WETLAND ASSESSMENT: UPGRADE OF HALFWAY HOUSE BULK WATER PIPELINE WITHIN THE JURISDICTION OF THE CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY IN THE GAUTENG PROVINCE.

Report Prepared By

Mora Ecological Services Pty
350 Johan Street,
Arcadia, 0007
Tel: 0814103763
Email: info@moraecological.co.za

Prepared and submitted to

NSOVO ENVIRONMENTAL CONSULTING

Date of First Draft: 28 February 2023
DRAFT_V01

DOCUMENT CONTROL

Report Name	MOLEPO, M. 2023. Wetland Assessment: Upgrade Of Halfway House Bulk Water Pipeline within the Jurisdiction of the City Of Johannesburg Metropolitan Municipality In The Gauteng Province
Reference	
Version	DRAFT_V01
Submitted to	Nsovo Environmental Consulting
AUTHOR	MOLEPO, M , (Pr. Sci. Nat 009509) ....
Draft Date Produced	24 February 2023

1. EXECUTIVE SUMMARY

MORA Ecological Services (Pty) Ltd was appointed by Nsovo Environmental Consulting to conduct a wetland delineation and impact assessment as part of the proposed upgrade of the Halfway House Bulk Water Pipeline within the jurisdiction of the City of Johannesburg Metropolitan Municipality in the Gauteng Province.

A site visit was conduected on the 11th and 27th of February 2023, by a team of ecologists and the purpose of the site visit was to collect data. The team investigated the presence of aquatic systems (wetlands; dams, pans, seeps, depressions) and determined their buffer zones.

The present ecological status (PES) of the wetland identified in the area is Moderate, with a PES score of 4-5, Category D. A large change in ecosystem processes and loss of natural habitat and biota has occurred, but some remaining natural habitat features (water and vegetation) are still recognizable with local ecological role provided.

Transformation of the areas led to the introduction of invasive alien plants. The proposed upgrade is likely to have minimum impact on the wetland. A 32m buffer around the wetland shall be a barrier to prevent the activities. All indirect and direct impacts on the wetland shall be managed accordingly to allow a natural flow of surface or/and groundwater into the wetland that will maintain its current status. As a result, it is the opinion of the specialist that this application is considered.

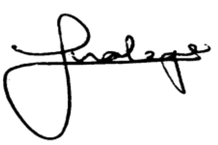
2. DECLARATION OF INDEPENDENCE

I, Mokgatla Molepo, in my capacity as a specialist consultant, hereby declare that I:

- Act/acted as an independent specialist to Nsovo Environmental Consulting for this project.
- Do not have any personal, business, or financial interest in the project except for financial remuneration for specialist investigations completed in a professional capacity as specified by the Environmental Impact Assessment Regulations, 2014, as amended.
- Will not be affected by the outcome of the environmental process, of which this report forms part.
- Do not have any influence over the decisions made by the governing authorities.
- Do not object to or endorse the proposed developments but aim to present facts and my best scientific and professional opinion about the impacts of the development.
- Undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Environmental Impact Assessment Regulations, 2014, as amended.

INDEMNITY

- This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken.
- This report is based on a desktop investigation using available information and data related to the site to be affected, *in situ* fieldwork, surveys, and assessments, and the specialist's best scientific and professional knowledge.
- The Precautionary Principle has been applied throughout this investigation.
- The findings, results, observations, conclusions, and recommendations given in this report are based on the specialist's best scientific and professional knowledge as well as information available at the time of the study.
- Additional information may become known or available later in the process for which no allowance could have been made at the time of this report.
- The specialist reserves the right to modify this report, recommendations, and conclusions at any stage should additional information become available.
- Information and recommendations in this report cannot be applied to any other area without proper investigation.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.



Mokgatla Molepo *Pr. Nat. Sci.* (009509)

28 February 2023

3. Contents

List of Figures

List of Tables

4. Introduction

MORA Ecological Services (Pty) Ltd was appointed by Nsovo Environmental Consulting to conduct a wetland delineation and impact assessment as part of the proposed upgrade of the Halfway House Bulk Water Pipeline within the jurisdiction of the City of Johannesburg MetropolitanMunicipality in the Gauteng Province.

A team of ecologists undertook a site assessment on the 11th and 27th of February 2023,. The purpose of the survey was to investigate the presence of aquatic systems (wetlands; dams, pans, seeps, depressions) and determined their buffer zones within the study area.

The assessment aims to identify and determine the natural importance and the current status of the wetlands in the study area.

The survey also looked at other available aquatic features that will assist in determining the impacts caused by the proposed activities. Mora Ecological Services will be guided by the findings of this study to suggest the appropriate recommendations in terms of mitigation measures that can be used to prevent or minimize further impact on the aquatic resources.

The scope of work for the project:
The project aimed at:

- Assessing the wetlands in the area
- Delineate the extent of the buffer zone of the existing wetland
- Document the findings and produce the report

5. What is a Wetland

Wetlands are described as a unique place on earth that is transitional between aquatic and terrestrial ecosystems, has its water table close to or above the soil surface, is characterized by (unique) saturated soil and hydrophytic vegetation types, and accommodating distinctive organisms (Edwards, *et al*., 2018). In terms of Section 1 of the National Water Act (NWA, Act 36 of 1998), wetlands are legally 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 are the results of an anaerobic process (i.e. without air–oxygen) in the soil (hydric) which favors and support specific and unique vegetation (hydrophytes) and perhaps attracts unique fauna/animals (Edwards, *et al*., 2018). The hydric soil of the wetland is distinctive and characterised by redoximorphic and/or gleying conditions.

Wetlands are biologically diverse and productive unique ecosystems (Cherry, 2011) and experience huge pressure. These are unique lands or areas on earth which occur in areas where the groundwater discharges to the surface forming seeps and springs. Wetlands are vitally important in that they provide several benefits to biodiversity and human life, directly and indirectly, (Kotze *et al*., 2005). Amongst the others, are water purification, flood reduction, erosion control, socio-economic (e.g. birding), tourism, and education. Protecting and conserving these habitats are critical and mandated by several legislation and laws.

These habitats are found where the topography and geological parameters impede the flow of water through the catchment, resulting in the soil profiles of these habitats becoming temporarily, seasonally, or permanently wet (Figure 1: Wetland diagram showing the different zones). There are up to seven different types of wetlands regarding their topography and geological features and differences, as per the WET-EcoServices technique. Some examples are; pan, valley channels, seepage, dams, etc, figure 2 and table 1.

The differentiation/classification of the wetlands in the study area into different wetland types was based on the WET-EcoServices technique (Kotze *et al,* 2005). These, are all significant to nature and the environment. There is a need to assess and compare wetlands in terms of ecosystem service delivery to prioritize protection and restoration efforts, (Walters, *et al.,* 2021)

Over 50% of the South African wetlands are lost and under serious threat (Edwards, *et al.,* 2018). Due to the continuing habitat loss, wetlands, and biodiversity, in general, are experiencing demise. In the past 20 years, South Africa lost up to 60% of its biodiversity (Wright, *et al.,* 2018) through human-induced activities. In the past 30 years, South Africa's grassland transformed or changed by more than 50%, (Schoeman, 2013).

