the general area the those with some kind of protected status (including endemic and near endemic) – i.e., species classified as rare (*Ozoroa namaquensis*) (Loots 2005); all the species protected by the Forest Act No. 12 of 2001 and the Nature Conservation Ordinance No. 4 of 1975 including all the species classified as near endemic. Species classified by the IUCN (2025) as endangered (*Commiphora buruxa*) and vulnerable (*(Aloidendron dichotomum) Aloe dichotoma*) are important.

Important plant species known and/or expected from the general project area and included in the Red Data Book for Namibia include at least 9 species of which 1 species is listed as endemic (*Moraea garipensis*), 3 species as rare (*Aloe meyeri*, *Othonna cyclophylla*, *Ozoroa namaquensis*) and 2 species as near threatened (*Lapidaria margaretae*, *Moraea garipensis*) (Table 13) (Loots 2005). All the species included in Table 13 are viewed as important.

Table 13. Important species – i.e., Red Data spp. – known to occur in the general area according to Loots (2004).

Species: Scientific name	Conservation status
Aloe meyeri	Rare, NC, C2
Conophytum quaesitum subsp. *quaesitum* var. *quaesitum*	NC, LC
Crassula mesembrianthemopsis	LC
Euphorbia friedrichiae	LC, C2
Lapidaria margaretae	NT, NC
Moraea garipensis	Endemic, NT
Othonna cyclophylla	Rare
Ozoroa namaquensis	Rare
Tylecodon hallii	LC

Endemic (Loots 2005)
NC – Nature Conservation Ordinance No. 4 of 1975

Rare; NT – Near Threatened; LC – Least Concern (Loots 2005)
C2 – CITES Appendix 2 spp.

Other species

Aloes

Other than *Aloe dichotoma* listed in Table 6, *Aloe gariepensis*, also occurs in the general area (Rothmann 2004). As all aloes are protected in Namibia (See Nature Conservation Ordinance No. 4 of 1975), those listed above are viewed as important (Figure 69). These species are important for their horticultural potential and often collected illegally.

Amaryllis

There are an estimated 260 members of the Amaryllidaceae family in southern Africa with several taxa in urgent need of conservation (especially associated habitats). In the Desert Biome in Namibia there are an estimated 13 species of which 3 species potentially occur in the general area (*Gethyllis namaquensis*, *Strumaria barbarae*, *S. luteoloba*) (Duncan *et al.* 2020). These species are important for their horticultural potential and often collected illegally.

Commiphora

Many endemic Commiphora species are found throughout Namibia (Steyn 2003) and excluding the species listed in Table 5, another *Commiphora* species potentially occurring in the general area is *Commiphora pyracanthoides*. Some *Commiphora* – e.g., *C. wildii* – have economic potential – i.e., resin properties used in the perfume industry (Nott and Curtis 2006) – making them potentially important (Figures 38 & 70). These species are important for their economic and horticultural potential and often collected illegally.

Euphorbias

At least 47 species of Euphorbia occur throughout Namibia of which 4 species are listed as rare, 1 endangered, 1 vulnerable and 1 near threatened (Möller and Becker 2019). Euphorbia species known/expected to occur in the general area include at least 20 species (*Euphorbia avasmontana*, *E. celata*, *E. chersina*, *E. cibdela*, *E. dregeana*, *E. ephedroides*, *E. friedrichiae*, *E. gariepina*, *E. gregaria*, *E. gummifera*, *E. guerichiana*, *E. hamata*, *E. hottentota*, *E. indecora*, *E. lignosa*, *E. juttae*, *E. multiramosa*, *E. mauritanica*, *E. rudis*, *E. virosa* – i.e., most not included in Table 6) potentially also occurring in the general area (Figure 71). These species are important for their horticultural potential and often collected illegally.

Hoodia

At least 10 species of *Hoodia* occur throughout Namibia with species protected by the Nature Conservation Ordinance no 4 of 1975. *Hoodia* species known/expected to occur in the general area include 1 species (*Hoodia gordonii*) (Anon n.d.) (Figures 44 & 72). These species are important for their horticultural potential and often collected illegally.

Ferns

At least 64 species of ferns, of which 13 species being endemic, occur throughout Namibia. Ferns in the general area include at least 8 endemic species (*Cheilanthes capensis, C. deltoidea*, *C. hastata*, *C. kunzei*, C*. namaquensis*, *C. robusta*, *C. rawsonii, Mohria caffrorum*) and 6 indigenous species (*Adiantum capillus-veneris*, *Asplenium cordatum*, *Cheilanthes multifida*, *Equisetum ramosissimum*, *Ophioglossum polyphyllum*, *Pellaea calomelanos*) (Crouch *et al.* 2011). Although the area is marginal habitat for ferns the general area is undercollected with more species probably occurring than presented above.

Lichens

The overall diversity of lichens is poorly known from Namibia, especially the coastal areas and statistics on endemicity is even sparser (Craven 1998). To indicate how poorly known

lichens are from Namibia, the recent publication by Schultz *et al.* (2009) indicating that 37 of the 39 lichen species collected during BIOTO surveys in the early/mid 2000's was new to science (i.e., new species), is a case in point. More than 120 species are expected to occur in the Namib Desert with the majority being uniquely related to the coastal fog belt (Wirth 2010). Lichen diversity is related to air humidity and generally decreases inland from the Namibian coast (Schults and Rambold 2007). Many lichens look similar, are highly variable in appearance and notoriously difficult to identify unless with the use of a microscope (e.g., crustose lichens) or certain chemical tests. Although lichens are known to occur in the general area these are usually limited to rocky areas and low in number and diversity and not viewed as particularly important.

Lithops

Lithops species – all protected (See Nature Conservation Ordinance No. 4 of 1975) – are also known to occur in the general area and often difficult to observe, especially during the dry season when their aboveground structures wither. At least two species of Lithops are expected to occur in the general area – *Lithops julii* var. *rouxii* and *Lithops divergens* var. *divergens* – and are all viewed as important (Cole and Cole 2005, Earle and Round n.d., Nel 1946). Lithops are often associated with quartz outcrops and fields and such features in the plateau area northwest of the Pit area (i.e., HLP2 & TSF3 areas) should be avoided as potential habitat (Figure 73). These species are important for their horticultural potential and often collected illegally.

Fygies

Aizoaceae (succulents or commonly referred to as "vygies") are common in southern Namibia, especially south-western Namibia, with many species being protected (see Nature Conservation Ordinance 4 of 1975) and although not easy to include in a literature review due to the number of species involved; rainfall related – i.e., often only emerge after winter rains in the area; have specific habitat requirements; varied distribution, etc. are also viewed as important (e.g. See Mannheimer *et al.* 2008) (Figure 74).

Other species with commercial potential that could occur in the general area include *Citrullus lanatus* (Tsamma melon) which potentially has a huge economic benefit (Mendelsohn *et al.* 2002). Furthermore, Southern Africa is an important centre of diversity for the melon family (*Cucurbitacea*e), and they have an excellent potential for development to supplement or replace cereal production in arid regions (Kolberg 1998).

Figure 69. *Aloe gariepensis* – protected NC – are numerous on some of the higher reaches of the hills/mountains along the Haib River.

Figure 70. *Commiphora gracilifrondosa* (karee corkwood) – near endemic; protected F – are not as common as *C. namaensis* (Nama corkwood) throughout the area.

Figure 71. *Euphorbia indecora* occur as individuals or in small patches in rocky terrain.

