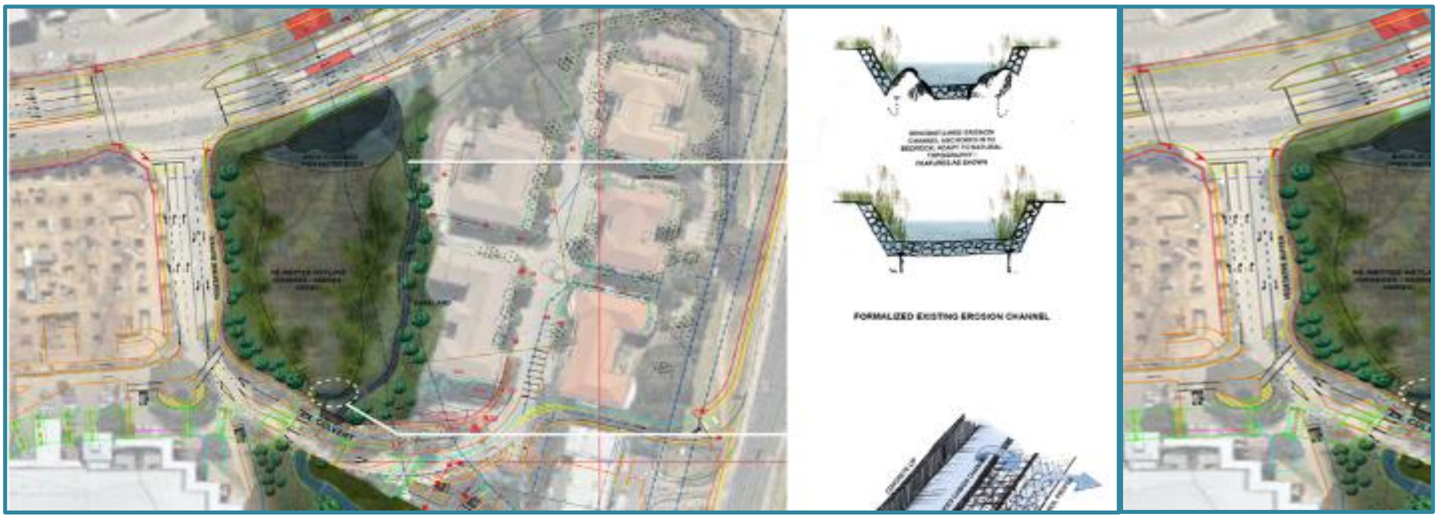
400KV MAJUBA SUBSTATION AND ASSOCIATED INFRASTRUCTURE:
Freshwater Baseline and Impact Assessment

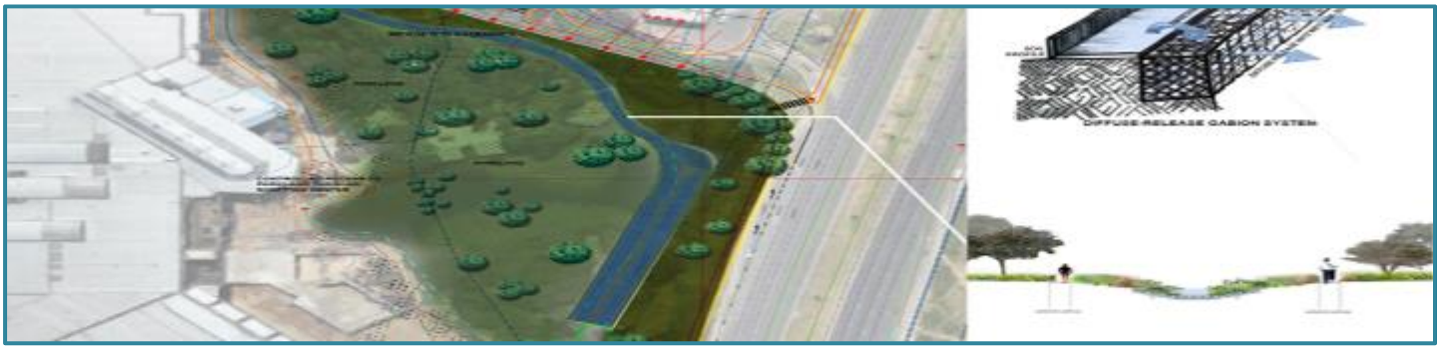
Prepared for:

NSOVO ENVIRONMENTAL CONSULTING

Prepared by:

WaterMakers





June 2024

Declaration of Independence by Specialist

I, **WILLEM LUBBE**, in my capacity as a specialist consultant, hereby declare that I -

- act as an independent consultant;
- will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- declare that there are no circumstances that may compromise my objectivity in performing such work;
- do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998), regulations and any guidelines that have relevance to the proposed activity;
- based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional ability;
- undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered; and
- as a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member.

Willem Lubbe *Pr.Sci.Nat*
Wetland Specialist
SACNASP Reg. No. 004750

01/06/2024

Date

Declaration of Independence by Specialist

I, **BYRON GRANT**, in my capacity as a specialist consultant, hereby declare that I -

- act as an independent consultant;
- will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- declare that there are no circumstances that may compromise my objectivity in performing such work;
- do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
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Byron Grant Pr.Sci.Nat.
Aquatic Specialist
SACNASP Reg. No. 400275/08

19/06/2024
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Date

EXECUTIVE SUMMARY

Eskom Holdings SOC Ltd (hereafter referred to as Eskom) proposes a new 132kV substation, expansion of the 400kV Majuba substation and associated infrastructure. The proposed project is located within the Pixley KaSeme Local Municipality, under the jurisdiction of the Gert Sibande District Municipality in the Mpumalanga Province. Nsovo Environmental Consulting was contracted to review the area and conduct the Environmental Impact Assessment (EIA) on their behalf. Subsequently, WaterMakers was appointed by Nsovo Environmental Consulting as independent specialists to conduct the relevant wetland-related studies in order to facilitate the required environmental authorisation and water use licence processes. The present study represents the baseline and wetland impact assessment of the study and aims to inform responsible decision making with regards to the project.

In order to enable an adequate description of potential wetland habitat and so as to ensure that the wetland study conducted is applicable for both an Environmental Authorisation as well as a Water Use Licence Application, the following approach was to be undertaken:

- Desktop assessment
- The wetland delineation should be conducted following the guidelines contained in the DWAF Guideline document entitled "A Practical Field Procedure for Identification and delineation of wetlands and riparian areas" (DWAF, 2008);
- Corroborate field and desktop data and classify confirmed wetlands into hydrogeomorphic units;
- Determine the functionality of wetlands, using a Level 2 Wet-EcoServices (Kotze *et al.*, 2005) assessment for wetlands within the study area;
- Determine the Present Ecological Status (PES) of identified wetlands within the study area through applying a Level 2 Wet-Health assessment (Macfarlane *et al*., 2008);
- Determine the Ecological Importance and Sensitivity (EIS) of identified wetlands by utilising methodology described by Rountree (2013);
- Determine and ground truth the NFEPA status of any wetlands on site, if any;
- Impact assessment for the proposed activities as well as potential mitigation measures.

A site visit to the area to be affected by the proposed activity/development was undertaken on the 30th of May 2024. A detailed description of the methodology used to address the above Terms of Reference is provided in Appendix A.

One hydro-geomorphic unit, a unchanneled valley bottom wetland was delineated within the vicinity of the proposed development. Artificial wetland habitat occurred discontinuously in various sections surrounding the Majuba power plant, a result of high-water demand processes and associated leaks occurring over prolonged periods. These artificial wetland habitats were patchy and resemble temporary zoned wetland habitat with a high graminoid basal cover interspersed with terrestrial vegetation.

Wetlands within the study area serve to improve habitat within and potentially downstream of the study area through the provision of various ecosystem services. Many of these functional benefits therefore contribute directly or indirectly to increased biodiversity within the study area as well as downstream of the study area through provision and maintenance of appropriate habitat and associated ecological processes

Combined area weighted Wet-Health results indicated that the wetlands from the study area have been moderately in most instances as a result of changes in water inputs (derived from its catchment) and water retention and distribution patterns within the wetlands units, as well as vegetation changes within the wetlands and surrounding catchments due to historic and current anthropogenic impacts, albeit relatively limited.

The valley bottom wetland was regarded as having a high Ecological Importance and Sensitivity as well as a high Hydrological and Functional Importance as a result of the relatively intact nature and various important ecosystem services they provide. Direct human benefits were associated with the provision of natural resources as well as grazing opportunities afforded by most wetlands within the study area. Collectively, the valley bottom systems along with their supporting hillslope processes, play an important role in contributing to good water quality and quantity to the downstream environment and serve as habitat and movement corridor for wetland related species .

The impact assessment identified sedimentation, alien invasive vegetation, loss of wetland functionality and changes to flow regimes as the major potential impacts during the construction and operational phases. Several general and specific mitigation measures are proposed. Development within the study area is proposed to constitute the re-alignment of existing Eskom infrastructure that is situated more than 200m from HGM 1. The re-alignment will constitute a few new pylons to realise the re-alignment within modified terrestrial grassland. This area also contains temporary artificial wetland habitat with very high basal cover. As a result of the high basal cover, general mitigation measures will be satisfactory in protecting the natural unchanneled valley bottom wetland further west. The rest of the proposed development will take place within the existing modified footprint of Majuba power station with little potential impact on watercourses downstream. Potential impact and increase of alien invasive vegetation should be addressed according to the terrestrial report for this project.

The DWS Risk Assessment Matrix, in terms of GA 509, calculated the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the freshwater resources assessed that is situated within 500m from the proposed development. By assessing the severity, spatial scale, duration and frequency of the proposed ESKOM infrastructure relocation, the risk to the potentially affected resource quality was determined to be low for all aspects during the construction and operational phases. The low risk identified was based on all recommended mitigation measures being implemented as outlined within this report.

The discontinuous artificial habitat is not off-limits. Normal mitigation measures apply within the discontinuous artificial habitat, where exceptionally wet habitat are detected (albeit unlikely), these areas should be avoided. Further, it is advised that all water leaks detected (especially in the western section of the power plant) be repaired in order to limit the development of artificial wetland habitat and the associated negative successional vegetation changes induced through the artificially increased hydrology on terrain. Care should be taken with regards to widening the access roads to not concentrate surface flows down the slope towards the natural wetland (by installing speedbumbs/berms with swales), this is especially important considering the artificial water inputs in the area that could exacerbate erosion process.

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ACRONYMS

CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DWA	Department of Water and Sanitation
DWS	Department of Water and Sanitation
EC	Ecological Category
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Area
GPS	Global Positioning System
HGM	Hydrogeomorphic
NBA	National Biodiversity Assessment
NFEPA	National Freshwater Ecosystem Priority Areas project
NWRS	National Water Resource Strategy
PES	Present Ecological State
SAIAB	South African Institute for Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
VEGRAI	Vegetation Reponses Assessment Index
WMA	Water Management Areas
WRC	Water Research Commission
WWF	Worldwide Fund for Nature

1. INTRODUCTION

1.1 Project Description

Eskom Holdings SOC Ltd (hereafter referred to as Eskom) proposes a new 132kV substation, expansion of the 400kV Majuba substation and associated infrastructure. The proposed project is located within the Pixley KaSeme Local Municipality, under the jurisdiction of the Gert Sibande District Municipality in the Mpumalanga Province.