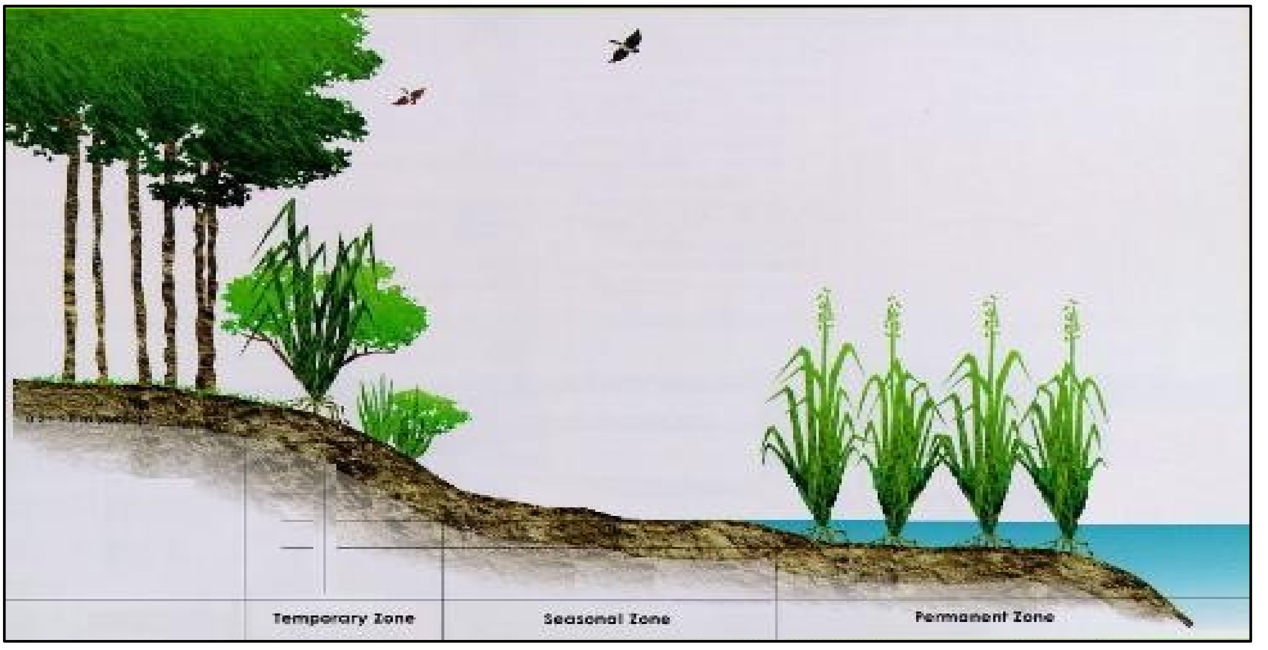


Figure 1: Wetland diagram showing the different zones.

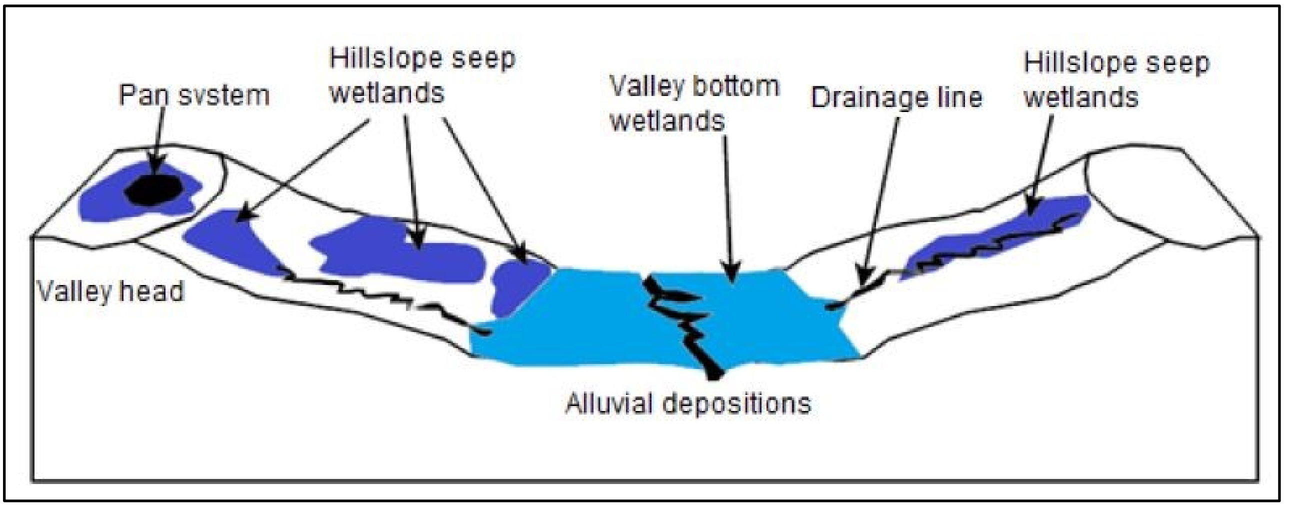


Figure 2: Wetland types as described by Kotze (2007) and Ollis (2013).

Table 1: Different types of wetlands

Hydro-geomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
Floodplain	Valley bottom areas with a well-defined stream channel, gently sloped & characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.	***	*/***
Valley bottom without a channel	Valley bottom areas with no clearly defined stream channel are usually gently sloped and characterized by alluvial sediment deposition, generally leading to the accumulation of sediment. Water inputs mainly from channels entering the wetland and also from adjacent slopes.	***	*/***
Hillslope seep with stream channel	Slopes on hillsides are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***
Isolated hillslope seepage	Slopes on hillsides are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes pans)	A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e., it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/***	*/***

Precipitation is an important water source and evapotranspiration is an important output

Water source: * Contribution usually small

** Contribution usually large

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

6. Terms Of Reference

This report is produced to outline detailed information/findings on the wetland assessment undertaken in the study area. It is to give a full picture of the potential impacts and recommended mitigation measures for the proposed activities.

The terms of reference for this study were as follows:

- Identify and delineate wetlands within the study area,

- Identify and apply buffers to the outer edges of the wetlands,
- Assess current impacts and suggest mitigation measures for minimizing impacts on wetlands; and
- Produce a detailed finding report with maps.

7. Assumptions and Limitations

The following assumptions and limitations apply to this report:

- The wetland assessment is confined to a 50m buffer of the project boundary; and
- The wetland delineation as presented in this report is regarded as the best estimate of the wetland boundary based on the site conditions present at the time of assessment. Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur.
- Survey was limited to a two-day survey and investigation
- Identification of wetlands is guided by National Wetland Map 5 (NWM5) of National Biodiversity Assessment 2018 of SANBI

8. Relevant Legislation

The Constitution of the Republic of South Africa Act, 1996 (Act No. 108 of 1996) – Section 24.