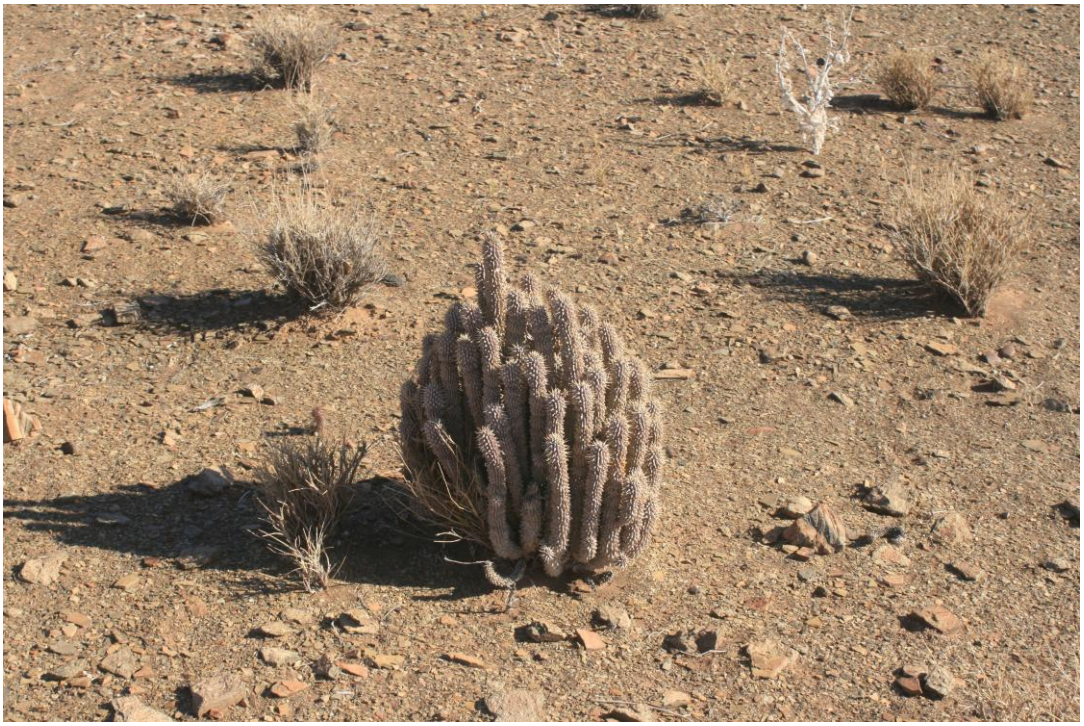

Figure 72. *Hoodia gordonii* – protected NC – scattered throughout the gravel plain areas.

Figure 73. Lithops are often associated with quartz outcrops and fields which should be avoided.

Figure 74. *Ruschia divaricata* form dense stands in the plateau area.

6.4 Important Areas & Ecosystem Services

The most important areas in the Haib Copper Project area are:

1. Orange River riparian habitat (perennial)

The Orange River is classified as a site of special ecological importance in Namibia (Curtis and Barnard 1998). This linear oasis with its rugged mountains supports many unique

succulent and fog dependent species with the Orange River mouth being a Ramsar site (Kolberg and Simmons 1998). The riparian habitat is important due to the riverine woodlands with large and often protected species – e.g., *Euclea pseudebenus*, *Salix mucronata* subsp. *capensis*, *Ziziphus mucronata, etc.* (See Table 6). Such larger trees serve as habitat to a variety of vertebrate fauna (e.g., bark and crevasse dwelling bats/reptiles; nesting/roosting/perching sites for various large raptors and aquatic species, etc.) as well as important ecosystem services such as stabilise the riverbank (e.g., *Z. mucronata*) and limit/prevent erosion (See Figure 75).

Permits: Permits would be required from the MEFT to destroy/remove any of the protected species.

Recovery potential: LOW (Affected vegetation would require >10yrs to recover after initial disturbance). Disturbances would also exacerbate the alien invasive infestation (e.g., *Prosopis* spp.).

2. Haib River riparian habitat (ephemeral)

The Haib River riparian habitat is important as larger trees are associated with is habitat, especially large and protected *Acacia erioloba*, *Euclea pseudebenus*, *Maerua schinzii*, etc. (See Table 6). Such larger trees serve as habitat to a variety of vertebrate fauna (e.g., bark and crevasse dwelling bats/reptiles; nesting/roosting/perching sites for various large raptors, etc.) as well as have important ecosystem services such as stabilise the riverbank (e.g., *T. usneiodes*) and limit/prevent erosion. Any disturbances would increase runoff and siltation of the perennial Orange River (See Figure 75).

Permits: Permits would be required from the MEFT to destroy/remove any of the protected species.

Recovery potential: LOW (Affected vegetation would require >10yrs to recover after initial disturbance). Disturbances would also exacerbate the alien invasive infestation (e.g., *Prosopis* spp.).

3. Various ephemeral drainage lines

The various ephemeral drainage lines which are tributaries to the Haib and Orange Rivers in the general project area are important as these serve similar functions as the Haib River habitat mentioned above. The seeps associated with the drainage line in the TSF5 area is viewed as particularly important for a variety of vertebrate fauna in an otherwise marginal area (Figures 9-10). Any disturbances would increase runoff and siltation of the perennial Orange River (See Figure 75).

Permits: Permits would be required from the MEFT to destroy/remove any of the protected species.

Recovery potential: LOW (Affected vegetation would require >10yrs to recover after initial disturbance). Disturbances would also exacerbate the alien invasive infestation (e.g., *Prosopis* spp.).

4. Rocky habitats

Rocky areas generally have high biodiversity and consequently viewed as important habitat for all vertebrate fauna and flora in the general area. Protected species associated with and confirmed from the hills in the project area include unique species such as *Aloe gariepensis*, *Commiphora gracilifrondosa*, *C. namaensis*, and various succulent species (See Tables 6 & 10). The well vegetated plateau area is viewed as particularly diverse floristically including rocky pothole features with water holding capacity and very important habitat (See Figures 12, 33, 53-54, 75).

Permits: Permits would be required from the MEFT to destroy/remove any of the protected species.

Recovery potential: LOW (Affected vegetation would require >10yrs to recover after initial disturbance). Disturbances would also exacerbate the alien invasive infestation (e.g., *Cylindropuntia fulgida*).

5. Booted eagle nesting site

Booted eagle (*Hieraaetus pennatus*) – endangered – have an estimated population estimate of 20 breeding pairs (±250 individuals) in Namibia (Simmons *et al.* 2015). Simmons *et al.* (1997) raise the importance of the Haib Copper area as a breeding area and estimate that 5 birds and 2 possible nesting sites may occur in the area (Simmons and Allen 2002). They nest in isolated rocky cliff areas with very few confirmed nesting sites in Namibia (and southern Africa). Rocky areas generally have high biodiversity and consequently viewed as important habitat for all vertebrate fauna (and flora) in the general area. A booted eagle nest site, although not confirmed, was located in the upper Haib River area and consequently viewed as an important area (See Figures 25 & 75).

Permits: N/A

Recovery potential: LOW (Disturbance of this site would be permanent and add to the overall pressure this species experiences throughout its range).

6. Bird flyways

Although very little is known regarding bird flight paths in Namibia, especially species moving/migrating at night, most birds seem to follow the shortest routes between selected habitats – e.g., dams, estuaries, bays, etc. However, unpredictable rainfall events may lure species into areas not normally frequented and storms (e.g., berg winds) may also force birds into areas not regularly visited. Planning for all eventualities is therefore not always possible. Figure 75 indicate important areas; potential flight paths and documented bird mortalities (Figure 29) caused by transmission lines in Namibia.