In response to high interest and inquiries, Eskom has strategically decided to install two new fully equipped 400/132kV 500 MVA transformer bays at Majuba MTS. This will ensure the availability of a total capacity of 950 MW unfirm and 475 MW firm capacity, accommodating 671 MW of 132kV IPP connections. The 2022 Transmission Development Plan anticipates a significant increase in demand for renewable energy (RE) generation by 2030, specifically requiring 31,095 MW of photovoltaic and wind generation, with a substantial portion needed by 2027. However, many transmission supply areas lack the necessary capacity, underscoring the importance of attracting and facilitating RE generation connections, particularly in areas with minimal network infrastructure. Grid Planning recognizes the need for additional transformer capacity at substations located within future areas of interest for RE generation. These areas are identified through a comprehensive process, including the analysis of applications from bid windows 5 and 6, and feedback obtained from an industry survey conducted among various RE associations.

The proposed development triggers the NEMA EIA listed activities as contained in Government Notice Regulations (GN R), GN 983, and GNR 985. As such, Eskom is required to undertake a Basic Assessment (EIA) process and obtain an Environmental Authorisation (EA) in line with the requirements of the EIA Regulations of 2014 as amended, promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). Furthermore, the project is identified as a Strategic Infrastructure Project and confirmation is enclosed.

The following is the high-level scope of work:

- **132kV Yard:**
  - Establish new 2 x 400/132 kV 500 MVA transformers.
  - 132kV yard includes 4 feeder bays and 2 spare bays.
  - Cater for FCLRs in series with transformers & between transformer pairs (1 x FCLR / busbar).
- **400kV Yard**
  - Extend the 400kV yard.
  - Equip 2 x 400 kV transformer bays.
  - Install a 400kV bus section to reduce outages and to switch between busbars during construction.
  - Deviate the 400kV Alpha line to accommodate the new transformer bays.
  - Relocate the Microwave tower to accommodate the new transformer bays.
  - A geotech will not be done. The area for the terminal 400kV line structure and 132kV yard will be over excavated and backfilled with soil mixed with firmer material.
- **Associated Infrastructure**
  - Access road will be widened and upgraded to accommodate transformers (approximately 523m)

Nsovo Environmental Consulting was contracted to review the area and conduct the Basic Assessment (BA) on their behalf. Subsequently, WaterMakers was appointed by Nsovo Environmental Consulting as independent specialists to conduct the relevant wetland-related studies in order to facilitate the required environmental authorisation and water use licence processes. The present study represents the baseline and wetland impact assessment of the study and aims to inform responsible decision making with regards to the project.

1.2 Scope of Work

In order to enable an adequate description of potential wetland habitat and so as to ensure that the wetland study conducted is applicable for both an Environmental Authorisation as well as a Water Use Licence Application, the following approach was to be undertaken:

- Desktop assessment
- The wetland delineation should be conducted following the guidelines contained in the DWAF Guideline document entitled “A Practical Field Procedure for Identification and delineation of wetlands and riparian areas” (DWAF, 2008);
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A site visit to the area to be affected by the proposed activity was undertaken on the 30th of May 2024. A detailed description of the methodology used to address the above Terms of Reference is provided in Appendix A.

1.3 Assumptions and Limitations

During the course of the present study, the following limitations were experienced:

- In order to obtain definitive data regarding the biodiversity, hydrology and functioning of particular wetlands, studies should ideally be conducted over a number of seasons and over a number of years. The current study relied on information gained during a single field survey conducted during a single season, desktop information for the area, as well as professional judgment and experience;
- Wetland and riparian areas within transformed landscapes, such as urban and/or agricultural settings, or mining areas with existing infrastructure, are often affected by disturbances that restrict the use of available wetland indicators, such as hydrophytic vegetation or soil indicators (e.g. as a result of dense stands of alien vegetation, dumping, sedimentation, infrastructure encroachment and infilling). As such, wetland and riparian delineations as provided are based on indicators where available and the author’s interpretation of the current extent and nature of the wetlands and riparian areas associated with the proposed activity;

- Wetland and riparian assessments are based on a selection of available techniques that have been developed through the Department of Water and Sanitation (DWS). These methods are, however, largely qualitative in nature with associated limitations due to the range of interdisciplinary aspects that have to be taken into consideration. Current and historic anthropogenic disturbance within and surrounding the study area has resulted in soil profile disturbances as well as successional changes in species composition in relation to its original /expected benchmark condition;
- Delineations of wetland areas were largely dependent on the extrapolation of field indicator data obtained during field surveys, 5m contour data for the study area, and from interpretation of geo-referenced orthophotos and satellite imagery as well as historic aerial imagery data sets received from the National Department of Rural Development and Land Reform. As such, inherent ortho-rectification errors associated with data capture and transfer to electronic format are likely to decrease the accuracy of wetland boundaries in many instances; and
- Wetlands outside of the study area boundary was extrapolated using aerial imagery, although some sampling was done outside of the study boundaries in order to confirm findings and better interpret hydropedological characterisation of the study area.
- Given that the primary consideration within the context of the present study was wetland-related, assessment of aquatic biota associated with the proposed project was conducted at a desktop level and based on data provided by the wetland specialist.
- No other specialist studies were available at the time of writing this report to support findings for determining Ecological Importance and Sensitivity of watercourses. However, all watercourses within the study and within 500m from the study area were regarded as sensitive (with the exception of artificial wetland habitat).
- No hydropedological studies were available to confirm wetlands drivers and hydropedological responses associated with the terrain.
- Despite numerous attempts, the author was unable to download historic imagery (from CDNGI Portal) to assist in determining the benchmark state of the landscape and wetlands within the study area.

2. GENERAL CHARACTERISTICS

2.1 Location

The proposed development is within the jurisdiction of Pixley Ka Seme Local Municipality which falls within the Gert Sibande District Municipality. The study site is located a few kilometres south of Amersfoort on the western side of the Majuba Power Station (Figure 1). Approximate central co-ordinates for the study area are: 27° 5'37.46"S and 29°45'53.84"E.

2.2 Biophysical Attributes

2.2.1 Climate

The climate for the study area was derived from recorded data (en.climate-data.org and worldweatheronline.com). The area around the study area receives seasonal summer rainfall and has generally very dry winters. Rainfall ranges between 620 – 750 mm, with the long term average around 650 mm. Most rain fall between November and March, peaking between December and February. Summer day temperatures fluctuate daily on average between 14°C and 25°C in January, but higher temperatures are experienced. The daily winter temperatures in July fluctuate on average between 1°C and 16°C. Incidence of frost is frequent which helps grasslands to persist.

2.2.2 Historic vegetation overview

Mpumalanga is known for its extensive grasslands and numerous wetlands, in which natural dominance of high shrubs and/or trees is largely prevented by frequent frost occurrences (and other factors) during winter, which tufted perennial grasses are better adapted to survive. Mpumalanga is host to approximately 21% of South Africa's flora. The majority (64 %) of these plant species are soft herbs and bulbous plants (geophytes) situated in the grassland biome. The majority of these species remain dormant during winter or very dry seasons, and re-sprout during early summer if rains are sufficient.

The grassland biome is made up of a mosaic of many different vegetation types, which vary according to the prevailing abiotic conditions. According to the delineation of these vegetation types, as described and mapped for South Africa (in Mucina and Rutherford, 2006 and updated 2012 on BGIS), the study area was historically covered and surrounded with Amersfoort Highveld Clay Grassland as well as Eastern Temperate Freshwater Wetland (AZf 3) Vegetation (Mucina and Rutherford, 2006). Amersfoort Highveld Clay Grassland potentially include the following species:

Graminoids: *Aristida aequiglumis, A. congesta, A. junciformis subsp. galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. curvula, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata subsp. eckloniana.*
Herbs*: Berkheya setifera , Haplocarpha scaposa , Justicia anagalloides , Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides subsp. latifolia, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata.*
Geophytes: *Gladiolus crassifolius, Haemanthus humilis* subsp. *hirsutus, Hypoxis rigidula* var. *pilosissima, Ledebouria ovatifolia.*
Succulents: *Aloe ecklonis.*
Low Shrubs: *Anthospermum rigidum* subsp. *pumilum, Stoebe plumosa*.

Eastern Temperate Freshwater Wetlands are found on flat or gently undulating landscapes or shallow depressions filled with (temporary) water bodies such as pans, periodically flooded vleis, and edges of calmly flowing rivers that support zoned systems of aquatic and hygrophilous vegetation where grasslands are temporarily flooded. Dominant Taxa that can be expected in the different zones in wetlands include:

Marshes:
Graminoids: *Cyperus congestus, Agrostis lachnantha, Carex acutiformis, Eleocharis palustris, Eragrostis plana, E. planiculmis, Fuirena pubescens, Helictotrichon turgidulum, Hemarthria altissima, Imperata cylindrica, Leersia hexandra, Paspalum dilatatum, P. urvillei, Pennisetum thunbergii, Schoenoplectus decipiens, Scleria dieterlenii, Setaria sphacelata, Andropogon appendiculatus, A. eucomus*.

Herbs: *Centella asiatica, Ranunculus multifidus, Berkheya radula, B. speciosa, Berula erecta subsp. thunbergii, Centella coriacea, Chironia palustris, Equisetum ramosissimum, Falckia oblonga, Haplocarpha lyrata, Helichrysum difficile, H. dregeanum, H. mundtii, Hydrocotyle sibthorpioides, H. verticillata, Lindernia conferta, Lobelia angolensis, L. flaccida, Mentha aquatica, Monopsis decipiens, Pulicaria scabra, Pycnostachys reticulata, Rorippa fluviatilis var. fluviatilis, Rumex lanceolatus, Senecio inornatus, S. microglossus, Sium repandum, Thelypteris confluens, Wahlenbergia banksiana.*
Geophytes: *Cordylogyne globosa, Crinum bulbispermum, Gladiolus papilio, Kniphofia ensifolia, K. fluviatilis, K. linearifolia, Neobolusia tysonii, Satyrium hallackii* subsp. *hallackii.*

Reed and sedge beds:
Graminoids: *Phragmites australis, Schoenoplectus corymbosus, Typha capensis, Cyperus immensus. Carex rhodesiaca.*

Water bodies:
Aquatic Herbs: *Aponogeton junceus, Ceratophyllum demersum, Lagarosiphon major, L. muscoides, Marsilea capensis, Myriophyllum spicatum, Nymphaea lotus, N. nouchali var. caerulea, Nymphoides thunbergiana, Potamogeton thunbergii.*
Carnivorous Herb: *Utricularia inflexa.*
Herb: *Marsilea farinosa* subsp. *farinosa*. (Mucina & Rutherford, 2006).

2.2.3 Mpumalanga Biodiversity Sector Plan

The Mpumalanga Biodiversity Sector Plan (MBSP) is a comprehensive environmental inventory and spatial plan that is intended to guide conservation and land use decisions in support of sustainable development (Lötter and Ferrar 2006; Mpumalanga Tourism and Parks Agency 2014). The MBSP maps the distribution of the Province’s known biodiversity into several categories for both the terrestrial and freshwater realms. These are ranked according to ecological and biodiversity importance and their contribution to meeting the quantitative targets set for each biodiversity feature.

According to the latest revision of the freshwater component of the MBSP (Mpumalanga Tourism and Parks Agency, 2019), the portion the wetland directly associated with the proposed project area is classified as wetlands falling within a declared protected area, namely the Majuba Nature Reserve that was declared on the 30th of July 1986. The remaining wetlands within the landscape outside of the declared protected area as well as the surrounding landscape are classified as Ecological Support Areas (ESAs). ESAs are areas that are not essential for meeting biodiversity, targets, but that play an important role in supporting the functioning of Protected Areas or Critical Biodiversity Areas (CBAs) and for delivering ecosystem services. ESAs need to be maintained in at least a functional and often natural state, supporting the purpose for which they were identified. They include features such as riparian habitat surrounding rivers or wetlands, migration corridors for over-wintering sites for Blue Cranes, and so on (Mpumalanga Tourism and Parks Agency 2014).