The Constitution is South Africa's overarching law. It prescribes minimum standards with which existing and new laws must comply. Chapter 2 of the Constitution contains the Bill of Rights in which basic human rights are enshrined. The government's commitment to give effect to the environmental rights enshrined in the Constitution is evident from the enactment of various pieces of environmental legislation since 1996, including the NWA, the NEMA, etc.

National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), as amended.

NEMA replaces a number of the provisions of the Environmental Conservation Act, of 1989 (Act No. 73 of 1989) (ECA). The Act provides for cooperative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance, and procedures for coordinating environmental functions. The principles enshrined in NEMA guide the interpretation, administration, and implementation of the Act about the protection and/ or management of the environment. These principles serve as a framework within which environmental management must be formulated. Section 2(4) specifies that "*sustainable development requires the consideration of all relevant factors including aspects specifically relevant to biodiversity*":

National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA).

NEMBA provides for the management and conservation of biological diversity and components thereof; the use of indigenous biological resources in a sustainable manner; the fair and equitable sharing of benefits arising from bio-prospecting of biological resources; and cooperative governance in biodiversity management and conservation within the framework of NEMA.

National Water Act, 1998 (Act No. 36 of 1998) (NWA).

The NWA is a legal framework for the effective and sustainable management of water resources in South Africa. Central to the NWA is the recognition that water is a scarce resource in the country which belongs to all the people of South Africa and needs to be managed sustainably to benefit all members of society. The NWA places a strong emphasis on the protection of water resources in South Africa, especially against its exploitation, and the insurance that there is water for social and economic development in the country for present and future generations.

The NWA requires any development to secure WUL's with the following activities:

Section 21 (c) and (i) use, i.e., river or wetland crossings, which includes any drainage lines by any infrastructure.

In terms of the definitions provided, activities included under Sections 21(c) and 21(i) are (amongst others) for the construction of roads, bridges, pipelines, culverts, and structures for slope stabilization and erosion protection. The Department of Water and Sanitation (DWS) will however need to be approached to guide on whether approval for Section 21 (c) and (i) water uses would be required.

General Authorisation in terms of section 39 of the NWA

According to the preamble to Part 6 of the NWA, "This Part established a procedure to enable a responsible authority, after public consultation, to permit the use of water by publishing General Authorizations in the Gazette.." "The use of water under a general authorization does not require a license until the general authorization is revoked, in which case licensing will be necessary…"

The General Authorisations for Section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks, or characteristics of a watercourse) as defined under the NWA have recently been revised (Government Notice R509 of 2016). Determining if a WUL is required for these water uses is now associated with the risk of degrading the ecological status of a watercourse. A low risk of impact could be authorized in terms of General Authorisations (GA).

Protected Areas Act of 2003 (Act 57 of 2003)

The Protected Areas Act promotes the establishment and management of formally protected areas. The act protects the integrity of the ecology and safeguards nature and cultural resources, providing sustainable livelihoods and supports sustainable development.

Conservation of Agricultural Resources Act (Act 43 of 1983)

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

Local and provincial legislative tools are available and differ from one province to the other, which are all guided by national legislation.

Gauteng Nature Conservation Bill, 2014 and Gauteng Provincial Environment Management Framework, 2015 (GPEMF)

“To provide for the sustainable utilization and protection of biodiversity within Gauteng; to provide for the protection of wild and the management of alien animals; protected plants; aquatic biota and aquatic systems; to provide for the protection of invertebrates and the management of alien invertebrates; to provide for professional hunters, hunting outfitters and trainers; to provide for the preservation of caves, cave formations, cave biota, and karst systems; to provide for the establishment of zoos; to provide for the powers and establishment of Nature Conservators; to provide for administrative matters and general powers; and to provide for matters connected therewith”.

Convention on the Conservation of Migratory Species (CMS)

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) aims to conserve terrestrial, aquatic, and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned 22 with the conservation of wildlife and habitats on a global scale. Since the Convention entered into force, its membership has grown steadily to include 117 (as of 1 June 2012) Parties from Africa, Central and South America, Asia, Europe, and Oceania. South Africa is a signatory to this convention.

Government Notice 509 of 2016 Authorizations related to wetlands are regulated by Government Notice 509 of 2016 regarding Section 21(c) and (i). This notice grants General Authorisation (GA) for water-related uses under certain conditions such as that, all the water uses should be regulated and registered with the relevant authority. The Notice sets out the conditions and considerations which should be taken. For instance, the user of the water must ensure that the selection of a site for establishing any impeding or diverting the flow or altering the bed, banks, course, or characteristics of a watercourse works:

(i) is not located on a bend in the watercourse;

(ii) avoid high gradient areas, unstable slopes, actively eroding banks, interflow zones, springs, and seeps.

Other Relevant Legislations and Guidelines:

- DWS Wetlands Delineation and Riparian area determination Guideline, 2005;
- Biodiversity management plans (BMP); and
- National biodiversity assessment 2018 (NBA).
- National Wetland Management Framework for South Africa, 2021

9. Study Area

The study area is located in Waterfall, Midrand in the Gauteng Province of South Africa. It is just within the City of Johannesburg Metropolitan Municipality. The central Geographical Position System (GPS) coordinates are 26° 1'14.34"S; 28° 6'36.60" E (Figure 3).

The vegetation of the site falls within the Egoli Granite Grassland vegetation unit (Mucina & Rutherford, 2006). It is surrounded by residential settlements and business development.

Climate

The climate in this area is mild and generally warm and temperate. The site receive more rain during than winters. The average annual temperature in Midrand is 16.6 °C. About 678 mm | 26.7 inches of precipitation falls annually.

According to Köppen -Geiger system (Kottek *et al*. 2006), the study site falls within the Cwb climatic region.

Vegetation

The study area is right within the Highveld Grasslands (Egoli Granite Grassland) vegetation (Figure 4). This vegetation is found in Gauteng Province: Johannesburg Dome extending in the region between northern Johannesburg in the south, and from near Lanseria Airport and Centurion (south of Pretoria) to the north, westwards to about Muldersdrift and eastwards to Tembisa. It occurs on a varying altitudes ranging between 1280–1660 m a.s.l (Bredenkamp & van Rooyen, 1996).

IMPORTANT TAXA

Occurrence of important flora

<u>Graminoids:</u> *Aristida canescens* (d), *A. congesta* (d), *Cynodon dactylon* (d), *Digitaria monodactyla* (d), *Eragrostis capensis* (d), *E. chloromelas* (d), *E. curvula* (d), *E. racemosa* (d), *Heteropogon contortus* (d), *Hyparrhenia hirta* (d), *Melinis repens* subsp. *repens* (d), *Monocymbium ceresiiforme* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tristachya leucothrix* (d), *Andropogon eucomus*, *Aristida aequiglumis*, *A. diffusa*, *A. scabrivalvis* subsp. *borumensis*, *Bewsia biflora*, *Brachiaria serrata*, *Bulbostylis burchellii*, *Cymbopogon caesius*, *Digitaria tricholaenoides*, *Diheteropogon amplectens*, *Eragrostis gummiflua*, *E. sclerantha*, *Panicum natalense*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *Tristachya rehmannii*, *Urelytrum agropyroides*.