Avifauna is expected to be potentially affected by the proposed new 33kV overhead transmission line. Although, none of the unique/important bird species are exclusively associated with the proposed development area, the effect of aboveground transmission line infrastructure(s) is expected to be detrimental to certain birds – e.g., “pylon sensitive” species. Species potentially affected by the proposed overhead transmission line once operational and at greatest risk would be those larger species flying at pylon height (e.g., bustards, eagles, vultures); nocturnal travellers (e.g., flamingos and Palaearctic species) and species potentially visiting the area for roosting/foraging, etc. (e.g., bustards, crows).

As Ludwig’s bustard were observed in the gravel plain habitat and are known to breed in the general area; are viewed as an a known “pylon sensitive” species (See Scot and Scot n.d.); species of conservation concern (endangered – IUCN 2025); located between known bird mortality “hotspot” areas and known to be negatively affected by transmission lines, anti-perching devices should be placed on pylons and anti-collision mechanisms – BFD’s (bird flight diverters) such as coils, flappers, etc. – should be attached to the entire transmission line (See Figures 27-29 & 76). Other important species that would also benefit from BFD’s and known to frequent the area after localised rainfall events, are kori bustard, as well as Karoo korhaan, white-backed vulture and lappet-faced vulture.

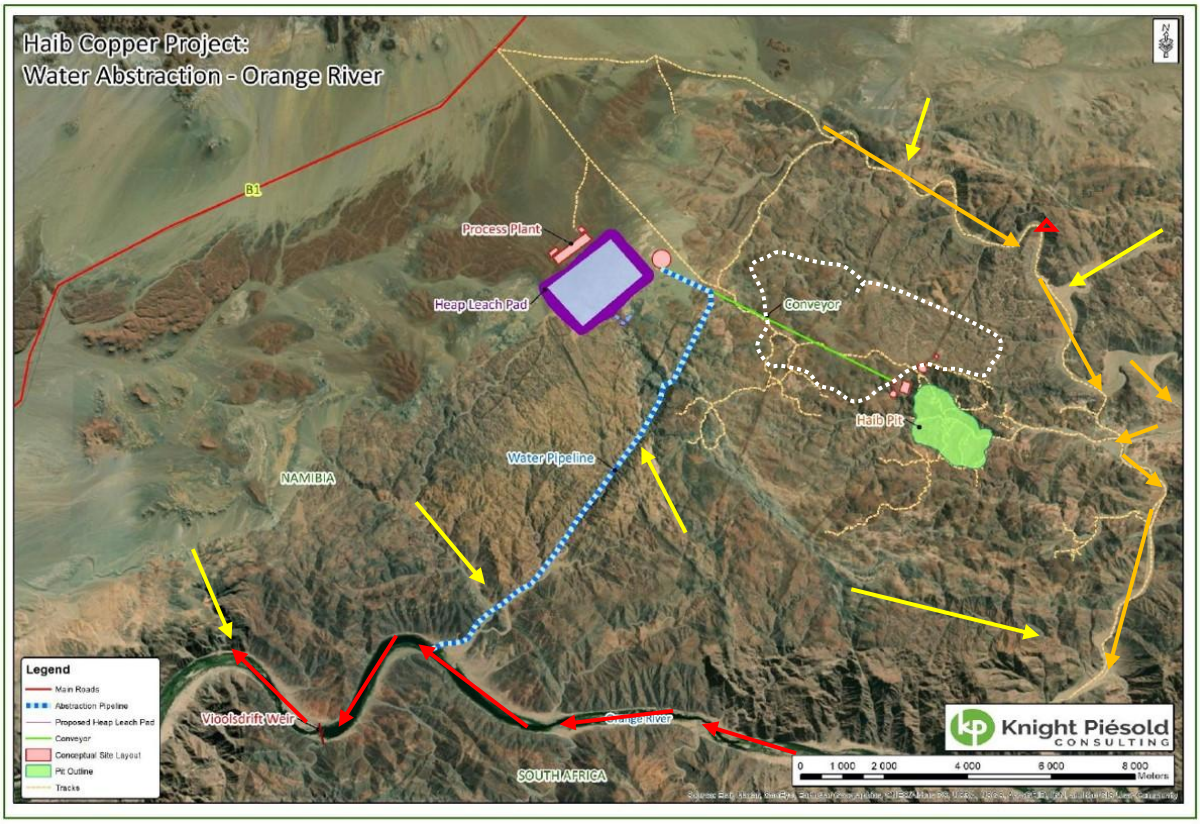

Figure 75. The most important areas in the Haib Copper Project are: 1) Orange River riparian habitat (red arrows); 2) Haib River riparian habitat (Orange arrows); 3) Ephemeral drainage lines (yellow arrows); 4) Plateau area (white dotted area); and 5) Booted eagle nesting site (red triangle) (Map from ©Knight Piésold Consulting).

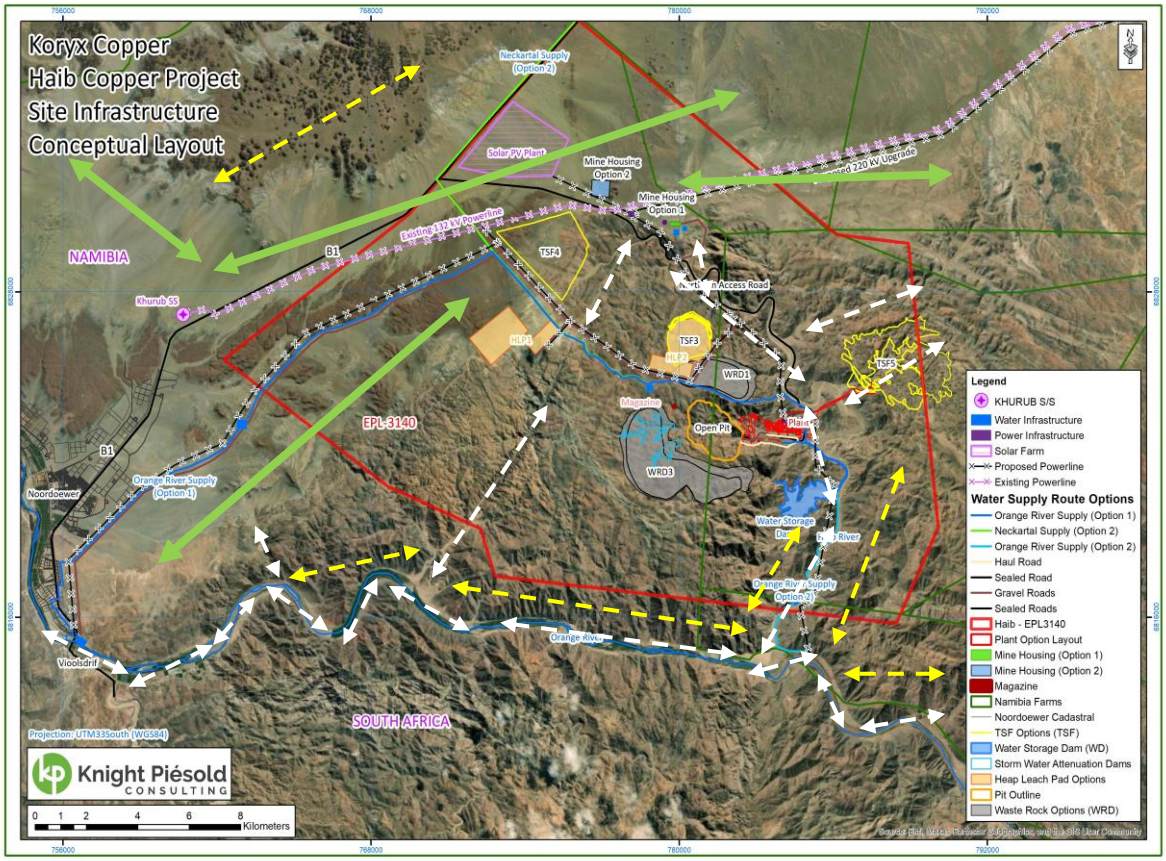

Figure 76. Expected bird flight paths along the perennial (Orange River) and various ephemeral drainage lines (white dashed arrows) and between mountainous areas (yellow dashed arrows) in the general area. Lüdwig's bustard flight paths observed/known/expected are indicated by the solid green arrows. The updated conceptual Haib Copper Project infrastructure layout is included (©Knight Piésold Consulting).