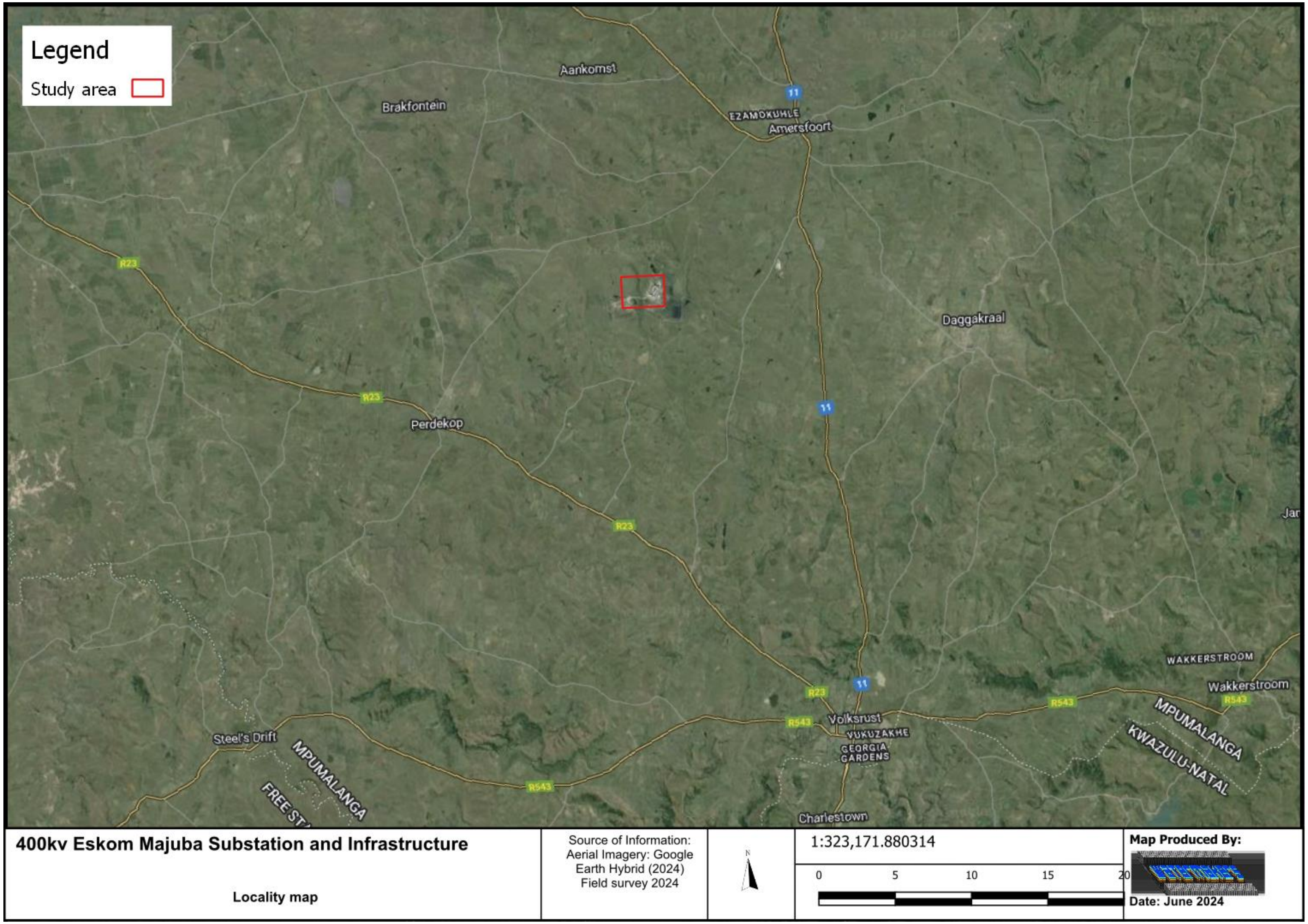


Figure 1: Locality map for the study area

2.2.4 Geology

Geology underlying the study area is made up of dolerite from Karoo Dolerite Suite of the Jurassic era, which in turn overlays the bluish grey-dark grey mudstone and shales as well as subordinate siltstone of the Volksrust formation (Ecca Group, Karoo Supergroup) from the Permian era. Although the Volkrust Formation are indicated on the 1:250,000 Geological map to dominate the study area (2628 Frankfort; Department of Mines – Geological Survey (Figure 2), dolerites and mudstone seem to dominate on terrain.

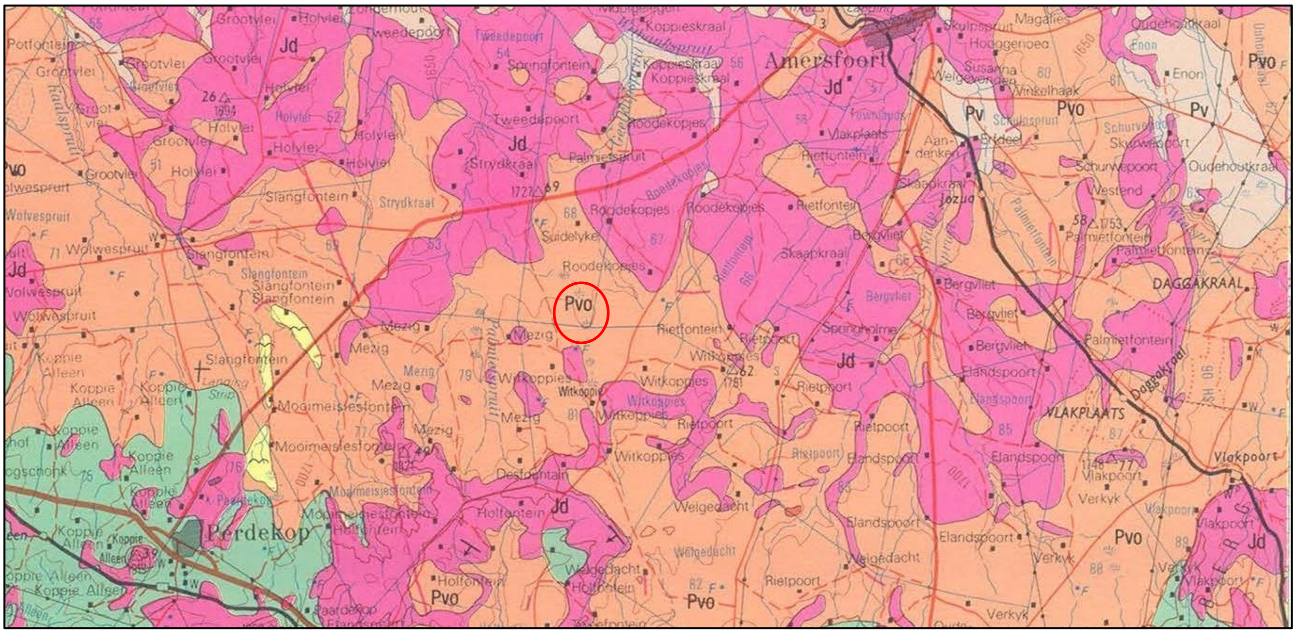


Figure 2: Geology of the study area (2728 Frankfort 1:250 000; Department of Mines – Geological Survey) with the approximate study area indicate by red polygon of the map inset

2.2.5 Associated Aquatic Ecosystems and Drainage

The NWRS-1 (National Water Resource Strategy, Version 1) originally established 19 Water Management Areas (WMA) within South Africa and proposed the establishment of the 19 Catchment Management Agencies to correspond to these areas. In rethinking the management model and based on viability assessments with respect to water resources management, available funding, capacity, skills and expertise in regulation and oversight, as well as to improve integrated water systems management, the original 19 designated WMAs have been consolidated into nine WMAs. Majuba power station is situated in Quaternary catchment C11J in the Vaal Major Water Management Area (WMA) which is situated in the north eastern part of South Africa, in the Mpumalanga Province. The study area ultimately drains into the Geelklipspruit which eventually drains into the Vaal River approximately 30km north of the study area.

2.2.6 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project represents a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water Affairs (DWA; now Department of Water and Sanitation, or DWS), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). More specifically, the NFEPA project aims to:

- Identify Freshwater Ecosystem Priority Areas (hereafter referred to as 'FEPAs') to meet national biodiversity goals for freshwater ecosystems; and
- Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

The first aim uses systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development. The second aim comprises a national and sub-national component. The national component aims to align DWS and DEA policy mechanisms and tools for managing and conserving freshwater ecosystems. The sub-national component aims to use three case study areas to demonstrate how NFEPA products should be implemented to influence land and water resource decision-making processes at a sub-national level (Driver et al., 2011). The project further aims to maximize synergies and alignment with other national level initiatives such as the National Biodiversity Assessment (NBA) and the Cross-Sector Policy Objectives for Inland Water Conservation.

Based on current outputs of the NFEPA project (Nel et al., 2011; Figure 3), no FEPA wetlands or wetland clusters were located within the study area or within several kilometres from the study area. (Figure 3). The sub-quaternary catchment within which the study area is located is however classified as a FEPA catchment on the basis of river ecosystem types present within the catchment.

2.2.7 Wetland Vegetation Group

According to Nel et al. (2011), the study area falls within the Mesic Highveld Grassland Group 8 wetland vegetation group. According to Macfarlane et al. (2014), the Mesic Highveld Grassland Group 8 wetland vegetation group is regarded as being Least Threatened (Macfarlane et al., 2014). According to the latest national wetland layer (NWM5 from the NBA2018 dataset), the indicated the floodplain classification(of the wetland in the vicinity of the study area) is listed as Not Protected, with an Ecosystem Threat status of Critically Endangered, and at very high risk. However, field verification dismissed the floodplain classification associated with the valley bottom wetland situated in the vicinity of the study area.