Herbs: *Acalypha angustata*, *A. peduncularis*, *Becium obovatum*, *Berkheya insignis*, *Crabbea hirsuta*, *Cyanotis speciosa*, *Dicoma anomala*, *Helichrysum rugulosum*, *Justicia anagalloides*, *Kohautia amatymbica*, *Nidorella hottentotica*, *Pentanisia prunelloides* subsp. *latifolia*, *Pseudognaphalium luteo-album*, *Senecio venosus*.
Geophytic Herbs: *Cheilanthes deltoidea*, *C. hirta*.
Small Tree: *Vangueria infausta*.
Tall Shrub: *Rhus pyroides*.
Low Shrubs: *Anthospermum hispidulum*, *A. rigidum subsp. pumilum, Gnidia capitata, Helichrysum kraussii, Ziziphus zeyheriana. Succulent Shrub: Lopholaena coriifolia.*

Conservation Status

According to the 2021 National List of threatened terrestrial ecosystems, this vegetation type is Critically Endangered. The assessment summary suggests that Egoli Granite Grassland is narrowly distributed with high rates of habitat loss in the past 28 years (1990-2018), placing the ecosystem type at risk of collapse.

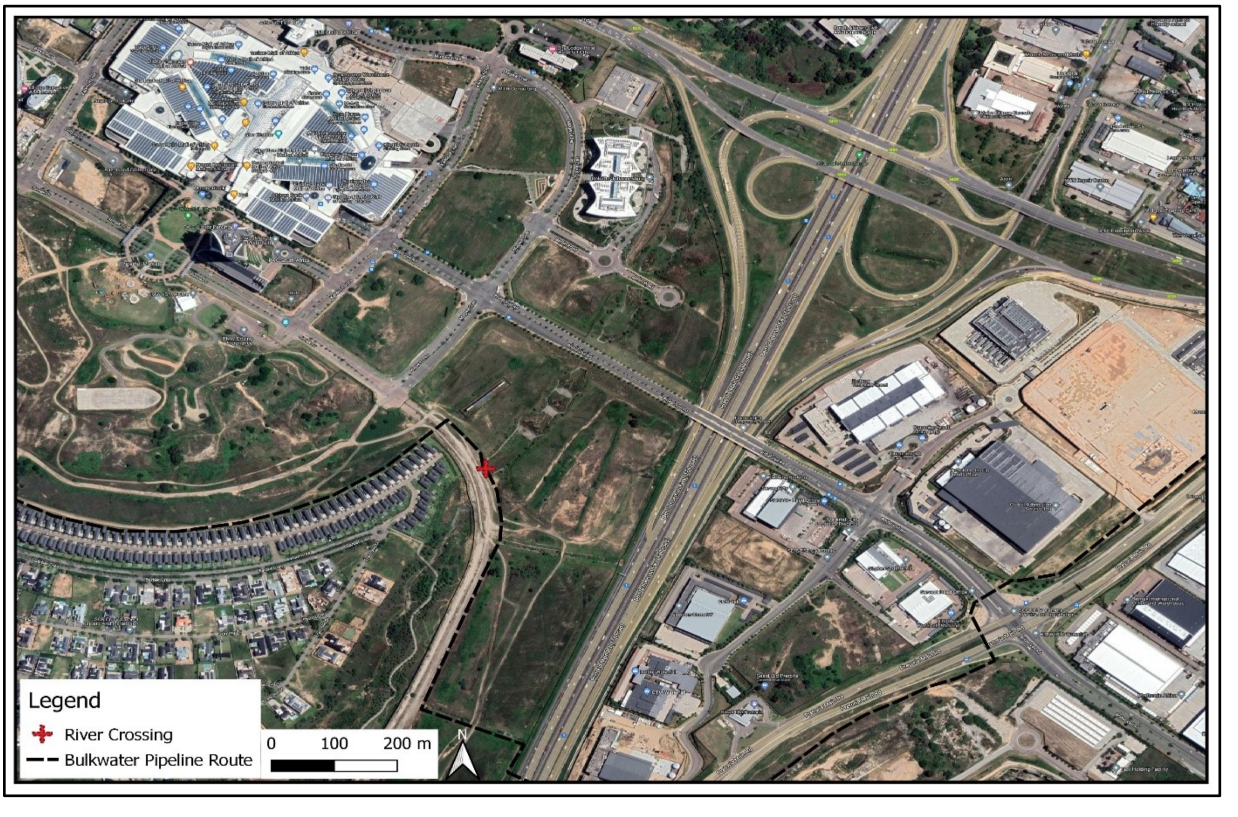


Figure 3: Locality of the study site.