Ecosystem services

Ecosystem services provide benefits that are used by humans and in doing so affect human wellbeing such as livestock, ground/surface/fresh/salt water, fish, soil formation/composition, tourism, recreation, spiritual interactions, etc. According to Harper-Simmonds *et al.* (2016) the key ecosystem services in Namibia include:

- Provisioning;
- Regulation and Maintenance; and
- Cultural.

The proposed Haib Copper Project falls within the ecosystem zone known as the Nama Karoo Shrublands with the main ecosystem services under each of the above headings viewed as:

Provisioning
- Cultivated crops;
- Livestock;
- Wild animals;
- Fish, wild & from aquaculture;
- Wild plants for nutrition;
- Plants for material & energy use;

- Surface water; and
- Ground water.

Regulation and Maintenance
- Soil formation and composition;
- Ground water recharge;
- Mediation of waste and pollution;
- Global and regional climate regulation;
- Ventilation and transpiration; and
- Food protection.

Cultural
- Physical interactions; and
- Spiritual, symbolic and intellectual interactions.

The broad drivers of change in the Nama Karoo Shrublands ecosystem zone, with their ecosystem specific pressures (in parenthesis), are viewed as:

- Habitat change (overgrazing & bush thickening);
- Exploitation (abstraction of surface water from the Orange River upstream in South Africa);
- Pollution (pollution of Orange River upstream in South Africa; pollution of surface water from irrigation schemes; contamination of boreholes);
- Invasive species (*Prosopis* spp. in riverbeds);
- Climate change (increased aridity); and
- Illegal use (poaching relatively minor threat).

The current and future expected impacts on the flow of the ecosystem services in the Nama Karoo Shrublands are:

- Pressures on the production of beef;
- Provision of groundwater because of habitat change;
- Groundwater pollution;
- Soil formation & composition; and
- Groundwater recharge.

The major pressure in this zone is from overgrazing, which has resulted in a gradual decline in rangeland productivity (Harper-Simmonds *et al.* 2016).

No key ecosystem services were identified in the proposed development area. However, any mining related activities that potentially may negatively affect the important Orange River ecosystem would have to be prevented and closely monitored.

7 Alternative Infrastructure Options

The following alternative infrastructure options have been investigated and ranked from least to most impact on the environment.

Mine Housing Options 1 & 2
The Mine Housing Option 2 is located on a flat and open sandy/gravel plain area between small rocky outcrops while Option 1 is located within rocky habitat closer to the Haib River. The rocky areas are habitat to a variety of unique vertebrate species, especially reptiles. Option 2 is viewed as the preferred option with less overall impact on the environment and associated vertebrate fauna and flora.

Ranking the two options, from best to worse ecological case scenario, is suggested as:

Option 2 – Option 1

HLP Options 1 & 2

The HLP Option 1 is flatter and less rocky with less diverse biodiversity than HLP Option 2 which is located within the important Plateau area northwest of the Open Pit. This area is diverse floristically with a high proportion of the trees/shrubs being protected while rock pools and potholes are important water holding features. HLP Option 1 is viewed as the preferred option with less overall impact on the environment and associated vertebrate fauna and flora. Biodiversity offset may be required if the HLP Option 2 is selected for development. Alternative sites are recommended to the south of the HLP Option 1 and/or TSF Option 4, areas (Figure 77).

Ranking the two options, from best to worse ecological case scenario, is suggested as:

Option 1 – Option 2

TSF Options 3, 4 & 5

The TSF Option 4 is flatter and less rocky with less diverse biodiversity than Options 3 & 5. TSF Option 3 is in a diverse rocky area located within the important Plateau area northwest of the Open Pit while TSF Option 5 is in an unspoilt drainage line with seeps and viewed as the most important site. TSF Option 4 is viewed as the preferred option with less overall impact on the environment and associated vertebrate fauna and flora. Biodiversity offset may be required if the TSF Options 3 & 5 are selected for development. Alternative sites are recommended to the south of the HLP Option 1 and/or TSF Option 4, areas (Figure 77).

Ranking the three options, from best to worse ecological case scenario, is suggested as:

Option 4 – Option 3 – Option 5

WRD Options 1 & 3

WRD Options 1 & 3 are in barren sparsely vegetated areas and expected to have few negative impacts on larger trees/shrubs. However, the western portions of the proposed WRD Option 1 would impact the important rocky habitat with unique flora (i.e., viewed as unique habitat) and should be decreased in size and/or move eastwards to avoid this area. WRD Option 3 is viewed as the preferred option with less overall impact on the environment and associated vertebrate fauna and flora. Biodiversity offset may be required if the western portions of the WRD Option 1 is selected for development.

Ranking the two options, from best to worse ecological case scenario, is suggested as:

Option 3 – Option 1

Orange River Supply Options 1 & 2

The Orange River Supply Option 2 along the Haib River is significantly shorter than Option 1 from the Noordoewer area making it the preferred option with less overall impact on the environment.

The abstraction points are heavily invested by the invasive alien *Prosopis* spp. with few indigenous species present and not in a pristine condition. Developing abstraction points at either Option 1 or 2 would not affect unique riparian species and/or the ecology if constructed with care (i.e., only remove invasive alien species on site and not indigenous vegetation; limited overall footprint at site; limit heavy vehicle operations to the bare minimum; limit siltation during construction, etc.). Furthermore, clearing of the invasive alien *Prosopis* spp. at these sites is recommended and would benefit the riparian ecology.

The pipeline should follow the edge of the Haib River and alignment negotiated beforehand to avoid the larger protected tree/shrub species associated with this ephemeral river (e.g., *Acacia erioloba*, *Euclea pseudebenus*, *Ziziphus mucronata*, etc.). The pipeline should also be buried to avoid becoming a barrier to non-jumping vertebrate fauna.

Ranking the two options, from best to worse ecological case scenario, is suggested as:

Option 2 – Option 1

Overhead Transmission Line Infrastructure

A new 33kV OTL route is proposed taking all the preferred mining infrastructure options into consideration – See Figure 28. It is proposed that this OTL route runs from the Solar PV Plant along the Mine Housing access route to the substation with one line branching off to the southwest initially following the existing 132kV OTL route and then southeast along the main access road to the HLP 1 area. The second line should follow the access road along the Haib River to the Plant and Orange River.

As many of the "pylon sensitive" bird species occur in the general area, it is recommended that BFD's (Bird Flight Diverters – e.g., coils, flappers, etc.) are installed along the entire 33kV transmission line network to minimise/prevent bird mortalities (See Figure 28).

It is recommended that the new 33kV transmission line network should be aligning in parallel (and as close as technically feasible) to the existing 132kV OTL (where coinciding – See Figure 28) with staggered pylon towers so that each tower is aligned with the mid-span of the neighbouring line, thus potentially making it more visible and prevent bird collisions as most collisions occur near the middle of a section of a span and fewer closer to the pylons.
The proposed OTL should follow the access routes and not along the ridges to minimise bird mortalities and facilitate maintenance and bird mortality monitoring (See Figure 28).

This new proposed OTL option is much shorter than the existing OTL option and expected to have less overall impact on the environment, and birds especially pylon sensitive bird species.