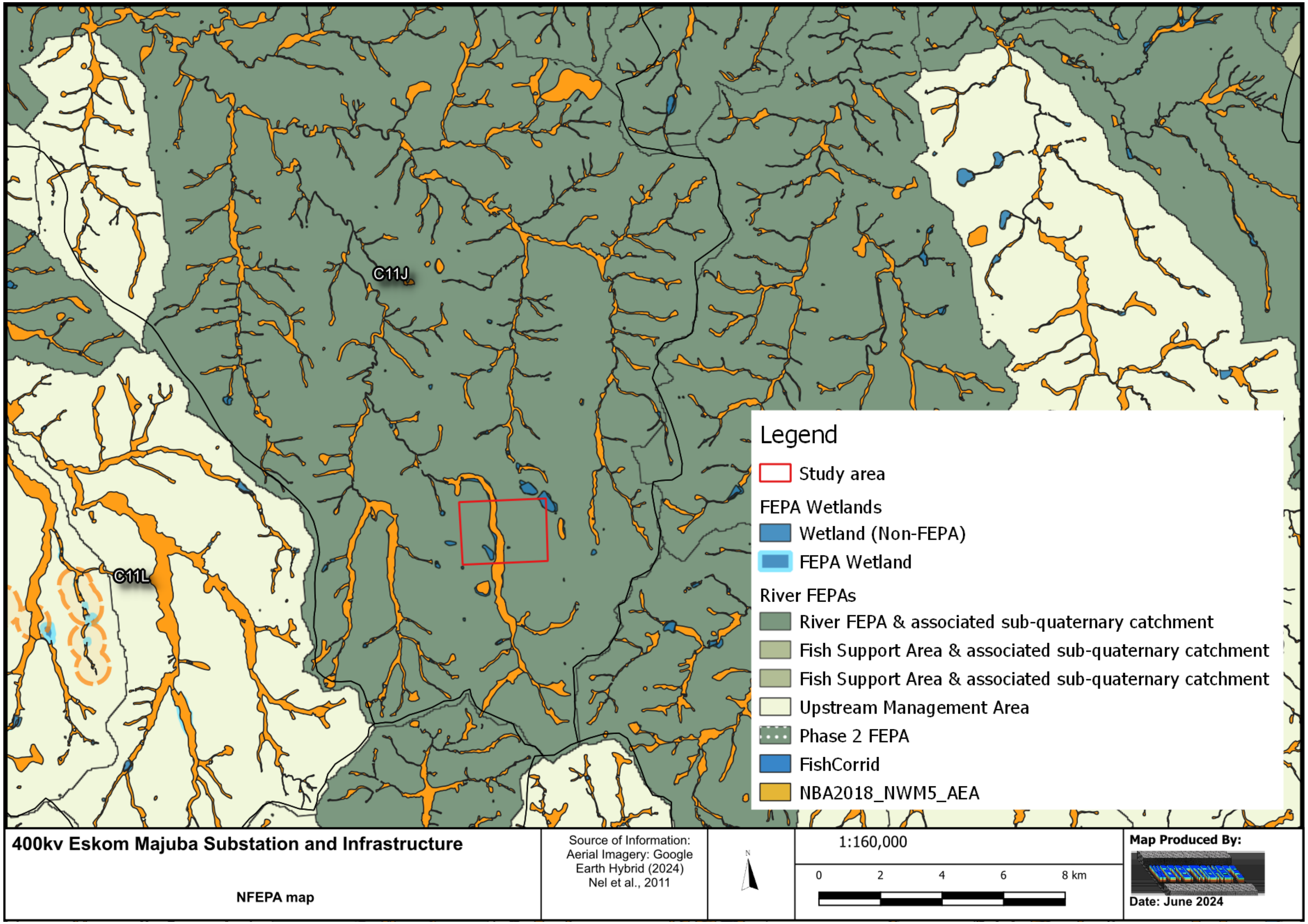


Figure 3: NFEPA map indicating closest FEPA features in relation to the study area.

3. ASSOCIATED WETLANDS

3.1 Wetland soils and hydropedological response of terrain

According to the Department of Water Affairs and Forestry (2005), the permanent zone of a wetland will always have either Champagne, Katspruit, Willowbrook or Rensburg soil forms present, as defined by the Soil Classification Working Group (1991). The seasonal and temporary zones of the wetlands will have one or more of the following soil forms present (signs of wetness incorporated at the form level): Kroonstad, Longlands, Wasbank, Lamotte, Estcourt, Klapmuts, Vilafontes, Kinkelbos, Cartref, Fernwood, Westleigh, Dresden, Avalon, Glencoe, Pinedene, Bainsvlei, Bloemdal, Witfontein, Sepane, Tukulu, Montagu. Alternatively, the seasonal and temporary zones will have one or more of the following soil forms present (signs of wetness incorporated at the family level): Inhoek, Tsitsikamma, Houwhoek, Molopo, Kimberley, Jonkersberg, Groenkop, Etosha, Addo, Brandvlei, Glenrosa, Dundee (Department of Water Affairs and Forestry, 2005). Hydric soil forms identified within the study area included the soil forms Avalon, Bainsvlei, Bloemdal, Dresden, Glencoe, Glenrosa, Katspruit, Rensburg, Longlands, Westleighs, Tukula, Kroonstad, Sepane and Wasbank.

The site's geology comprises igneous dolerite which dominates the site and gives rise to typically dark coloured well-structured soils. Topsoil horizons were dominated by smectic vertic and melanic horizons leading to Arcadia, Bonheim and Mayo terrestrial soil forms dominating many sections of the landscape. The geology had a significant influence on the landscape pedology, giving rise to clayey soils albeit grey in all instances (which made it very difficult to distinguish and pick up on gleyed soils, often pertinent to wetland delineation differentiation).

Poorly drained soils were observed within the lower lying positions of the landscape which included valley bottom and hillslope seepage wetlands and comprising mostly of the Rensburg and Willowbrook soil forms (Figure 4). The Katspruit soil form also contains a G horizon with marked gleyed features indicative of a permanent wetland zone.

Terrestrial soils within the majority of the wetland catchment were well to very well structured, likely leading to high surface runoff during precipitation events, which was also likely why no interflow soils were observed within the study area. The smectic high shrinking and swelling properties contained in many sections of the study area are also highly erosive and requires plants adopted to the root pruning effect of these soils (Figure 5). It should be noted that all surface soils were grey within the study area as well as surrounding landscapes due to the strong geological colour influences of the dolerites.

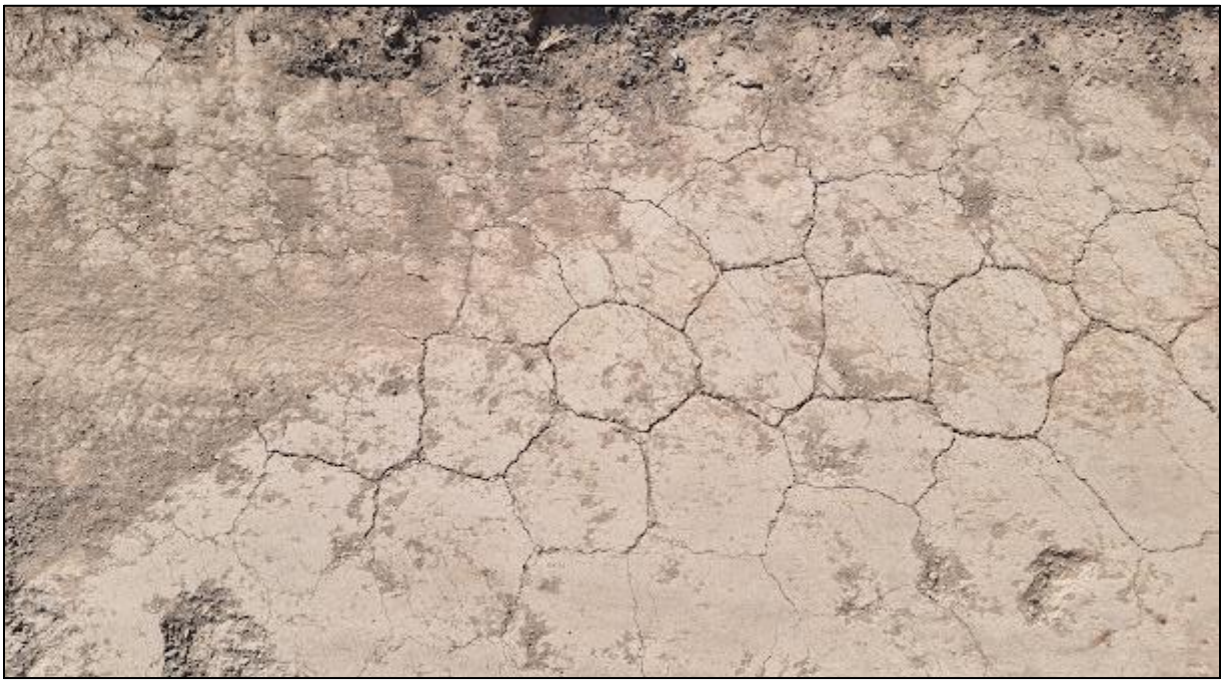


Figure 4: Cracking of grey clays due the smectic properties of soils dominating the study area

Avalon, Katspruit, Rensburg and Willowbrook soil forms were regarded as hydric soil forms associated with wetland habitat.

According to the DWAF (2005), soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence due to the fact that soil wetness indicators remain in wetland soils in most instances, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 500mm of the soil profile alone is sufficient to identify the soil as being hydric (a wetland soil), or non-hydric (non-wetland soil) (Collins, 2005). Redoximorphic features were present within soil profiles of the disturbed valley bottom wetland as well as within the hillslope seepage wetland including black, orange and red mottles and rhizospheres (Figure 5).

Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of iron and manganese oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic. Redoximorphic features typically occur in three types (Collins, 2005):

- **A reduced matrix** - i.e. an *in situ* low chroma (soil colour), resulting from the absence of Fe^{3}+ ions which are characterised by "grey" colours of the soil matrix (Figure 5).
- **Redox depletions** - the "grey" (low chroma) bodies within the soil where Fe - Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur.
- **Redox concentrations** - Accumulation of iron and manganese oxides (also called mottles). These can occur as:
  - Concretions - harder, regular shaped bodies;
  - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours (Figure 6); and,

- Pore linings – zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognised as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres

Figure 5: Reduced matrix (grey) with orange and yellow mottles as well as black manganese concretions observable within an augered soil sample from the permanent zone of a valley bottom wetland.

Landscapes within the study were largely dominated by soils that will class as responsive soils according to van Tol, and Le Roux (2019), the hydropedological grouping of South African soil forms Overland flow- will thus dominate on these responsive soils, both as infiltration excess in the arcadia and saturation in the Rensburg. The smectitic clay swells when saturated, causing a dramatic decrease in infiltration. The low infiltration then causes the overland flow.

3.2 Wetland Vegetation

According to the Department of Water Affairs and Forestry (2005), vegetation is regarded as a key component to be used in the delineation procedure for wetlands. Vegetation also forms a central part of the wetland definition in the National Water Act (Act 36 of 1998). Using vegetation as a primary wetland indicator however, requires undisturbed conditions (Department of Water Affairs and Forestry, 2005). A cautionary approach must therefore be taken as vegetation alone cannot be used to delineate a wetland, as several species, while common in wetlands, can occur extensively outside of wetlands. When examining plants within a wetland, a distinction between hydrophilic (vegetation adapted to life in saturated conditions) and upland species must be kept in mind.
There is typically a well-defined 'wetness' gradient that occurs from the centre of a wetland to its edge that is characterized by a change in species composition between hydrophilic plants that dominate within the wetland to upland species that dominate on the edges of, and outside the wetland (Department of Water Affairs and Forestry, 2005). It is important to identify the vegetative indicators which determine the three

wetness zones (temporary, seasonal and permanent) which characterize wetlands. Each zone is characterized by different plant species which are uniquely suited to the soil wetness within that zone.

Areas identified within the study area with permanent zonation and associated high water tables contained hydrophylic plants such as *Typha capensis, Persicaria lapathifolia, Persicaria* sp., *Phragmites australis*, as well as grasses and sedges such as *Hemarthria altissima* and *Agrostis lachnanta. Typha capensis, Persicaria lapathifolia* and *Phragmites australis* were able to grow in water of up to 50cm deep while areas with standing water of up to 20cm was dominated by graminoids and geophytes such as *Schoenoplectus brachyceras, Berkheya sp, Lobelia angolensis*. *Agrostis lachnanta*, an obligatory wetland species, was present in all three wetland zones but flourished more abundantly in seasonal zones. Temporary and seasonal wetland zones were dominated by grass species such as *Eragrostis curvula, E. cloromelas, Eragrostis* spp., *Pennisetum clandestinum, Cynodon dactylon, Andropogeon eucomus* as well as sedges such as *Bulbostylis* sp., *Pycereus* sp. Artificial grassland wetlands were identified in areas surrounding the powerplant, a result of various water leaks and water demanding process. These terrestrial grasslands are dominated by facultative wetland species in various sections including *Verbena bonariensis, Arisitda congesta* var. *congesta, Helichrysum* sp. and *Agrostis lachnantha* (Figure 6).