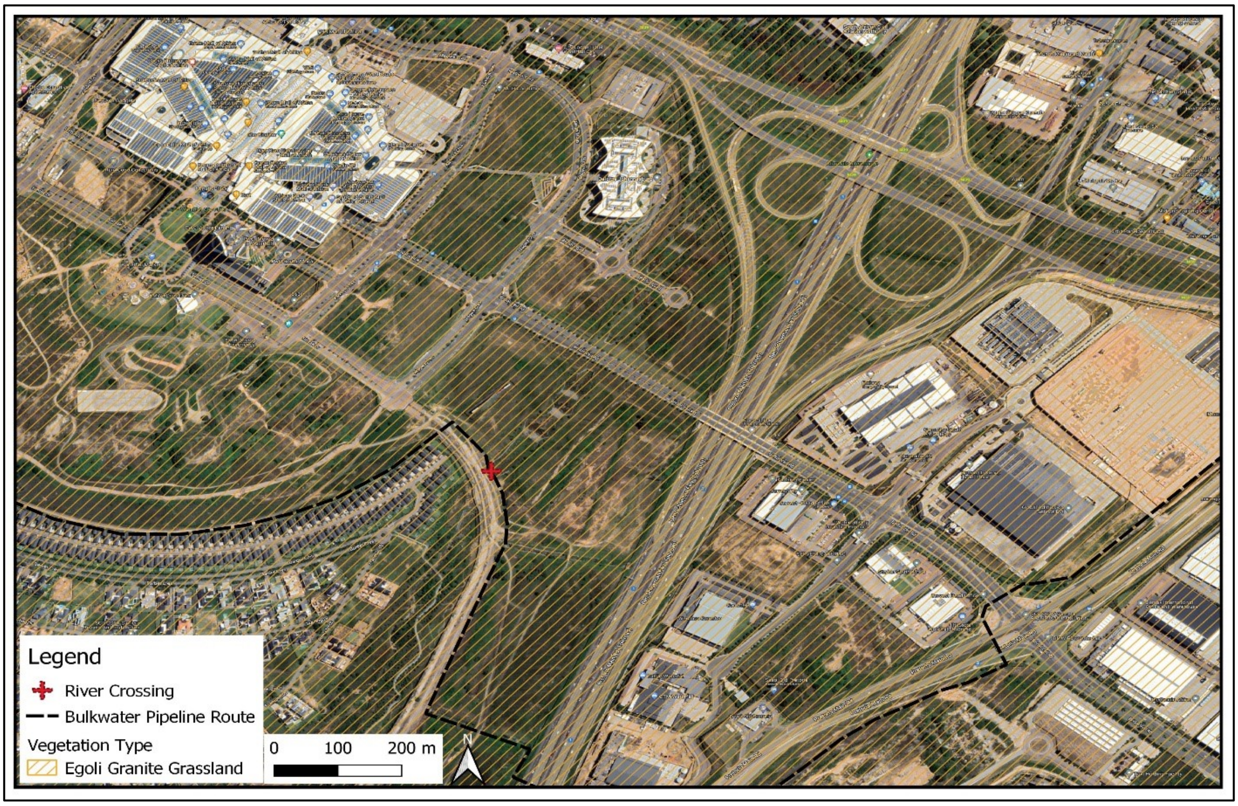


Figure 4: Vegetation types on the study area.

10. Methodology

Literature Review and Desktop Assessment

Remote sensing of the area was undertaken,this was done to identify all the aquatic ecosystems and features on the site. Computer programs such as Google Earth Pro were used to access satellite imagery of the area to detect and study changes in land cover and other environmental features.

The South African National Biodiversity Institute (SANBI) Biodiversity Geographic Information System (GIS) website as well as the latest Freshwater Ecosystem Priority Areas (FEPA) dataset were consulted to identify any constraints in terms of fine-scale biodiversity conservation mapping.

A literature review of publications related and relevant to the study area was undertaken (see list of references). These were essential mainly during the identification of species, assessment guidelines, processes, and protocols on wetlands. Other resources visited and consulted include;

- SANBI Red List of South Africa Plants web: Threatened Species Programme | SANBI Red List of South African Plants (accessed on 05 January 2022) to attain the list of any red-lit plants in the area,
- Plants Of South Africa, of SANBI web: Home Page - BRAHMS Online (sanbi.org) (accessed on 05 January 2022) to attain any of the protected and endemic species,
- SANBI Institute's Biodiversity-GIS Map Viewer and database Biodiversity Data (sanbi.org) to access and view current aquatic systems from the study area,
- A cloud-based platform, Hub ArcGIS – Maps-wetlands, accessed at https://hub.arcgis.com/maps/edit?content=d1db45ea109b44828ba74a7bd941544b_20 to access and view the study area and analyze the current aquatic systems
- Intermediate Ecological Reserve PES method for [floodplain] wetlands (Duthie, 1999b)
- Guidelines for delineation of wetland boundaries and wetland zones (Marneweck and Kotze,1999): Part of the DWAF (1999c)

Desktop tools, programs, and applications such as Google Earth Pro (version 3) and Quantum Geographic Information Systems (QGIS 3.28.0) to view and compare the 3D satellite imagery of the study area to establish present and past events/situations of the terrain. During this assessment, the tools were used to determine and establish the 500m buffer from the borders of the study area/project site.

Recent and latest various national datasets accessed mainly from the SANBI database were used to screen and assess the study area remotely. Other sources of information such as the Conservation Plan for Gauteng and other priority areas were sourced from the Gauteng Department of Agriculture and Rural Development (GDARD). The data extracted and used was mainly in a shapefile format formap production. Some of that data includes;

- National Wetland Management Framework For South Africa Report, 2021
- National; Terrestrial Threat Status and Protection level of 2018
- Gauteng Conservation Plan Version 3.3
- Highveld Wetlands, 2014 (from MTPA)
- National Wetland Map 5 (NWM5) of National Biodiversity Assessment 2018

Field Study

For instance, the Present Ecological Status (PES) of the wetland is vitally important to know/determine. Methods or approaches to assess and determine the status of the wetlands based on the level or extent of destruction caused by anthropogenic activities are available. Some of those methods are the Wetland-Use, Version 1 (Kotze *et al*., 1994) which does not apply to this study because of its shortcomings, complexity, and efficiency. The Wetland-Use, Version 1 mainly looks at the land-use changes for the habitat.

The Wetland Fix Assessment Forms (Wyatt, 1997), is another available method that is generally focusing on the field guide on how to assess, manage and rehabilitate the wetland. It has no scoring system which helps to arrive at the status of the importance/sensitivity.

The third method, DEAT Wetland Classification System, Draft 1 (Dini *et al*., 1998) is one of the methods that deals with classifying the types of wetlands and not giving the status of their health/importance. These were amongst the methods not used in this study as they are deemed not applicable to arrive at the present ecological status of these particular sites.

For this assessment, this study applied and used the following standard methods to determine and assess the ecological condition and status of the wetlands identified on-site, (Ollis and Malan, 2014). These are the;

- Present ecological status (PES) method, for floodplain and other palustrine wetlands (Kleynhans (1996 & 1999; Duthie, 1999b) included in the Resource Directed Measures (RDM-99 method) Manual for Wetland Ecosystems (DWAF, 1999c),
- Wetland Index of Habitat Integrity (Wetland-IHI) for floodplain and valley-bottom wetlands developed (DWAF, 2007b),
- WET-Health assessment tool (Macfarlane *et al*., 2007; Kotze *et al*., 2012).

Generally, the Wetland-IHI and WET-Health assessment methods are the most preferred and recommended methods used to assess the present ecological status (PES) and ecological importance and sensitivity (EIS) of the wetlands in southern Africa. These methods promote the use of the following environmental aspects; (i) hydrology (i.e. presence or movement of water), (ii) geomorphology (i.e. landform characteristics and processes), (iii) vegetation, and (iv) water quality to arrive at the present ecological status (PES) of the wetland (Brinson, 1993; Ollis *et al*., 2013; Ollis and Malan, 2014).

These aspects (criteria) are scored and rated separately and later the overall score is determined. They will constitute a direction to get to a wetland (PES) category and sensitivity/importance score (weight) as guided by Duthie (1999b) method.

The Wetland-IHI and WET-Health assessment methods are relevant and applicable to the seepage, floodplain, and channeled valley-bottom wetlands, as is the case in this study. The study area and surrounding aquatic systems fall within the area dominated by the seepage, pan, and valley-bottom wetland as revealed during the desktop assessment. To assess and come to an understanding of the ecosystem services provided by the wetlands, a WET-EcoServices (Kotze *et al*., 2007), the method was applied.

It was important to determine if the wetland will provide any conservation benefits within the larger aquatic catchment. The capability of the wetland to provide these services to the communities was also assessed and indicators for each of those services/demands were rated.