Ranking the options, from best to worse ecological case scenario, is suggested as:

Proposed New Option – Existing Option

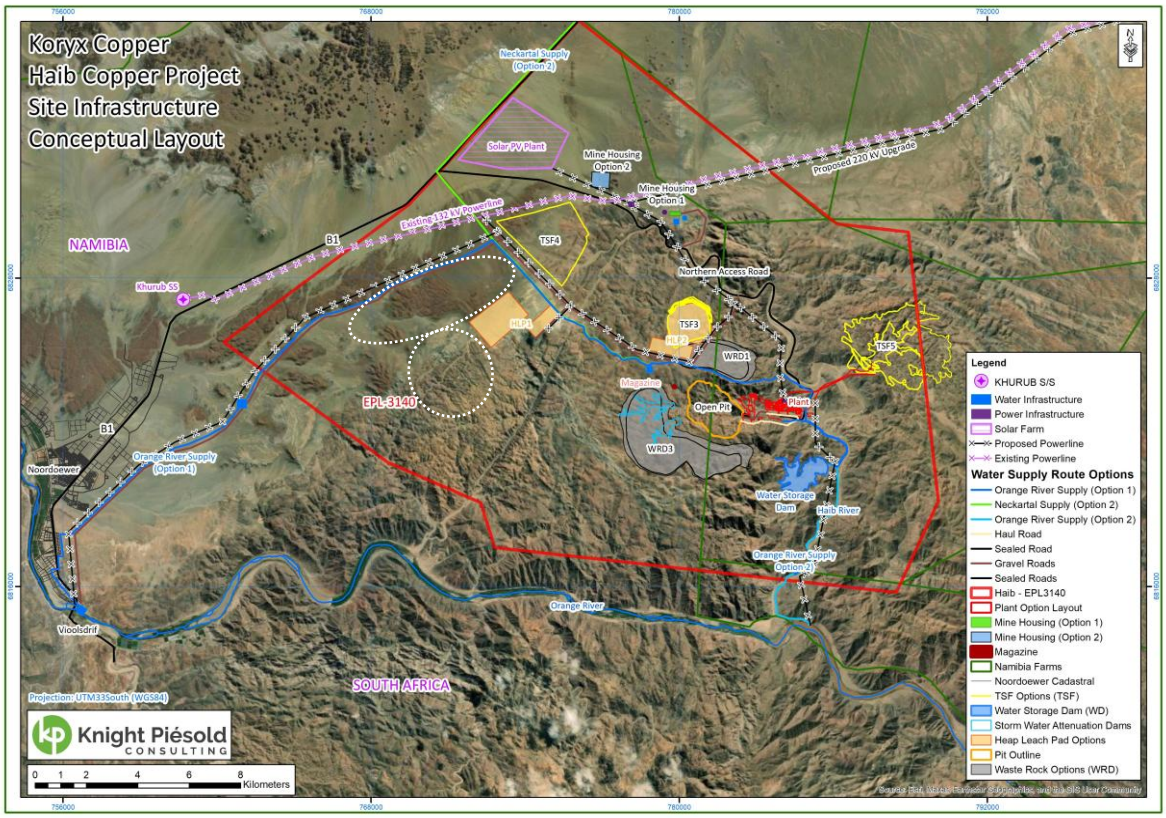

Figure 77. Alternative sites recommended for the TSF3, TSF5 & HLP2 to prevent the destruction of the unique habitats expected at the current proposed sites (See dotted circle/oblong south of the TSF4 & HLP1 sites).

8 Envisaged impacts

All developments change or are destructive to the local vertebrate fauna and flora to some or other degree. Assessing potential impacts is occasionally obvious, but more often difficult to predict accurately. Such predictions may change depending on the scope of the development – i.e., development, once initiated, may have a different effect on the vertebrate fauna and flora as originally predicted. Thus, continuing monitoring of such impacts during the development phase(s) is imperative.

The impacts that the construction, operation and decommissioning of the proposed Haib Copper mine project may have on the vertebrate fauna and flora recorded throughout the general area were based on a comprehensive literature review and rapid field assessments conducted during November 2023 and October 2025.

Possible impacts and their sources that the Haib Copper Project developments, especially related to the conceptual infrastructure layout (See Figure 1), is likely to have on the vertebrate fauna; avifauna and flora are provided for the construction; operation & decommissioning phases (Tables 14-19).

1. Vertebrate fauna, especially protected species

Description of Impact: The land clearing activities by mechanical methods at the various development sites would result in numerous species being eradicated and/or dispersed (See Tables 1-5). Vertebrate fauna (e.g., especially sedentary, slow moving and ground nesting species; various cavity dwellers such as bats, various reptiles, etc.; various avifauna using vegetation in affected areas for perching/roosting/breeding, etc.) associated with the area,

especially the well vegetated ephemeral drainage lines and rocky habitats, etc., would be killed and/or displaced.

Mitigation Measures:

- Remove and relocate important slow-moving species such as tortoise, chameleon, etc. prior to construction activities as well as when serendipitously encountered throughout the proposed development areas;
- Prevent destruction of the well vegetated ephemeral drainage line habitats – e.g., Haib River; TSF5;
- Prevent destruction of the important rocky habitats – e.g., plateau; HLP2; TSF 3 & 5;
- Consider alternatives to the HLP2, TSF3 & 5 and decrease the WRD1 expansion westwards into this area (See Section 7);

[If these unique areas are selected for development then as per IFC PS 6 undertake a Critical Habitat Assessment and demonstrate no Net Loss of biodiversity (Natural Habitat) or Net Gain of biodiversity (Critical Habitats). The mitigation strategy should be captured in a dedicated Biodiversity Action Plan. The use of Biodiversity Offsets should be implemented where necessary]

- Prevent poaching (e.g., setting snares) & killing of perceived dangerous species (e.g., snakes);
- Maintain and enforce track discipline;
- Avoid all areas not directly targeted for the various mine infrastructures;
- Rehabilitate areas, especially drill sites and associated access tracks on steep gradients;
- Avoid trees/cliffs with raptor (e.g., booted eagle; white-backed vulture, etc.) nests;
- Consider the proposed shorter pipeline route along the Haib River;
- Avoid an aboveground pipeline and rather burry pipeline;
- Do not leave pipeline trench open as this could act as a pitfall trap.
- Consider the proposed shorter OTL network (See Figure 28);
- Avoid OTL's placed on exposed ridges and rather follow the access roads;
- Attach BFD's to the entire OTL route to avoid bird mortalities;
- Do not leave pole/pylon holes open as these could act as a pitfall trap; and
- Inform contractors & staff regarding important habitats & species and consider appointing an Environmental Officer (EO) to ensure on site compliance.

Table 14. Impacts of construction, operation & decommissioning on vertebrate fauna.

Vertebrate fauna																	
Construction	Loss/Disturbance of vertebrate fauna	-	D	3	3	5	3	5	70	H	2	3	2	2	5	45	M
Operation	Loss/Disturbance of vertebrate fauna	-	D	2	3	4	3	5	60	H	2	1	2	3	5	40	M
Decommission	Loss/Disturbance of vertebrate fauna	-	D	1	1	1	1	5	20	L	1	1	1	1	5	20	L

2. Avifauna, especially pylon sensitive species

Description of Impact: A new 33kV OTL network is expected to impact on pylon sensitive bird species, especially the endangered Ludwig's bustard, known to frequent the gravel plains between the B1 tarmac highway and the proposed mining area.