Figure 6: Terrestrial grasslands dominated by facultative wetland species due to several artificial water sources in the small catchment (likely mostly leaks)

3.3 Delineated Wetland Areas

According to the National Water Act (Act no 36 of 1998), a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*." Wetlands typically occur on the interface between aquatic and terrestrial habitats and therefore display a gradient of wetness – from permanent, to seasonal, to temporary zones of wetness - which is represented in their plant species composition, as well as their soil characteristics. It is important to take cognisance of the fact that not all wetlands have visible surface water.

An area which has a high water table at or just below the surface of the soil is as much a wetland as a pan that only contains water for a few weeks during the year.

Hydrophytes and hydric soils are subsequently used as the two main wetland indicators. The presence of these two indicators is symptomatic of an area that has sufficient saturation to classify the area as a wetland. Terrain unit, which is another indicator of wetland areas, refers to the land unit in which the wetland is found.

In practice all indicators should be used in any wetland assessment/delineation exercise, the presence of redoximorphic features being most important, with the other indicators being confirmatory. An understanding of the hydrological processes active within the area is also considered important when undertaking a wetland assessment. Indicators should be 'combined' to determine whether an area is a wetland and to delineate the boundary of a wetland. According to Department of Water Affairs and Forestry (2005), the more wetland indicators that are present the higher the confidence of the delineation. In assessing whether an area is a wetland, the boundary of a wetland or a non- wetland area should be considered to be the point where indicators are no longer present. Classification for the purpose of the current project therefore focused on classifying watercourses according to the most dominant hydrological and geomorphological drivers, especially in terms of relating potential impacts of the potential development on especially the watercourses associated with the study area. Wetland boundaries determined within the study area focused on identifying terrain units, soil forms, perceived organic content and the presence of vegetation species that are adapted to saturated conditions.

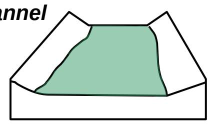
One hydro-geomorphic unit (HGM), HGM 1, a unchanneled valley bottom wetland was delineated within the catchment of the prosed development (Figure 7). It should be noted that desktop platforms such as NWM5 classified the wetland as a floodplain wetland, which is incorrect. Artificial wetland habitat occurred discontinuously in various sections surrounding the Majuba power plant, a result of high-water demand processes and associated leaks occurring over prolonged periods. These artificial wetland habitats were patchy and resemble temporary zoned wetland habitat with a high graminoid basal cover interspersed with terrestrial vegetation.

HGM units encompass three key elements (Kotze *et al.*, 2005):

(1) Geomorphic setting. This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment);
(2) Water source. There are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and
(3) Hydrodynamics, which refers to how water moves through the wetland.

Table 1 describes the characteristics that form the basis for the classification of the HGM units within the study area. The disturbance caused by anthropogenic impacts and resulting successional vegetation changes made the use of vegetation indicators complex in various circumstances, especially on the temporary boundaries of wetlands. Therefore, identifying wetland features on site was primarily done by identifying terrain unit, soil forms and soil wetness features such as the presence of mottling, a gleyed matrix and/or Fe and Mg concretions. However, vegetation indicators did confirm to delineated boundaries and wetness zonation in many instances.

Table 1: Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa within the vicinity of the study area (adapted from Kotze et al., 2008)

Hydro-geomorphic types	**Description**	**Source of water maintaining the wetland[1]**	
		Surface	**Sub-surface**
Valley bottom without a channel 	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source: * Contribution usually small

*** Contribution usually large

*/ *** Contribution may be small or important depending on the local circumstances

 Wetland

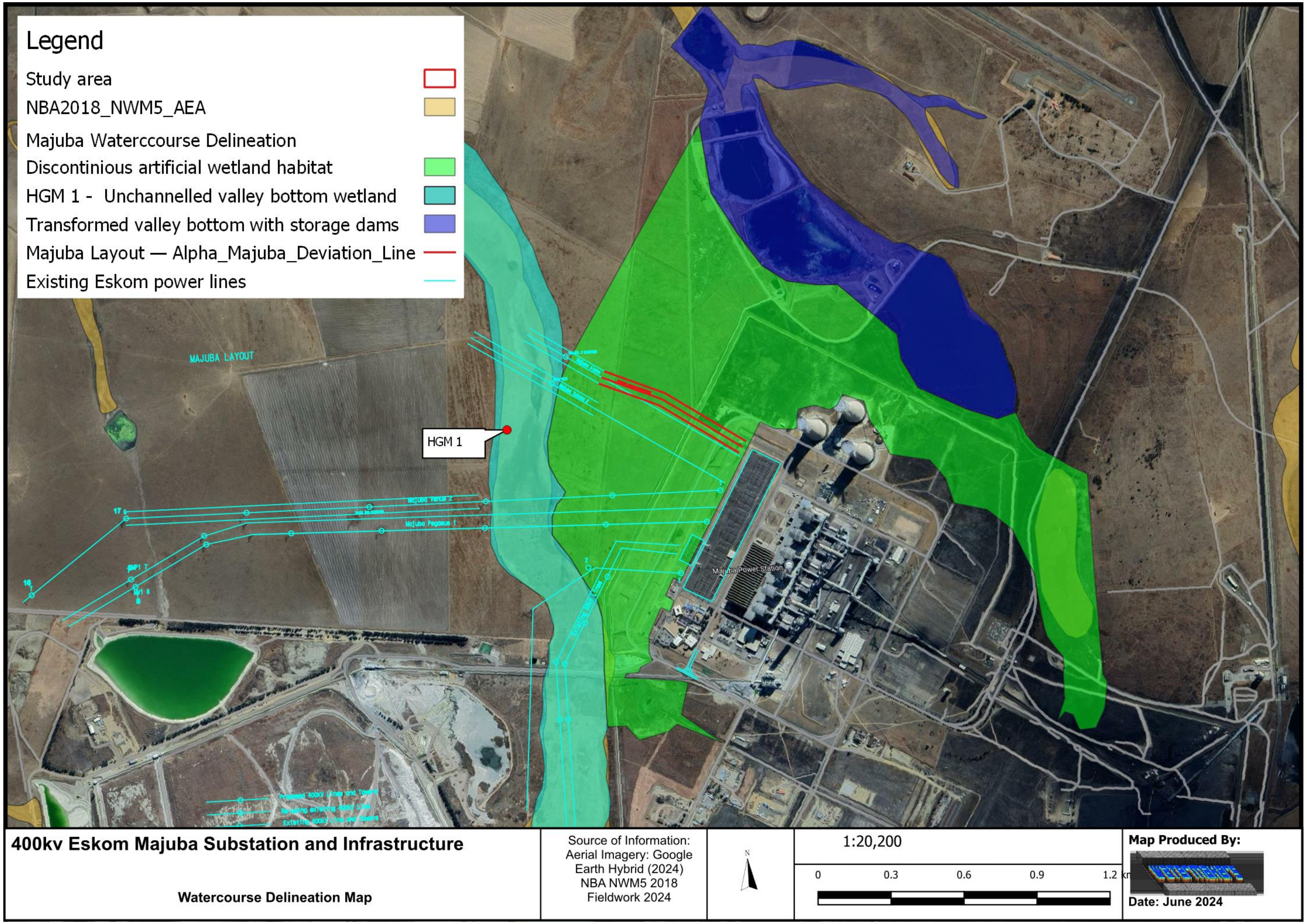


Figure 7: Delineated wetlands within the study area and within 500m

3.4 Functional and Present Ecological State Assessment

Wetlands within the study area serve to improve habitat within and potentially downstream of the study area through the provision of various ecosystem services. Many of these functional benefits therefore contribute directly or indirectly to increase biodiversity within the transformed study area as well as downstream of the study area through provision and maintenance of appropriate habitat and associated ecological processes (Table 2).

Hydro-geomorphic units are inherently associated with hydrological characteristics related to their form, structure and particularly their position in the landscape. This, together with the biotic and abiotic character (or biophysical environment) of wetlands, means that certain wetland types are able to contribute better to some ecosystem services than to others (Kotze et al., 2005) (Table 3).

Table 2: Potential wetland services and functions in study area

Function	Aspect
Water balance	Streamflow regulation
	Flood attenuation
	Groundwater recharge
Water purification	Nitrogen removal
	Phosphate removal
	Toxicant removal
	Water quality
Sediment trapping	Particle assimilation
Harvesting of natural resources	Reeds, Hunting, etc.
Foraging	Water for animals
	Grazing for animals

Table 3: Preliminary rating of the hydrological benefits potentially provided by a wetland given its particular hydro-geomorphic type (Kotze *et al*., 2005)

WETLAND HYDRO-GEOMORPHIC TYPE	HYDROLOGICAL BENEFITS POTENTIALLY PROVIDED BY THE WETLAND							
	Flood attenuation		Stream flow regulation	Erosion control	Enhancement of water quality			
	Early wet season	Late wet season			Sediment trapping	Phos-phates	Nitrates	Toxicants[2]
Valley bottom - unchannelled	+	+	+?	++	++	+	+	++

[2]Toxicants are taken to include heavy metals and biocides

Rating: 0 Benefit unlikely to be provided to any significant extent +
Benefit likely to be present at least to some degree
++ Benefit very likely to be present (and often supplied to a high level)

Each wetland's ability to contribute to ecosystem services within the study area is also dependant on the particular wetland's Present Ecological State (PES) in relation to a benchmark or reference condition. Present Ecological State scores were determined for wetlands within the study area using Wet-Health Level 2 assessment. Through the use of a scoring system, the perceived departure of elements of each particular system from the "natural-state" was determined (current state versus anticipated future rehabilitated state). The following elements were considered in the assessment:

- Hydrologic: Flow modification (has the flow, rates, volume of run-off or the periodicity changed);
- Geomorphic (Canalisation, impounding, topographic alteration and modification of key drivers);
- Biota (Changes in species composition and richness, Invasive plant encroachment, over utilization of biota and land-use modification)

For the purpose of the present assessment, the determined Present Ecological State and wetland ecosystem services provided by wetlands within the study area are discussed in more detail below.

3.4.1 Unchanneled Valley-bottom Wetland (HGM 1)

HGM 1 received its highest ecosystem services scores from the Wet-EcoServices assessment for flood attenuation, sediment trapping, erosion control, maintenance of biodiversity, carbon storage and the provision of natural resources (Figure 13). The relatively relaxed gradient associated with this valley bottom wetland would allow for high levels of sediment deposition. Stream channel input will be spread diffusely across the wetlands even in low flows, resulting in extensive areas of the wetlands remaining saturated and tending to have high levels of soil organic matter. During flow events shallow water pools are present which would promote sunlight penetration, contributing to the photodegradation of certain toxicants. In addition there are also several farm dams with shallow water sections which would also further facilitate photodegradation processes. However, phosphate retention levels would of likely been lower than in floodplains because a certain amount of phosphate may be re-mobilized under prolonged anaerobic conditions (Cronk and Siobhan Fennessy, 2001; Keddy, 2002).

Some nitrate and toxicant removal potential would be expected, particularly from the water being delivered from the adjacent hillslopes as well as a few open water bodies present (The Federal Interagency Stream Restoration Working Group, 1998). From a biodiversity perspective, no species of conservation concern was observed during the field survey, however the potential exist that the valley bottom do provide habitat for species of conservation concern. Further, the valley bottom network serves as a movement corridor for fauna to connect terrestrial grassland and wetland habitat to each other.