Possible and potential sites identified as wetlands (dams, pans) through a desktop assessment were visited for verification and delineation. The field assessment was undertaken, by an experienced wetland ecologist, on the 11th and 27th of February 2023 and the following were performed;

Delineation of a wetland

The delineation method documented by the Department of Water Affairs and Forestry in their document

- Updated manual for identification and delineation of wetlands and riparian areas, (DWAF, 2008);
- Minimum Requirements for Biodiversity Assessments, (GDACE, 2009)
- Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems, (Ollis *et al*, 2013) was

Attention was paid to the wetland indicators to note the presence and potential wetlands. The buffer zones were determined on-site. The following aspects were noted and assessed to determine if there is a wetland or not and where their boundaries/buffer zones are;

- the landscape position (e.g. hilltop, midslope, valley bottom, floodplain),
- soil formation, presence, and type,
- vegetation,
- predoxymorphic features, (the presence of water – extent of saturation/inundation).

Hydric Soil

Soil morphology forms the basis of wetland delineation in the region, mainly because it provides a long-term indication of the "natural" hydrological regime. DWAF (2008) suggested that there are four forms of soil formations (Champagne, Katspruit, Willowbrook, and Rensburg types) that can tell if the area is a wetland or not. Furthermore, other soil formations can be used as guidance and indicate a wetland but, if they are used in consideration with other factors, (Table 2). These can be the basic indication of possible wetlands that need to be verified by applying other factors, not only soil.

However, soil morphology alone cannot be considered a determining factor for the current hydrological conditions. Considerations are to be made especially on areas where the site where has gone through some sort of hydrological modification or disturbance, (DWAF, 1999, 2005 & 2007; Ollis *et al*., 2013; Ollis and Malan, 2014).

Soil coloration – the development of various colors in the soil during the formation stage, displays various colorations from yellowish to soil light brown and/or purple, blue, or greenish, this will be the most basic aspect to look at with the naked eye – mottles. The mottles are, therefore, one of the main indicators when determining the "wet" land due to their ability to be present in such areas for the longest time (years).

Therefore, the use of mottles (soil coloration) to identify a wetland can be accepted, following the method or guideline as per Munsell Soil Colour Chart (1994). A note should be made when mottles are used as they vary from one soil type to another and changes over time in a particular area. For instance, in an area where there is more saturation, the mottles are less than in an area that is not. This will also assist in determining the saturation period or timeline.

Duration of saturation and frequency of inundation of the soil can be used to determine and classify if the wetland is permanent, seasonal, intermediate, or never (unknown), (Ollis *et al*., 2013). Other factors or wetland "descriptors" are taken into consideration when assessing an area if it is a wetland. These amongst others are; the salinity of the water, and whether it is artificial (e.g, dams) or permanent.

Typically, indicators of soil wetness based on soil morphology correspond closely with vegetation distribution, since hydrology affects soils and vegetation systematically and predictably. In systems where the hydrological regime has been modified due to human activities, vegetation distribution will vary systematically with soil morphology. The response of vegetation to alteration of hydrological conditions is rapid (i.e., months/years), whereas the response of soil morphology to such alteration is slow (i.e., centuries). Therefore, lowering the water table or reduction of surface flows may lead to the rapid establishment of non-wetland-related terrestrial vegetation, whereas the soil morphology will retain indicators of wetness for a lengthy period.

Table 2: Other soil formations associated with wetlands, (DWAF, 2008)

Other Soil Formations that can be associated with a wetland

Avalon	Glencoe	Pinedene	Addo	Houwhoek
Bainsvlei	Kinkelbos	Sepane	Brandvlei	Inhoek
Bloemdal	Klapmuts	Tukulu	Dundee	Jonkersberg
Cartref	Kroonstad	Vilafontes	Etosha	Kimberley
Dresden	Longlands	Wasbank	Glenrosa	Molopo
Estcourt	Lamotte	Westleigh	Groenkop	Tsitsikamma
Fernwood	Montagu	Witfontein	*(signs of wetness for these soil forms are incorporated at the family level)*	

<u>*Hydrology*</u>

National Freshwater Ecosystems Priority Areas (NFEPA) dataset was consulted as key reference point. Land inundated by water or which displays saturated soils when these soils are biologically active (the growth season), (i.e. presence or movement of water) was also used to determine the wetland (existence and edges/zones). Duration of saturation and frequency of inundation of the soil can be used to determine and classify if the wetland is permanent, seasonal, intermediate, or never (unknown), (Ollis *et al*., 2013). A soil auger was used to determine the edges of the wetlands. The following were undertaken,

- *Permanent zones* – soil auger used to extract soil from the ground, at least 1-2m away from the surface waters. The depth in which the auger was applied was at least 0.5m and at most 1m. The indicators such as greyish-colored soil, very little/absence of mottles, and sulphuric odor smell from the soil were observed.
- *Seasonal zones* – due to the timing of the study, the indicators observed are the occurrence of the mottles and the gleyed soil content.
- *Temporary zones* – distinctive mottles were studied and observed as well as the coloration of the soil. The wetness of the soil was considered.

The delineation assessment started from the centre/wettest (close to the surface water) moving towards the outer/edge and up the slope (against the water flow) of the area. The soil samples using a soil auger were extracted at up to 1m deep. From each sample, the presence of mottles and gleying were examined. This was done to determine where the different zones (permanent, seasonal, temporary zones) are.

Hydrophytes (Vegetation)

The study site falls within the Mesic Highveld Grassland (Soweto and Klipriver Highveld) as per the national vegetation dataset. Certain vegetation/species (*Obligate and facultative species)* are associated with a wetland. However, several environmental considerations are taken when this aspect is used for determination. Considerations such as disturbance of the area, season or time of the survey, and vegetation expertise. Vegetation diversity and species composition, for example, vary from the edge (wetland zones) to the centre of the permanent, seasonal, and temporary wetlands.

A great knowledge and experience in grasses, herbaceous, and shrub species of the Highveld area, especially the Gauteng, is key. Several sources and publications were consulted to verify and identify a few species found on-site which were not identified during the survey, (van Oudtshoorn, 2012; DWAF, 1999, 2005 & 2007).

Obligate and facultative wetland species – these plants were searched onsite. These are plant species that predominately grow and thrive in a wetland. A great knowledge of the local species was key to undertaking this task. Because the area falls within the mesic highveld grassland only the key indicator herbaceous and grass species (such as *Panicum* spp.) were looked at.

Sedges	Bulrush
	

Determining Buffer Zones

Tools for calculating buffer zones are available, such as the “Guideline for the Determination of Buffer Zones for Rivers, Wetlands, and Estuaries. Consolidated Report” by the WRC (Macfarlane & Bredin, 2017). This tool aims to calculate the best-suited buffer for each wetland or section of a wetland based on numerous on-site observations and the extent of the development’s impact or risk to the ecosystem. Various buffer zones were developed and suggested to be applicable, see Table 3: Indicating the calculated buffer zones (Macfarlane *et al*, 2015). and Table 4: Stepwise tasks for buffer recommendation. below. It is also used to aid in watercourse classification and determining the need and extent of buffer zones. With other publications, this publication recognizes the following definition:

- **Buffer zone**: A strip of land with a use, function, or zoning specifically designed to protect one area of land against impacts from another.
- **Aquatic impact buffer zone**: A zone of vegetated land designed and managed so that sediment and pollutant transport carried from source areas via diffuse surface runoff is reduced to acceptable levels.