Mitigation Measures:

- Consider the proposed shorter OTL network (See Figure 28);
- Avoid OTL's placed on exposed ridges and rather follow the access roads;
- Attach anti-collision mechanisms – BFD's (bird flight diverters) such as coils, flappers, etc. – along the entire OTL route to minimise bird mortalities;
- Stagger the poles/pylons with the existing 132kV OTL where applicable to minimise collisions;

- Do not leave pole/pylon holes open as these could act as a pitfall trap;
- Monitor OTL mortalities to identify problem areas; and
- Inform contractors & staff regarding important habitats & species and consider appointing an Environmental Officer (EO) to ensure on site compliance.

Table 15. Impacts of construction, operation & decommissioning on avifauna.

Avifauna																	
Construction	Mortalities of avifauna - 33kV OTL's	-	D	2	1	4	3	5	50	M	2	1	2	2	5	35	M
Operation	Mortalities of avifauna - 33kV OTL's	-	D	4	1	4	5	5	70	H	1	1	4	5	5	55	M
Decommission	Mortalities of avifauna - 33kV OTL's	-	D	1	1	1	1	5	20	L	1	1	1	1	5	20	L

3. Vegetation, especially protected species

Description of Impact: The land clearing activities by mechanical methods, at the various development areas would result in numerous species being eradicated and/or dispersed (See Tables 6-10). Flora (e.g., unique species) associated with the area, especially the well vegetated ephemeral drainage lines; rocky habitats, etc., would be killed.

Mitigation Measures:

- Remove and relocate all protected species with a good relocation/survival potential – e.g., *Aloe* spp., *Commiphora* spp., *Hoodia* spp., *Lithop* spp., *Tylecodon* spp., etc.;
- Establish a nursery of local/indigenous species for rehabilitation purposes;
- Prevent destruction of the well vegetated ephemeral drainage line habitats – e.g., Haib River; TSF5;
- Prevent destruction of the important rocky habitats – e.g., plateau; HLP2; TSF 3 & TSF5;
- Consider alternatives to the HLP2, TSF3 & TSF5 and decrease the WRD1 expansion westwards into this area (See Section 7);

[If these unique areas are selected for development then as per IFC PS 6 undertake a Critical Habitat Assessment and demonstrate no Net Loss of biodiversity (Natural Habitat) or Net Gain of biodiversity (Critical Habitats). The mitigation strategy should be captured in a dedicated Biodiversity Action Plan. The use of Biodiversity Offsets should be implemented where necessary]

- Prevent poaching (e.g., illegal collecting of unique flora such as *Aloe*, *Commiphora* spp., *Hoodia* spp., *Lithop* spp., *Tylecodon* spp., etc);
- Maintain and enforce track discipline;
- Avoid all areas not directly targeted for the various mine infrastructures;
- Rehabilitate areas, especially drill sites and associated access tracks on steep gradients;
- Avoid the destruction of old/large protected tree spp. (e.g., *Euclea*, *Maerua*, etc.);
- Consider the proposed shorter pipeline route along the Haib River;
- Follow the edge of the river and not the main channel;
- Align pipeline route to avoid old/large protected tree spp.; and
- Inform contractors & staff regarding important habitats & species and consider appointing an Environmental Officer (EO) to ensure on site compliance.

Table 16. Impacts of construction, operation & decommissioning on flora.

Flora																	
Construction	Loss/Disturbance of flora	-	D	4	3	5	2	5	70	H	2	1	1	2	5	30	M
Operation	Loss/Disturbance of flora	-	D	2	3	4	2	5	55	M	1	1	1	2	5	25	L
Decommission	Loss/Disturbance of flora	-	D	1	1	1	1	5	20	L	1	1	1	1	5	20	L

4. Sensitive habitats

Description of Impact: The land clearing activities by mechanical methods, at the various development areas, would result in some sensitive habitats being destroyed and/or detrimentally affected (See Sections 6.4 & 7). Vertebrate fauna and flora associated with these sensitive habitats, would be killed and/or displaced.

Mitigation Measures:

- Limit the development to actual mine sites to be developed and avoid affecting adjacent areas, especially well vegetated ephemeral drainage lines and rocky habitats, throughout the entire area;
- Avoid/limit development and associated infrastructure in sensitive areas – e.g., Plateau area (plateau; HLP2; TSF 3 & TSF5) and well vegetated ephemeral drainage lines, especially with seeps in the TSF5 area (See Section 6.4). This would minimise the negative effect on the local environment especially unique features serving as habitat to various vertebrate fauna and flora species (See alternative sites proposed – Figure 77);

[If these unique areas are selected for development then as per IFC PS 6 undertake a Critical Habitat Assessment and demonstrate no Net Loss of biodiversity (Natural Habitat) or Net Gain of biodiversity (Critical Habitats). The mitigation strategy should be captured in a dedicated Biodiversity Action Plan. The use of Biodiversity Offsets should be implemented where necessary]

- Maintain and enforce track discipline, especially along access route through the important Plateau area;
- The pipeline route along the Haib River should follow the edge of the river and not the main channel;
- Align pipeline route to avoid old/large protected tree spp.; and
- Inform contractors & staff regarding important habitats & species and consider appointing an Environmental Officer (EO) to ensure on site compliance.

Table 17. Impacts of construction, operation & decommissioning on sensitive habitats.

Sensitive habitats																	
Construction	Loss/Disturbance of sensitive habitats	-	D	5	5	5	3	5	90	H	2	3	2	2	5	45	M
Operation	Loss/Disturbance of sensitive habitats	-	D	2	3	4	1	5	50	M	1	1	1	1	5	20	L
Decommission	Loss/Disturbance of sensitive habitats	-	D	1	1	1	1	5	20	L	1	1	1	1	5	20	L

5. Soil erosion issues

Description of Impact: The land clearing activities by mechanical methods, at the various development areas would result in erosion issues. Although rainfall is sparse and variable throughout the project area, occasional strong downpours are known which could cause massive erosion issues if not anticipated, planned and prevented. Furthermore, the entire area drains into the only perennial river in southern Namibia (i.e., Orange River) with erosion potentially harming the downstream riparian ecology.

Mitigation Measures:

- Avoid clear felling of vegetation in areas viewed as erosion prone – i.e., ephemeral rivers; steep slopes (hill areas);
- Plan access route(s) to mine site to avoid areas viewed as erosion prone – i.e., ephemeral rivers; steep slopes (hill areas);
- Where new tracks must be made off the main routes, the routes should be selected causing minimal damage to the environment – e.g., use the same tracks; cross drainage lines at right angles; avoid placing tracks within drainage lines; avoid

collateral damage (i.e., select routes that do not require the unnecessary removal of trees/shrubs, especially protected species);
- Rehabilitate all new tracks created (especially tracks on steep gradients) – i.e., immediately after drilling operations and not wait until the end of the project;
- Maintain and enforce track discipline;
- Implement erosion control measures where applicable – e.g., backfill erosion gullies with rock; cross drains on slopes, etc.;
- Conduct erosion maintenance after each rainy season; and
- Monitor on site erosion and rehabilitation procedures.

Table 18. Impacts of construction, operation & decommissioning on soil erosion.

Erosion issues																	
Construction	Soil loss & siltation	-	D	4	3	4	3	5	70	H	2	3	1	3	5	45	M
Operation	Soil loss & siltation	-	D	2	3	4	3	5	60	H	2	1	1	1	5	25	L
Decommission	Soil loss & siltation		D	1	1	1	1	5	20	L	1	1	1	1	5	20	L

6. Invasion and spread of invasive alien plant species

Description of Impact: Soil disturbances by mechanical methods, at the various development areas would favour invasive alien plant species becoming established. Invasive alien plant species, already present in the area (See Section 6.2.3), would flourish in the disturbed areas and could also inadvertently be transported into the area as seed on the various vehicles accessing the mine site.