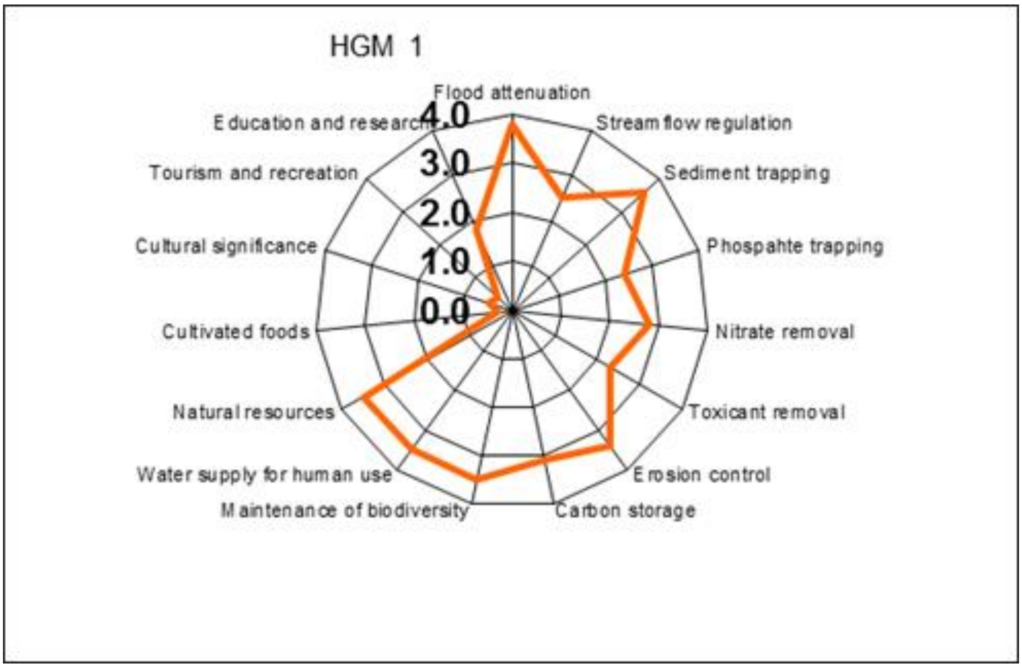


Figure 8: Radar diagrams depicting ecosystem services for HGM 1

Historic and current impacts on the wetland in combination with land use changes in the surrounding catchment resulted in geomorphological, hydrological and vegetation changes within the valley bottom wetlands. Impact on the hydrology of the valley bottom wetlands included evidence of channel formation within most reaches of the watercourses. Channel formation (south and north of the study area) was attributed to concentrated dam outflow as well as concentrated preferential pathways formed from road crossings and especially cattle paths and disturbances. Further, within the valley bottom wetland's catchments, decreased surface roughness associated with extensive fields, dirt roads, negative successional vegetation changes as well as increased water inputs affected the hydrological score of the valley bottom wetland

From a geomorphological perspective, the highest impact calculated within the valley bottom wetlands were related to altered runoff characteristics, especially in the vicinity of the ash dumps. Further impacting features with regards to the geomorphology included the presence of dams (excavations), roads (excavations and infill), and some limited erosional features, although their magnitude of impact were determined to be limited in several instances due to the average gully width in relation to the width of the wetlands.

Due to the nature of historic and current land uses within the catchment, species composition within some sections of the wetland (especially north and south from the study area) is expected to have changed relative to the perceived natural condition of the wetlands, especially as a result of overgrazing practices.

Based on the assessment of the individual drivers of the wetlands, the Present Ecological State for HGM 1, were determined to be representative of a Category C (moderately modified) (Table 4).

Table 4: Wet-Health scores for HGM 1

HGM Unit	Hydrology	Geomorphology	Vegetation	PES category
HGM 1	2.5	2.0	3.0	**C (2.5)**

3.5 Ecological Importance and Sensitivity

All wetlands, rivers, their flood zones and their riparian areas are protected by law and no development is allowed to negatively impact on rivers and river vegetation. The vegetation in and around rivers and drainage lines play an important role in water catchments, assimilation of phosphates, nitrates and toxins as well as flood attenuation. Quality, quantity and sustainability of water resources are fully dependent on good land management practices within the catchment. All flood lines, riparian zones and wetlands along with corresponding buffer zones must be designated as sensitive.

The Ecological Importance and Sensitivity (EIS) assessment was undertaken to rank water resources in terms of:

- Provision of goods and service or valuable ecosystem functions which benefit people;
- biodiversity support and ecological value; and
- Reliance of subsistence users (especially basic human needs uses).

Water resources which have high values for one or more of these criteria may thus be prioritised and managed with greater care due to their ecological importance (for instance, due to biodiversity support for endangered species), hydrological functional importance (where water resources provide critical functions upon which people may be dependent, such as water quality improvement) or their role in providing direct human benefits (Rountree et al., 2013). Ecological Importance and Sensitivity results for wetlands identified to be associated with the study area are listed in Table 5.

Table 5: Ecological Importance and Sensitivity scores for wetland complexes

Wetland	Parameter	Rating (0 -4)	Confidence (1 – 5)
HGM 1	Ecological Importance & Sensitivity	High (3.4)	Low (1.2)
	Hydrological / Functional Importance	High (3.0)	Moderate (2.1)
	Direct Human Benefits	Moderate (2.9)	Moderate (2.0)

The valley bottom wetland was regarded as having a high Ecological Importance and Sensitivity as well as a high Hydrological and Functional Importance as a result of the relatively intact nature and various important ecosystem services they provide as well as forming part of a protected area (Majuba Nature Reserve). Direct human benefits were associated with the provision of natural resources as well as grazing opportunities afforded by most wetlands within the study area. Collectively, the valley bottom systems along with their supporting hillslope processes, play an important role in contributing to good water quality and quantity to the downstream environment and serve as habitat and movement corridor for wetland related species.

3.6 Aquatic Biota

Given the nature of the watercourse associated with HGM 1 in close proximity to the proposed activities, hydraulic and general habitat diversity from an aquatic biota perspective is expected to be extremely limited, and thus not supportive of highly diverse biotic assemblages. Further limiting the potential occurrence of diverse aquatic biota is the expected low dissolved oxygen levels due to reducing nature of the wetland environment. From an aquatic macroinvertebrate perspective, the assemblage present within HGM 1 is expected to be depauperate and dominated by taxa that are tolerant to poor water quality, with taxa regarded as sensitive expected to be absent. Furthermore, habitat specialists as well as taxa requiring medium to fast flowing water are expected to be absent, with taxa dominated by an assemblage with a preference for limited flow and aquatic vegetation and water column as a habitat. Fish within the immediate proximity of the proposed activities are further expected to be absent.

The general system further represents a high order system dominated by an unchannelled valley-bottom wetland system (in immediate proximity to the proposed project) that grades down into a channelled valley-bottom wetland system further downstream and as such, aquatic habitat is expected to increase marginally downstream of the proposed project area which is expected to result in a marginal increase in aquatic biotic diversity. However, the system is still reflective of an aggradational (depositional) valley-bottom wetland system, and thus hydraulic diversity will remain limited. Aquatic macroinvertebrate communities will thus still be dominated by taxa with a preference for water of limited flow and with a preference for aquatic vegetation as a habitat medium. Furthermore, the community is still expected to support few (if any) taxa regarded as moderately or highly sensitive to water quality impairment.

From a fish perspective, only a single fish species is expected to be present in the watercourses in the downstream proximity of the proposed project, namely *Enteromius cf. oraniensis* (Orange River Chubbyhead Barb) which has not been adequately assessed in terms of the IUCN Red List categories. While the conservation status of the *Enteromius anoplus* species complex itself has been determined to be of Least Concern (Woodford, 2017), the very recent studies of Kambikambi et al. (2021) have described several new species from the complex including *Enteromius oraniensis*, with more new species descriptions expected. Consequently, the results obtained by Kambikambi et al. (2021) indicate that the current IUCN Red List assessment of *E. anoplus* is obsolete. It is, therefore, clear that further studies are required to understand the geographic ranges and thus conservation status of the unique populations of this *Enteromius* group to determine the significance of those specimens likely present within the present study area. Accordingly, the conservation status for the *Enteromius cf. oraniensis* population, which is the only Chubbyhead Barb described from the species complex within the larger Orange River Catchment (and within which the Vaal River falls), has not been determined.

4. FRESHWATER ECOSYSTEM BUFFERS

Buffer zones associated with water resources have been shown to perform a wide range of functions, and have been proposed as a standard measure to protect water resources and associated biodiversity on this basis. These functions can include (Macfarlane & Bredin, 2016):

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

However, despite the range of functions potentially provided by buffer zones, buffer zones are unable to address all water resource-related problems. For example, buffers can do little to address impacts such as hydrological changes caused by for example stream flow reduction activities or changes in flow brought about by abstractions or upstream impoundments. Buffer zones are also not the appropriate tool for mitigating against point-source discharges (e.g. sewage outflows), which can be more effectively managed by targeting these areas through specific source-directed controls (Macfarlane & Bredin, 2016).

Nevertheless, buffer zones are well suited to perform functions such as sediment trapping and nutrient retention which can significantly reduce the impact of activities taking place adjacent to water resources. Buffer zones are therefore proposed as a standard mitigation measure to reduce impacts linked with diffuse storm water runoff from land-uses / activities planned adjacent to water resources. These must, however, be considered in conjunction with other mitigation measures which may be required to address specific impacts for which buffer zones are not well suited (Macfarlane & Bredin, 2016).

Determination of the preliminary buffer requirements for natural wetland features associated with the proposed study area followed the approach of Macfarlane & Bredin (2016), whereby the preliminary required buffers were developed based on various factors, including assumed agricultural impacts, slope, annual precipitation, rainfall intensity, channel width, catchment to wetland ratio, etc. Accordingly, conservative preliminary buffer requirements for the identified wetland habitat were determined to be 48m from the edge of HGM 1. Since the development is taking place more than 200m away from HGM 1, no impacts are expected on HGM 1 (normal mitigation measures applied). From a practical point of view, the buffer would therefore likely not be necessitated for the proposed development.

5. ASSESSMENT OF IMPACTS

Potential impacts of the proposed activity on the associated freshwater ecosystem were assessed in terms of a formalised method whereby a typical risk assessment process was undertaken in order to determine the significance of the potential impacts without the application of mitigation/management measures (i.e. without mitigation measures, or WOMM). Once the significance of the impacts without the application of mitigation/management measures was known, the impacts were then re-evaluated, taking cognisance of proposed mitigation/management measures provided in order to reduce the impact (i.e. with mitigation measures, or WMM), thus enabling an understanding of the overall impact after the implementation of mitigation/management measures.

In order to assess these impacts, the proposed development has been divided into two project phases, namely the construction phase and the operational phase. The criteria against which these activities were assessed are discussed below.

Nature of the Impact

This is an appraisal of the type of effect the project would have on the environment. This description includes what would be affected and how and whether the impact is expected to be positive or negative.

Extent of the Impact

A description of whether the impact will be local, limited to the study area and its immediate surroundings, regional, or on a national scale.

Duration of the Impact

This provides an indication of whether the lifespan of the impact would be short term (0-5 years), medium term (6-10 years), long term (>10 years) or permanent.

Intensity

This indicates the degree to which the impact would change the conditions or quality of the environment. This was qualified as low, medium or high.

Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of any prevention measures).

Degree of Confidence

This describes the degree of confidence for the predicted impact based on the available information and level of knowledge and expertise. It has been divided into low, medium or high.

The following risk assessment was used to determine the significance of impacts:

Significance = (Magnitude + Duration + Scale) x Probability

The maximum potential value for significance of an impact is 100 points. Environmental impacts can thus be rated as high, medium or low significance on the following basis:

- High environmental significance 60 – 100 points
- Medium environmental significance 30 – 59 points
- Low environmental significance 0 – 29 points

Table 6 illustrates the scale used to determine the overall ranking.