According to this guideline, buffer widths should be tailored according to risk. This criterion recognizes the importance of using risk as a basis for establishing an appropriate buffer width. Where risk or uncertainty is high, ecologically conservative buffers should be established whereas less conservative buffers are appropriate for low-risk situations.

Several key risk factors have been identified for possible inclusion in the approach. These are:

(i) Risks posed by adjacent land uses or activities;

(ii) The importance and sensitivity of the water resource;

(iii) The conservation status (risk of extinction) of aquatic and semi-aquatic species;

(iv) Characteristics of the buffer that affects the functionality of the buffer; and

(v) Mitigation measures that may be applied to reduce risks.

The extent of the buffer zone is calculated from the:

(i) Edge of the active channel (Rivers and streams);

(ii) Edge of the temporary zone (Wetlands).

This method of calculating the extent of the buffer is designed for site-based assessments and includes a more detailed evaluation of risks and consideration of site-specific factors that can affect the buffer requirements. Such an approach is designed to inform any detailed development planning and provide an appropriate level of information for authorization purposes. Table 4: Stepwise tasks for buffer recommendation. below, shows the stepwise methodology to be applied.

Table 3: Indicating the calculated buffer zones (Macfarlane *et al*, 2015).

Wetland	Construction Phase	Operational Phase
Seepage Wetlands	50 m	79 m
Depressional Pan Wetlands	42 m	80 m
Unchannelled Valley Bottom Wetlands	58 m	92 m
Channelled Valley Bottom Wetlands	62 m	98 m

Table 4: Stepwise tasks for buffer recommendation.

Step	Task	Scope
1	Define objectives and scope to determine the most appropriate level of assessment	**Desktop assessment:** This assessment is designed to characterize risks at a desktop level to red-flag land located adjacent to water resources that should potentially be set aside and managed to limit impacts on water resources.

Step	Task	Scope
		Site-based assessment: This assessment is designed for site-based assessments and includes a more detailed evaluation of risks and consideration of site-specific factors that can affect buffer requirements.
2	Map and categorize water resources	The assessor is required to generate a map delineating the boundaries of the water resources potentially affected by proposed developments within the study area.
2.1	Classify the watercourse	E.g., Wetland, spring, or river, and subcategories: Ephemeral drainage line and type of channel (albeit with or without active channel).
2.2	Map the line from which aquatic impact buffer zones will be delineated (Edge of the active channel)	• Rivers and streams – the outer edge of the active channel; • Wetlands – the edge of the temporary zone.
2.3	Identify the water source type	Desktop: Level 3: Sub-system/landscape unit. Site-based: Level 4: Hydromorphic unit.
3	Management objectives	Use appropriate references and methods (below) to formulate management objectives for the watercourse.
3.1	Determine the Present Ecological State	Desktop or site-based assessment depending on requirements from regulating authority.
3.2	Determine the Importance and Sensitivity	To determine the overall importance and sensitivity of a water resource, the ecological, social, and economic importance should be considered.
4	Risk Assessment of water resources	Undertake a risk assessment to assess the potential impacts of planned activities on water resources.
5	Risk Assessment for the protection of biodiversity	Assess risks posed by the proposed development on biodiversity and identify management zones
6	Delineate and demarcate recommended setback requirements	Finalize and delineate setback requirements on a layout plan and in the field. In doing so, it is also important to ensure that setback requirements also cater to a range of other potentially important management, functional, and legal requirements.
7	Document management measures necessary to maintain the effectiveness of setback areas	Key aspects of the setback requirements will include: • An aquatic impact buffer zone; • Possible core habitat requirements; • Possible corridor requirements; • Any additional aspects requiring consideration to ensure effective management of setback areas.

Figure 5: Wetland types found on site according to NBA 2018, National Wetland Maps).

11. Assessing The Impacts

According to the NEMA regulations (2014), all the impact assessments should provide quantified scores which show the expected impact and those that will likely result from proposed activities. Significance scoring both assesses and predicts the environmental impacts through the evaluation of the following factors;

- probability of the impact,
- duration of the impact,
- extent of the impact, and
- magnitude of the impact.

The significance of those environmental impacts is then assessed by considering any proposed mitigations. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required. Each of the above impact factors has been used to assess each potential impact using ranking scales as detailed in Tables 6 and 7 below.

Table 5: Criteria for Assessment of Impacts.

Severity (Magnitude) The severity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment. The intensity is rated as:	
(I)nsignificant	The impact alters the affected environment in such a way that the natural processes or functions are not affected.
(M)oderate	The affected environment is altered, but functions and processes continue, albeit in a modified way.
(V)ery High	The function or process of the affected environment is disturbed to the extent that it temporarily or permanently ceases.
Duration The lifetime of the impact is measured by the lifetime of the proposed development.	
(T)emporary	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.
(S)hort term	The impact will be relevant through to the end of the construction phase (1.5–2 years).
(M)edium term	The impact will last up to the end of the development phases, where it will be entirely negated.
(L)ong term	The impact will continue or last for the entire operational lifetime i.e. exceed 30 years of the development but will be mitigated by direct human action or by natural processes thereafter.
(P)ermanent	This is the only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact is transient.
Spatial scale Classification of the physical and spatial scale of the impact	
(F)ootprint	The impacted area extends only as far as the activity, such as the footprint occurring within the total site area.
(S)ite	The impact could affect the whole, or a significant portion of, the site.
(R)egional	The impact could affect the area including the neighboring farms, the transport routes, and the adjoining towns.
(N)ational	The impact could have an effect that expands throughout the country (South Africa).
(I)nternational	Where the impact has international ramifications that extend beyond the boundaries of South Africa.
Probability This describes the likelihood of the impacts occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:	
(I)mprobable	The possibility of the impact occurring is none, due either to the circumstances, design, or experience. The chance of this impact occurring is zero (0 %).
(P)ossible	The possibility of the impact occurring is very low, due either to the circumstances, design, or experience. The chance of this impact occurring is defined as 25%.
(L)ikely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chance of this impact occurring is defined as 50%.
(H)ighly Likely	It is most likely that the impacts will occur at some stage of development. Plans must be drawn up before carrying out the activity. The chance of this impact occurring is defined as 75%.
(D)efinite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100%.

Table 6: Significance scoring used for each potential impact.

PROBABILITY	***DURATION***
1-very improbable *2-improbable* *3-probable* *4-high probable* *5-definite*	*1- very short duration (0-1years)* *2- short duration (2-5 years)* *3- medium term (5-15 years)* *4- long term (>15 years)* *5- permanent/unknown*
EXTENT	***MAGNITUDE***
1- Limited to the site *2- Limited to the local area* *3-Limited to the region* *4-National* *5-International*	*2- minor* *4- low* *6-moderate* *8-high* *10-very high*

The following formula was used to calculate impact significance:

Impact Significance: (Magnitude + Duration + Extent) x Probability)

The formula gives a maximum value of 100 points which are translated into 1 of 3 impact significance categories; Low, Moderate, and High as per Table 7 below.