Mitigation Measures:
- Limit land clearing activities at the mine site and infrastructures areas to prevent random soil disturbances favouring invasive alien plant species;
- Remove and destroy all invasive alien plants encountered in the project area (See Table 12; Figures 64-68);
- Do not use chemicals to eradicate alien spp. as these could end up in the perennial Orange River, but rather conduct manual and/or semi-mechanised (chainsaw) methods;
- Ensure that vehicles accessing the route are free of vegetation, especially if contractors are used which also use their vehicles in urban areas;
- Conduct annual maintenance (alien plant removal) after rainy season; and
- Monitor reestablishment & regrowth of invasive alien species and conduct follow-up procedures when necessary.

Table 19. Impacts of construction, operation & decommissioning on invasive alien plant spp.

Invasive alien plants																	
Construction	Invasion by invasive species	-	D	4	1	4	3	5	60	H	1	1	1	2	5	25	L
Operation	Invasion by invasive species	-	D	2	1	4	3	5	50	M	1	1	1	1	5	20	L
Decommission	Invasion by invasive species	-	D	1	1	1	1	5	20	L	1	1	1	1	5	20	L

7. Water abstraction points in the Orange River

Description of Impact: Disturbances by mechanical methods within the Orange River habitat, at the abstraction sites (Options 1 & 2 – See Figure 1) would result in siltation and affect the riparian & aquatic ecology downstream and/or result in increased density of invasive alien plant species (e.g., *Prosopis* spp.) if not handled with care. The actual site selection for the abstraction is important so as not to destroy the indigenous riparian vegetation and associated ecology.

Mitigation Measures:

- Limit heavy vehicles & mechanical activities within the Orange River during construction at the abstraction site to prevent downstream siltation;
- Ensure drip trays for all construction vehicles that may be used at the abstraction site during the construction period to prevent hydrocarbon spills;
- The sites selected should focus on areas dominated by the invasive alien *Prosopis* spp. and not patches dominated by indigenous species;
- Remove (manual eradication preferred) and destroy all invasive alien plant species encountered at the selected abstraction points (Figure 78);
- Do not use chemicals to eradicate alien plant species in the riparian zone; and
- Conduct annual maintenance (invasive alien plant removal) after flood season around the abstraction site. *Prosopis* spp. are known to coppice & thicken after mechanical clearing operations which may impact on the abstraction point.

Table 20. Impacts of construction, operation & decommissioning at abstraction site in the Orange River.

Abstraction sites - Orange River																	
Construction	Riparian habitat destruction & siltation	-	D	4	3	4	5	5	80	H	2	3	4	2	5	55	M
Operation	Siltation	-	D	1	1	4	5	5	55	M	1	1	1	5	5	40	M
Decommission	Siltation	-	D	1	1	1	2	5	25	L	1	1	1	1	5	20	L

Figure 78. The invasive alien *Prosopis* spp. (mesquite) forms dense impenetrable stands along large parts of the Orange River (bright green trees in background while the grey trees in foreground are *Tamarix usneoides* – protected F).

IFC Performance Management Issues

A summary of the findings of the baseline provides inputs into a comparative analysis from where the various infrastructure options were assessed. The comparison provided in Table 21 provides a high-level assessment with specifics provided in this section.

Table 21. Summary of findings for each proposed development site related to the IFC requirements.

Infrastructure	Habitat Type	Habitat status (Unique features)	Sedentary Protected Species	Impact to Biodiversity	IFC Habitat Type (TBC)	Risk of Critical Habitat Classification (Requires CHA)	IFC Trigger Requirement
Open Pit	Ephemeral Drainage line	Impacted Sparse vegetation		Low Impact 100% loss	Modified	Low	
Solar Plant	Gravel Plains	Impacted Sparse vegetation	*Aloidendron dichotomum* *Hoodia gordonii* *Sarcocaulon flavescens*	Low Impact 100% loss	Natural / Modified	Low	Offset (No Net Loss), Demonstrate no viable alternatives
TSF 3	Rocky Habitat	Untouched, Unique, Well vegetated (Biodiversity Hotspot)	*Aloidendron dichotomum* *Ceraria fruticulose* *Commiphora cervifolia* *Commiphora namaensis* *Maerua schinzii* *Portulacaria namaquensis* *Ruschia divaricata*	100% loss High impact	Natural	High	Offset (Net Gain), Demonstrate no viable alternatives
TSF4	Gravel Plains	Impacted Sparse vegetation		100% loss Low impact	Natural / Modified	Low	Offset (No Net Loss), Demonstrate no viable alternatives
TSF 5	Ephemeral Drainage line	Untouched, Unique, Well vegetated (Biodiversity Hotspot, Seeps)	*Commiphora namaensis* *Maerua schinzii*	100% loss High impact	Natural	High	Offset (Net Gain), Demonstrate no viable alternatives
WRD 1 (East)	Rocky Habitat	Sparse vegetation		100% loss Low impact	Natural	High	Offset (No Net Loss), Demonstrate no viable alternatives
WRD 1 (West)	Rocky Habitat	Untouched, Unique Well vegetated (Biodiversity Hotspot)	*Aloidendron dichotomum* *Ceraria fruticulose* *Commiphora cervifolia* *Commiphora namaensis* *Maerua schinzii* *Portulacaria namaquensis* *Ruschia divaricata*	100% loss High impact	Natural	High	Offset (Net Gain), Demonstrate no viable alternatives

Infrastructure	Habitat Type	Habitat status (Unique features)	Sedentary Protected Species	Impact to Biodiversity	IFC Habitat Type (TBC)	Risk of Critical Habitat Classification (Requires CHA)	IFC Trigger Requirement
WRD 3	Rocky Habitat	Sparse vegetation		100% loss Low impact	Natural	Low	Offset (No Net Loss), Demonstrate no viable alternatives
WD1	Ephemeral Drainage Line	Sparse vegetation		Moderate impact	Natural	Low	Offset (No Net Loss), Demonstrate no viable alternatives
Haib Pipeline (shorter)	Ephemeral Drainage Line	Ephemeral riparian vegetation	*Euclea pseudebenus* *Maerua schinzii*	Some loss Low impact	Natural / Modified	Low	Offset (No Net Loss), Demonstrate no viable alternatives
Western Pipeline (longer)	Gravel Plains	Limited vegetation		Loss avoided, migration impacted Moderate impact	Natural / Modified	Low	Offset (No Net Loss), Demonstrate no viable alternatives
HLP 1	Gravel Plains	Impacted Sparse vegetation		100% loss Low impact	Natural / Modified	Low	Offset (No Net Loss), Demonstrate no viable alternatives
HLP 2	Rocky Habitat	Untouched, Unique Well vegetated (Biodiversity Hotspot)	*Aloidendron dichotomum* *Ceraria fruticulose* *Commiphora cervifolia* *Commiphora namaensis* *Maerua schinzii* *Portulacaria namaquensis* *Ruschia divaricata*	100% loss High impact	Natural	High	Offset (Net Gain), Demonstrate no viable alternatives
Mine Housing Option 1	Gravel Plains	Higher habitat diversity		Moderate impact	Natural	Low	Offset (No Net Loss), Demonstrate no viable
Mine Housing Option 2	Gravel Plains	Lower habitat diversity		Moderate impact	Natural / Modified	Low	Offset (No Net Loss), Demonstrate no viable

The following biodiversity related IFC Performance Management Standards (highlighted in bold) are expected to be relevant and actions addressed included (italics):

Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts Performance

Risks identified: Important species (Sections 6 – See 6.3); Important habitats (Section 6 – See 6.4); Alternative infrastructure options (Section 7) and Envisaged impacts (Section 8) were identified during this study. Furthermore, for each section under the receiving environment – i.e., vertebrate fauna (amphibians, birds, mammals & reptiles) & flora (larger trees/shrubs, grass, other species) – the impacts were addressed as well as alternatives presented and mitigations suggested for the general habitats and the conceptual infrastructure layouts.