Table 6: Scale used to determine significance ranking

Magnitude (M)		**Duration (D)**	
Description	**Numerical value**	**Description**	**Numerical value**
Very high	10	Permanent	5
High	8	Long-term (ceases at end of operation)	4
Moderate	6	Medium-term	3
Low	4	Short-term	2
Minor	2	Immediate	1
Scale (S)		**Probability (P)**	
Description	**Numerical value**	**Description**	**Numerical value**
International	5	Definite (or unknown)	5
National	4	High	4
Regional	3	Medium	3
Local	2	Low	2
Site	1	Improbable	1
None	0	None	0

5.1 Impact Assessment

Development within the study area is proposed to constitute the re-alignment of existing Eskom infrastructure that is situated more than 200m from HGM 1. The re-alignment will constitute a few new pylons to realise the re-alignment within modified terrestrial grassland. This area also contains temporary artificial wetland habitat with very high basal cover. As a result of the high basal cover, general mitigation measures will be satisfactory in protecting the natural unchanneled valley bottom wetland further west. The rest of the proposed development will take place within the existing modified footprint of Majuba power station with little potential impact on watercourses downstream. Potential impact and increase of alien invasive vegetation should be addressed according to the terrestrial report for this project.

Assessment Criteria

The environmental impacts are assessed with mitigation measures (WMM) and without mitigation measures (WOMM) and the results presented in impact tables which summarise the assessment. Mitigation and management actions are also recommended with the aim of enhancing positive impacts and minimising negative impacts.

In order to assess these impacts, the proposed development has been divided into two project phases, namely the construction and operation phase. The criteria against which these activities were assessed are discussed below.

Nature of the Impact

This is an appraisal of the type of effect the project would have on the environment. This description includes what would be affected and how and whether the impact is expected to be positive or negative.

Extent of the Impact

A description of whether the impact will be local (extending only as far as the servitude), limited to the study area and its immediate surroundings, regional, or on a national scale.

Duration of the Impact

This provides an indication of whether the lifespan of the impact would be short term (0-5 years), medium term (6-10 years), long term (>10 years) or permanent.

Intensity

This indicates the degree to which the impact would change the conditions or quality of the environment. This was qualified as low, medium or high.

Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of any prevention measures).

Degree of Confidence

This describes the degree of confidence for the predicted impact based on the available information and level of knowledge and expertise. It has been divided into low, medium or high.

The possible impacts of the proposed project on the delineated wetland within the study area during the various phases are presented below. Table 7, Table 8 and Table 9 list a summary of the possible risks that could occur within the construction phase, the operational phase and the decommissioning phase, respectively. In determining the applicability of measures to be undertaken to limit impacts on the associated wetlands, it is recommended that the environmental impact hierarchy to be adhered to should follow:

- Avoidance of impact – the design and route planning of the new powerline took into consideration the environmental sensitivities of the site and undertake to avoid impacts wherever possible (HGM 1 is adequately avoided).
- Minimisation of impact – most impacts to the wetland are avoidable by following mitigation measures in this report, the route design and infrastructure design must be undertaken in such a way as to minimise the impacts associated with their activities; and

- Mitigation of impact – once all possible impacts have been avoided and minimised as far as possible, the remaining significant impacts must be mitigated on site. This can be undertaken through control measures during construction and maintenance of the powerline, and through effective rehabilitation measures if necessitated.
- Off-set mitigation – where avoidance, minimisation and mitigation measures fail or are not possible, an appropriate off-set approach should be followed. This is not a consideration currently for the project since all significant impacts are avoidable.

Table 7: Primary impacts arising during construction phase relating to the associated wetland ecosystems

Possible impact	Source of impact
Sedimentation of wetlands	Runoff from construction activities and clearing of natural and secondary vegetation
Destruction of wetland habitat and associated loss of wetland functionality	Destruction of hydric soils and hydrophytic vegetation
Changes to surface and sub-surface flow regimes	Excavations of pits / trenches, channelling as a result of large machinery, removal and disturbances to vegetation.

Table 8: Primary impacts arising during operation phase relating to the associated wetland ecosystems

Possible impact	Source of impact
Destruction of wetland habitat and associated loss of wetland functionality	Maintenance crews working in wetlands

Table 9: Primary impacts arising during closure phase relating to the associated wetland ecosystems

Possible impact	Source of impact
Decrease in wetland functionality	Dependant on closure approach.

<u>Construction Phase</u>

Sedimentation of watercourse

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Local	Short	Medium	Medium Probability	Medium	Low	High

<u>Description of Impact</u>

The clearing of natural vegetation and the stripping of topsoil and sub-soils for placing pylons will potentially result in increased runoff of sediment from the site into watercourses associated with the study area. Considering the nature of the operation to be undertaken and the proposed work procedure, the proposed impact will likely not be significant. However, care must be taken where the existing access road is widened, it is cardinal that low gradient speedbumbs/berms with associated run-off swales be installed in order to prevent the road from becoming a preferential pathway for surface run-off. Where a road follows the contour few berms and swales will be necessitated, the more the road aligns perpendicular to the contours the more berms would have to be installed.

Mitigation Measures

- The layout of pylons should take cognisance of the delineated wetland boundaries. Approach to the working site should be designed to effectively avoid wetland habitat as far as possible
- Develop soil management measures for the construction sites which will prevent runoff of sediment into the associated watercourses, e.g. scheduling the construction phase during low rainfall periods, installing soil curtains and use of swales to capture run-off water and settle suspended materials etc. Avoiding the possibility of sediment ending up in watercourses.
- A wetland monitoring program should be in place for Majuba power station. The monitoring program should take cognisance of the new proposed development. The Environmental Control Officer (ECO) for the construction process need to pro-actively detect threats to wetlands before it can cause damage through an adaptive management approach, e.g. the initiation of new concentrated drainage pathways and erosion processes as a result of new access roads etc. The ECO needs to ensure that no negative impacts on wetlands have occurred or that processes have been initiated that could harm wetlands in the future, e.g. preferential flow paths or erosion.

Destruction of wetland habitat and associated loss of wetland functionality

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Local	Short	High	Medium Probability	Medium	Low	High

Description of Impact

The footprint of new infrastructure and construction activities could infringe or destroy wetland habitat and associated biota through removal of hydrophytic vegetation and or hydric soils. Activities are also likely to negatively affect supporting hydrological sources of wetlands.

Mitigation Measures

- Avoid construction activities in natural wetlands (HGM 1) as far as possible through proper planning, demarcation and appropriate environmental awareness training. Appropriate no-go areas must be assigned in particular next to the valley-bottom wetland. Keeping work as far a possible upslope from the wetland, e.g place soil stockpiles upslope from the excavations and installing soil curtains and or swales to capture any possible run-off.
- The discontinuous artificial habitat is not off-limits. Normal mitigation measures apply within the discontinuous artificial habitat, where exceptionally wet habitat are

detected (albeit unlikely), these areas should be avoided. Further, it is advised that all water leaks detected (especially in the western section of the power plant) be repaired in order to limit the development of artificial wetland habitat and the associated negative successional vegetation changes induced through the artificially increased hydrology on terrain.

- All construction staff must be informed of the need to be vigilant against any practice that will have a harmful effect on wetlands e.g. Do not take short-cuts through valley bottoms (wetlands) but use existing road infrastructure.
- Any proclaimed weed or alien species that germinate during the construction and operational period shall be cleared.
- Caution must be taken to ensure building materials are not dumped or stored within the delineated wetland zones
- Emergency plans must be in place in case of spillages.
- Littering and contamination of water sources during construction must be mitigated by effective construction camp management.
- All construction materials including fuels and oil should be stored in a demarcated area that is contained within a bunded impermeable surface to avoid spread of any contamination (outside of wetlands or wetland buffer zones).
- Cement and plaster should only be mixed within mixing trays. Washing and cleaning of equipment should also be done within a bermed area, in order to trap any cement or plaster and avoid excessive soil erosion. These sites must be rehabilitated prior to commencing the operational phase.

Changes to surface and sub-surface flow regimes of wetlands

Extent	**Duration**	**Intensity**	**Probability of occurrence**	**Significance**		**Confidence**
				WOMM	WMM	
Local	Short	Med	High Probability	Med-Low	Low	High

<u>Description of Impact</u>

Linear construction activities, excavations, removal and disturbances to vegetation (e.g. widening of access road) could create preferential flow paths and/or cut off existing flow paths on the surface as well as sub-surface. Hydrology is an important driver of wetlands and changes thereto could have various negative impacts on wetlands and their associated functionality. Considering the small extent of infrastructure relocation, significant changes in sub-surface flow regime is highly unlikely. Care should be taken with regards to widening the access roads to not concentrate surface flows down the slope towards the natural wetland (by installing speedbumbs/berms with swales), this is especially important considering the artificial water inputs in the area that could exacerbate erosion process.

<u>Mitigation Measures</u>

- Avoid construction activities in natural wetlands or natural preferential hydrological pathways supporting wetlands through proper planning, appropriate design and minimising the construction footprint as per previous impacts discussed. Site selection should be sensitive towards preferential flow paths supporting wetlands. Especially stormwater design should ensure that natural wetlands do not received concentrated flows, but should be spread diffusely well outside the wetland boundaries and buffers. For example, access roads should have berms/speedbumps intermittently installed with flow diffusers to avoid concentrating flows down the slope towards the wetland.

- Soils should be replaced in the same order as removed.
- Re-vegetation of the affected areas should be done as priority.
- Hassian netting to protect newly rehabilitated vegetation in combination with silt curtains to be installed where necessary (slope >1%).

Operational Phase

Destruction of wetland habitat and associated loss of wetland functionality

Extent	**Duration**	**Intensity**	**Probability of occurrence**	**Significance**		**Confidence**
				WOMM	WMM	
Local	Short	Medium	Low Probability	Low	Low	High

Description of Impact

Maintenance activities are likely to have a lower impact than construction activities, except for worst case scenarios where sections of the powerline might have to be reconstructed. Wetland habitat could be impacted on or be destroyed through maintenance operations e.g. through removal of hydrophytic vegetation and or hydric soils and access roads concentrating flows towards wetlands.

Mitigation Measures

- Mitigation measures for worst case scenarios would be the same as for the construction phase

Decommissioning Phase

Loss of wetland functionality during removal operations

Extent	**Duration**	**Intensity**	**Probability of occurrence**	**Significance**		**Confidence**
				WOMM	WMM	
Local	Short Term	Medium	High Probability	Medium	Low	High

The assumed life expectancy of the powerline is likely to be long term with an unforeseen closure date. An appropriate closure and rehabilitation plan should be designed and implemented if decommissioning is to take place however.

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5.2 Risk Matrix Assessment (Based on DWS 2023 publication: Section 21 c and I water use Risk Assessment Protocol)

In addition to the approach presented above, a further assessment of potential risks associated with the various activities on the receiving aquatic ecosystem was done in accordance with Department of Water and Sanitation Notice(Gazette No. 49833, Notice 4167, 8 December 2023). The risk matrix for impacts associated with the proposed development, as required by DWS, is presented in Appendix B. It should be borne in mind that when assessing the impact significance following the DWS Risk Assessment Matrix, determination of the significance of the impact assumes that mitigation measures as listed within the present report are feasible and will be implemented, and as such does not take into consideration significance before implementation of mitigation measures. Accordingly, should proposed mitigation measures not be deemed feasible, a re-evaluation of the impact significance may be required.

The DWS Risk Assessment Matrix, calculated the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the freshwater resources assessed that is situated within 500m from the proposed development. By assessing the severity, spatial scale, duration and frequency of the proposed ESKOM infrastructure relocation, the risk to the potentially affected resource quality was determined to be low for all aspects during the construction and operational phases. The low risk identified was based on all recommended mitigation measures being implemented as outlined within this report.

6. CONCLUSION AND RECOMMENDATIONS

One hydro-geomorphic unit, a unchanneled valley bottom wetland, was delineated within proximity to the prosed development. Artificial wetland habitat occurred discontinuously in various sections surrounding the Majuba power plant, a result of high-water demand processes and associated leaks occurring over prolonged periods. These artificial wetland habitats were patchy and resemble temporary zoned wetland habitat with a high graminoid basal cover interspersed with terrestrial vegetation.

Wetlands within the study area serve to improve habitat within and potentially downstream of the study area through the provision of various ecosystem services. Many of these functional benefits therefore contribute directly or indirectly to increased biodiversity within the study area as well as downstream of the study area through provision and maintenance of appropriate habitat and associated ecological processes

Combined area weighted Wet-Health results indicated that the wetlands from the study area have been moderately in most instances as a result of changes in water inputs (derived from its catchment) and water retention and distribution patterns within the wetlands units, as well as vegetation changes within the wetlands and surrounding catchments due to historic and current anthropogenic impacts, albeit relatively limited.

The valley bottom wetland was regarded as having a high Ecological Importance and Sensitivity as well as a high Hydrological and Functional Importance as a result of the relatively intact nature and various important ecosystem services they provide. Direct human benefits were associated with the provision of natural resources as well as grazing opportunities afforded by most wetlands within the study area. Collectively, the valley bottom systems along with their supporting hillslope processes play an important role in contributing to good water quality and quantity to the downstream environment and serve as habitat and movement corridor for wetland-related species.

The impact assessment identified sedimentation, alien invasive vegetation, loss of wetland functionality and changes to flow regimes as the major potential impacts during the construction and operational phases. Several general and specific mitigation measures are proposed. Development within the study area is proposed to constitute the re-alignment of existing Eskom infrastructure that is situated more than 200m from HGM 1. The re-alignment will constitute a few new pylons to realise the re-alignment within modified terrestrial grassland. This area also contains temporary artificial wetland habitat with very high basal cover. As a result of the high basal cover, general mitigation measures will be satisfactory in protecting the natural unchanneled valley bottom wetland further west. The rest of the proposed development will take place within the existing modified footprint of Majuba power station with little potential impact on watercourses downstream. Potential impact and increase of alien invasive vegetation should be addressed according to the terrestrial report for this project.

The DWS Risk Assessment Matrix, calculated the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the freshwater resources assessed that is situated within 500m from the proposed development. By assessing the severity, spatial scale, duration and frequency of the proposed ESKOM infrastructure relocation, the risk to the potentially affected resource quality was determined to be low for all aspects during the construction and operational phases.

The low risk identified was based on all recommended mitigation measures being implemented as outlined within this report.

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APPENDIX A – Methodology

Wetland Delineation

The report incorporated a desktop study, as well as field surveys, with site visits conducted during August 2023. Additional data sources that were incorporated into the investigation for further reliability included:

- Google Earth images;
- 1:50 000 cadastral maps;
- ortho-rectified aerial photographs; and
- 5m contour data.
- Historic imagery (CDNGI-Geospatial Portal, 2023)

A pre-survey wetland delineation was performed in order to assist the field survey. Identified wetland areas during the field survey were marked digitally using GIS (changes in vegetation composition within wetlands as compared to surrounding non-wetland vegetation show up as a different hue on the orthophotos, thus allowing the identification of wetland areas). These potential wetland areas were confirmed or dismissed and delineation lines and boundaries were imposed accordingly after the field surveys.

The wetland delineation was based on the legislatively required methodology as described by Department of Water Affairs and Forestry (2005). The DWAF delineation guide uses four field indicators to confirm the presence of wetlands, namely:

- terrain unit indicator (i.e. an area in the landscape where water is likely to collect and a wetland to be present);
- soil form indicator (i.e. the soils of South Africa have been grouped into classes / forms according to characteristic diagnostic soil horizons and soil structure);
- soil wetness indicator (i.e. characteristics such as gleying or mottles resulting from prolonged saturation); and
- vegetation indicator (i.e. presence of plants adapted to or tolerant of saturated soils).

The wetland delineation guide makes use of indirect indicators of prolonged saturation by water, namely wetland plants (hydrophytes) and (hydromorphic) soils. The presence of these two indicators is indicative of an area that has sufficient saturation to classify the area as a wetland. Hydrophytes were recorded during the site visit and hydromorphic soils in the top 0.5 m of the profile were identified by taking cored soil samples with a bucket soil auger and Dutch clay auger (photographs of the soils were taken). Each auger point was marked with a handheld Global Positioning System (GPS) device (Figure 38).

Wetland Functionality

The methodology “Wet-EcoServices” (Kotze et al., 2008) was adapted and used to assess the different benefit values of the wetland units. A level one assessment, including a desktop study and a field assessment were performed to determine the wetland functional benefits between the different hydro-geomorphological types within the study area. Other documents and guidelines used are referenced accordingly. During the field survey, all possible wetlands and drainage lines identified from maps and aerial photos were visited on foot. Where feasible, cross sections were taken to determine the state and boundaries of the wetlands.

Following the field survey, the data was submitted to a GIS program for compilation of the map sets. Subsequently the field survey and desktop survey data were combined within a project report.

In order to gauge the Present Ecological State of various wetlands within the study area, a Level 2 Wet-Health assessment was applied in order to assign ecological categories to certain wetlands. Wet-Health (Macfarlane et al., 2008) is a tool which guides the rapid assessment of a wetland's environmental condition based on a site visit. This involves scoring a number of attributes connected to the geomorphology, hydrology and vegetation, and devising an overall score which gives a rating of environmental condition.

Wet-Health is useful when making decisions regarding wetland rehabilitation, as it identifies whether the wetland is beyond repair, whether rehabilitation would be beneficial, or whether intervention is unnecessary, as the wetland's functionality is still intact. Through this method, the cause of any wetland degradation is also identified, and this facilitates effective remediation of wetland damage. There is wide scope for the application of Wet-Health as it can also be used in assessing the Present Ecological State of wetlands and thereby assist in determining the Ecological Reserve as laid out under the National Water Act. Wet-Health offers two levels of assessment, one more rapid than the other.

For the assessments, an impact and indicator system were used. The wetland is first categorized into the different hydrogeomorphic (HGM) units and their associated catchments, and these are then assessed individually in terms of their hydrological, geomorphologic and vegetation health by examining the extent, intensity and magnitude of impacts, of activities such as grazing or draining. The extent of the impact is measured by estimating the proportion the wetland that is affected. The intensity of the impact is determined by looking at the amount of alteration that occurs in the wetland due to various activities. The magnitude is then calculated as the combination of the intensity and the extent of the impact and is translated into an impact score. This is rated on a scale of 1 to 10, which can be translated into six health classes (A to F – compatible with the EcoStatus categories used by DWAF, Table 12). Threats to the wetland and its overall vulnerability can also be assessed and expressed as a likely Trajectory of Change.

Determination of Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity was determined by utilising a rapid scoring system. As wetlands outside of the study area were only partially visited, there could easily be oversight as detailed studies are required to increase the confidence of the assessment which relied heavily on the experience of the author. The system has been developed to provide a scoring approach for assessing the Ecological, Hydrological Functions; and Direct Human Benefits of importance and sensitivity of wetlands. These scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments, and the work conducted by Kotze et al. (2008) on the assessment of wetland ecological goods and services from the WET-EcoServices tool (Rountree et al., 2013). An example of the scoring sheet is attached as Table 12. The scores are then placed into a category of very low, low, moderate, high and very high as shown in Table 13.

Table 12: Interpretation of scores for determining present ecological status (Kleynhans 1999)

Rating of Present Ecological State (Ecological Category)
CATEGORY A Score: 0-0.9; Unmodified, or approximates natural condition.
CATEGORY B Score: 1-1.9; Largely natural with few modifications, but with some loss of natural habitats.
CATEGORY C Score: 2 – 3.9; Moderately modified, but with some loss of natural habitats.
CATEGORY D Score: 4 – 5.9; Largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
OUTSIDE GENERAL ACCEPTABLE RANGE
CATEGORY E Score: 6 -7.9; Seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
CATEGORY F Score: 8 - 10; Critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

* If any of the attributes are rated <2, then the lowest rating for the attribute should be taken as indicative of the PES category and not the mean

Table 13: Example of scoring sheet for Ecological Importance and sensitivity

Ecological Importance	Score (0-4)	*Confidence (1-5)*	Motivation
Biodiversity support			
Presence of Red Data species			
Populations of unique species			
Migration/breeding/feeding sites			
Landscape scale			
Protection status of the wetland			
Protection status of the vegetation type			
Regional context of the ecological integrity			
Size and rarity of the wetland type/s present			
Diversity of habitat types			
Sensitivity of the wetland			
Sensitivity to changes in floods			
Sensitivity to changes in low flows/dry season			
Sensitivity to changes in water quality			
ECOLOGICAL IMPORTANCE & SENSITIVITY			

Table 14: Category of score for the Ecological Importance and Sensitivity

Rating	Explanation
Very low (0-1)	Rarely sensitive to changes in water quality/hydrological regime.
Low (1-2)	One or a few elements sensitive to changes in water quality/hydrological regime.
Moderate (2-3)	Some elements sensitive to changes in water quality/hydrological regime.
High (3-3.5)	Many elements sensitive to changes in water quality/ hydrological regime.
Very high (+3.5)	Very many elements sensitive to changes in water quality/ hydrological regime.

APPENDIX B: DWS IMPACT RISK ASSESSMENT (for wetlands situated within 500m from the proposed development during the construction and operational phases)

PROJECT: **Majuba400kv Substation and associated infrastructure**

RISK ASSESSMENT MATRIX for Section 21 (c) and (i) Water Use activities - Version 2.0

Name of Assessor: Willem Lubbe

Signature: 

SACNASP Registration Number: 4750

Date: 06/06/2024

Risk to be scored for all relevant phases of the project (**factoring in specified control measures**). MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating
						Abiotic Habitat (Drivers)			Biota (Responses)										
			Name/s	PES	Ecological Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna									
CONSTRUCTION	<1>Site preparation and typical construction activities: Vegetation clearing, cutting/filling/shaping. stormwater infrastructure development, foundations, building and assocaited infrastructure development such as water, electricity,roads and sewage	Decreased Water Quality, especialy through increased sedimentaion loads, but other potential sources as well. E.g. hydrocarbons	HGM 1	C	High	1	2	0	1	0	4	2	2	8	4	32	40%	12.8	L
		<1b>Increased peak flow dicharges received by HGM 1	HGM 1	C	High	2	2	1	1	1	4	2	2	8	4	32	40%	12.8	L
		<1c>Increased alien invasive vegetation infestation	HGM 1	C	Moderate	0	0	1	2	1	4	2	2	8	3	24	40%	9.6	L
OPERATIONAL	<1>Developed area with mixed used activities, including more hardened surfaces and introduced pollution sources such as point and non point pollution (e.g. industy, vechiles	<1a> Altered hydrological regime	HGM 1	C	High	2	2	0	1	1	4	2	2	8	4	32	40%	12.8	L
		<1b> Deteriorated water quality	HGM 1	C	High	1	2	0	1	1	4	2	2	8	4	32	40%	12.8	L
		<1c> Spread of alien vegetation	HGM 1	C	High	1	1	0	2	2	4	2	2	8	4	32	40%	12.8	L