Standard 2: Labor and Working Conditions Performance

N/A

Standard 3: Resource Efficiency and Pollution Prevention Performance

N/A

Standard 4: Community Health, Safety, and Security Performance

N/A
Standard 5: Land Acquisition and Involuntary Resettlement Performance

N/A

Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources Performance

*Modified Vs Natural habitat: Although many areas (specifically gravel plains infrastructure and the pit area) are not viewed as pristine habitat due to various anthropogenic activities throughout the area, it falls between Modified and Natural habitat. The infrastructure areas are classified in terms of Modified and Natural Habitat (*Table 22*). This report deals with the various biodiversity related issues relevant to the proposed development area, highlighting important species and habitats potentially affected.*

Natural habitats are defined as areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition

IFC requires that natural habitat must not significantly be converted or degraded, unless all of the following are demonstrated:

- *No other viable alternatives within the region exist for development of the project on modified habitat;*
- *Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation; and*
- *Any conversion or degradation is mitigated according to the mitigation hierarchy.*

Critical habitat: Critical habitats are areas with high biodiversity value, including (i) habitat of significant importance to Critically Endangered and/or Endangered species; (ii) habitat of

significant importance to endemic and/or restricted-range species; (iii) habitat supporting globally significant concentrations of migratory species and/or congregatory species; (iv) highly threatened and/or unique ecosystems; and/or (v) areas associated with key evolutionary processes.

*Based on the above the only critically endangered or endangered species identified (As per IUCN Red List) includes bird species (of which none are especially restricted to the Haib site nor are they sedentary) and habitats of significant importance to endemic and/or restricted-range species for the Leg-Karee Corkwood). Critical habitats as per IFC definition have thus not especially been identified in the assessment. The areas identified to be high probability of critical habitat include the rocky habitats associated with the plateau area (TSF 3, WRD 1 Western portion), HLP 2 and the TSF 5 areas (*Table 22*). If these areas are selected for development a Critical Habitat Assessment (CHA) must be undertaken.*

Table 22: IFC Habitat Type Classification – Haib Project area.

Infrastructure	IFC Habitat Type (TBC)	Risk of Critical Habitat Classification (Requires CHA)
Open Pit	Modified	Low
Solar Plant	Natural / Modified	Low
TSF 3	Natural	High
TSF 4	Natural / Modified	Low
TSF 5	Natural	High
WRD 1 (East)	Natural	Low
WRD 1 (West)	Natural	High
WRD 3	Natural	Low
WRD 1	Natural	Low
Haib River Pipeline (shorter route)	Natural / Modified	Low
Western Pipeline (longer route)	Natural / Modified	Low
HLP 1	Natural / Modified	Low
HLP 2	Natural / Modified	High
Mine Housing Option 1	Natural	Low
Mine Housing Option 2	Natural / Modified	Low

Note for undertaking a CHA: The determination of critical habitat based on other listings is as follows: (i) If the species is listed nationally/regionally as critically endangered or endangered, in countries that have adhered to IUCN guidance, the critical habitat determination will be made on a project by project basis in consultation with competent professionals; and (ii) in instances where nationally or regionally listed species' categorizations do not correspond well to those of the IUCN (e.g., in Namibia species are listed as "protected" or "important"), an assessment will be conducted to determine the rationale and purpose of the listing. In this case, the critical habitat determination will be based on such an assessment.

If the above habitats are identified as critical habitat, the development may not implement any project activities unless all of the following are demonstrated:

- *No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical;*

- *The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;*

- *The project does not lead to a net reduction in the global and/or national/regional population of any Critically Endangered or Endangered species over a reasonable period of time; and*

- *A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program- i.e., Biodiversity Action Plan.*

In such cases where the development is able to meet the requirements defined in the requirements above, the project's mitigation strategy will be described in a ***Biodiversity Action Plan*** *and will be designed to achieve net gains of those biodiversity values for which the critical habitat was designated.*

If the development of Natural or Critical habitats results in residual impacts, IFC PS 6 requires a demonstration of:
- *No net loss (for Natural Habitat), or*
- *Net gain (for Critical Habitat).*

A biodiversity offset could be used as a tool to design and implement measurable conservation outcomes that can reasonably be expected to result in no net loss (NATURAL HABITATS) and preferably a net gain of biodiversity (CRITICAL HABITATS). The design of a biodiversity offset must adhere to the "like-for-like or better" Principle 4 and must be carried out in alignment with best available information and current practices. When a client is considering the development of an offset as part of the mitigation strategy, external experts with knowledge in offset design and implementation must be involved.

Standard 7: Indigenous Peoples Performance

N/A

Standard 8: Cultural Heritage

N/A

9 Conclusion

As all development have potential negative environmental consequences, identifying the most important faunal species including high risk habitats beforehand, coupled with environmentally acceptable mitigating factors, lessens the overall impact of such development.

Vertebrate fauna species most likely to be adversely affected by the proposed Haib Copper Project developments would be sedentary species (i.e., species with limited mobility) such as unique reptiles (i.e., tortoises [*Psammobates tentorius veroxii*]; *Varanus niloticus* and *Bitis xeropaga*]. Amphibians are not viewed as important in the area and mammals are more mobile and although important species are known to occur and/or pass through the area (see elsewhere in this report) none are expected to be specifically associated and/or expected to be negatively affected by the developments. Although general disturbances could affect bird species of concern – i.e., species classified as critically endangered (white-backed vulture), endangered (black harrier, martial eagle, secretarybird, Ludwig's bustard and lappet-faced

vulture), vulnerable (tawny eagle) and near threatened (kori bustard) by the IUCN (2025) as well as those classified by Simmons *et al.* (2015) from Namibia as endangered (Ludwig's bustard, white-backed vulture, black harrier, tawny eagle, booted eagle, martial eagle, black stork), vulnerable (African fish eagle, lappet-faced vulture, secretarybird) and near threatened (Cape eagle owl, kori bustard, Verreaux's eagle, peregrine falcon, marabou stork).

Flora species most likely to be adversely affected by the proposed mine and associated infrastructures would be the various protected species (including endemic and near endemic) – i.e., species classified as rare (*Ozoroa namaquensis*) (Loots 2005); all the species protected by the Forest Act No. 12 of 2001 and the Nature Conservation Ordinance No. 4 of 1975 including all the species classified as near endemic. Species classified by the IUCN (2025) as endangered (*Commiphora buruxa*) and vulnerable (*Aloidendron dichotomum*) are important – See Tables 6, 7 & 13; Section 6.3 – although these species are not specifically associated with the development sites.

Important areas in the general vicinity are viewed as the Orange River; Haib River; ephemeral drainage lines (especially those with seeps such as the TSF5 area); rocky areas (especially the well vegetated plateau area in the HLP2, TSF3 & western portion of the WRD1); booted eagle nest site(s) & bird fly paths – See Section 6.4 and Figures 75 & 76.

Alternative sites for the contentious TSF Options 3 & 5 and HLP Option 2 and western portions of the WRD1 infrastructure sites are recommended so as not to destroy these unique habitats (See Section 7; Figure 77).

Alternative pipeline and 33Kv OTL routes are suggested (See Section 7; Figure 28, 75 & 76).

It is not expected that the Haib Copper Project developments will adversely affect any unique vertebrate fauna and flora, or at least be ameliorated, especially if the proposed recommendations (mitigation measures) and alternative options are incorporated – See Sections 6.3, 6.4, 7 & 8. This is especially important for the TSF Options 3 & 5 and HLP Option 2 and western portions of the WRD Option 1 sites currently proposed within unique habitats.

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