Table 7: Impact significance ratings.

SIGNIFICANCE POINTS	**SIGNIFICANCE RATING**
0 - 30 points	Low environmental significance
31 - 59 points	Moderate environmental significance
60 -100 points	High environmental significance

Details of the significance of the various impacts identified are presented in Tables 8 and 9.

Determination of Significance – With Mitigation

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. The Significance Rating (SR) is determined as follows:

Significance Rating (SR) = (Extent + Intensity + Duration) x Probability

Identifying the Potential Impacts without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a value for each impact (before the implementation of mitigation measures). Significance without mitigation is rated on the following scale (Table 8):

Table 8: Significance Rating Scales without mitigation

SR < 30	Low (L)	Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
30 < SR < 60	Medium (M)	Where it could influence the decision unless it is mitigated. An impact or benefit which has important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
SR > 60	High (H)	The impact is significant, mitigation is critical in reducing the impact or risk. The resulting impact could influence the decision depending on the possible mitigation. An impact that could influence the decision about whether or not to proceed with the project.

Identifying the Potential Impacts with Mitigation Measures (WM)

To gain a comprehensive understanding of the overall significance of the impact, after the implementation of the mitigation measures, it will be necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale, Table 9.

Table 9: Significance Rating Scales with mitigation.

SR < 30	Low (L)	The impact is mitigated to the point where it is of limited importance.
30 < SR < 60	Medium (M)	Notwithstanding the successful implementation of the mitigation measures to reduce the negative impacts to acceptable levels, the negative impact will remain significant. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
SR > 60	High (H)	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance after mitigation could render the entire development option or entire project proposal unacceptable.

Baseline Assessment

The wetlands likely to be impacted were identified using the 'likelihood of impact' guidelines in Table 10.

Table 10: Qualitative 'likelihood of impact' ratings and descriptions.

Likelihood of Impact Rating	Description of Rating Guidelines
Definite	These resources are likely to require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within the footprint of the proposed development activity and will be impacted by the project; and/or ➢ ➢ resources located within 15m upstream and/or upslope of the proposed development activity and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ ➢ resources located within 15m or downslope of the development and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located downstream within the following parameters: ○ within 15m downstream of a low-risk development; ○ within 50m downstream of a moderate risk development; and/or ○ within 100m downstream of a high-risk development e.g. mining, large industrial land uses.
Likely / Possible	These resources may require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within 32m but greater than 15m upstream, upslope, or downslope of the proposed development; and/or ➢ resources located within a range at which they are likely to incur indirect impacts associated with the development (such as water pollution, sedimentation, and erosion) based on development land use intensity and development area. This is generally resources located downstream within the following parameters: ○ within 32m downstream of a low-risk development; ○ within 100m downstream of a moderate-risk development; and/or ○ within 500m downstream of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high-risk developments or

	developments that have extensive water quality and flow impacts e.g. dams/abstraction and treatment plants).
Unlikely	These resources are unlikely to require impact assessment or Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located a distance upstream, upslope, or downslope (>32m) of the proposed development and which are unlikely to be impacted by the development project; and/or ➢ resources located downstream but well beyond the range at which they are likely to incur impacts associated with the development (such as water pollution, sedimentation, and erosion). This is generally resources located downstream within the following parameters: ○ greater than 32m downstream of a low-risk development; ○ greater than 100m downstream of a moderate-risk development; and/or ○ greater than 500m downstream of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high-risk developments or developments that have extensive water quality and flow impacts e.g. dams/abstraction and treatment plants).
None	These resources will not require impact assessment or a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within another adjacent sub-catchment, and which will not be impacted by the development in any way, shape, or form.

12. Results

Assessment results

PRESENT ECOLOGICAL STATUS (PES)

The PES of the wetland system identified in the area is **Moderate, with a PES score of 4-5, Category D,** Table 11. This implies that the wetland system (Figure 5) has been largely modified.

A large change in ecosystem processes and loss of natural habitat and biota has occurred, but some remaining natural habitat features (water and vegetation) are still recognizable with the local ecological role provided. The area and the wetland lost most of their natural habitats due to urbanization. Some of the attributes used to guide and assess the wetland's integrity, are indicated on Table 12 below.

Table 11:Health categories used by WET-Health for describing the integrity of wetlands (Macfarlane *et al*, 2007).

Description	**Impact Score Range**	**PES Score**	**Summary**
Unmodified, natural.	0.0.9	A	Very High
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B	High
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	C	Moderate
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D	Moderate
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E	Low
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.10	F	Very Low

Table 12: Habitat integrity assessment criteria for wetlands (Dickens, *et al*, 2003; DWAF, 1999) such as adapted from Kleynhans (1996).

Criteria & Attributes	**Relevance**
Hydrologic	

Criteria & Attributes	Relevance
Flow Modification	A consequence of abstraction, regulation by impoundments, or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, and velocity affect the inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.
Permanent Inundation	A consequence of impoundment destroying the natural wetland habitat and cues for wetland biota.
Water Quality	
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements, and industrial activities. Aggravated by the volumetric decrease in flow delivered to the wetland.
Sediment Load Modification	Reduction due to entrapment by dams or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.
Hydraulic/Geomorphic	
Canalisation	Results in desiccation or changes to inundation patterns of wetlands and thus changes in habitats. River diversions or drainage.
Topographic Alteration	A consequence of infilling, plowing, dykes, trampling, bridges, roads, railway lines, and other substrate disruptive activities that reduce or change wetland habitat directly in inundation patterns.
Biota	
Terrestrial Encroachment	Desiccation of wetlands and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing, or firewood collection affects wildlife habitat and flow attenuation functions, organic matter inputs, and increases the potential for erosion.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Overuse of Biota	Overgrazing, overfishing, etc.

Scoring guidelines per attribute:

natural, unmodified = 5;

Largely natural = 4,

Moderately modified = 3;

Largely modified = 2; - Category D*; largely modified, largely loss of natural habitat and basic ecosystem function has occured*

seriously modified = 1;

Critically modified = 0.

Relative confidence of score:

Very high confidence = 4;

High confidence = 3;

Moderate confidence = 2;

Marginal/low confidence = 1.

Ecological Importance and Sensitivity (EIS)

This section indicates the results of the Ecological Importance and Sensitivity (EIS) assessment. Also, the Ecological Importance (EI) which is the expression of how important the wetland is, in terms of its maintenance of biological diversity and ecological functioning at a local/regional and landscape level, (Kotze *et al*., 2020) was determined. Ecological Sensitivity refers to the ecosystem's fragility or the ability to resist or recover from a disturbance, (Kotze *et al*., 2020).

The wetland system was assessed as being **Moderate** (*Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers, DWAF, 1999*) for Ecological Importance and Sensitivity (EIS) driven by the current impacts and conditions, on the local footprint, Table 13.

These impacts are asa result of urbanization and other human activities in the area. The most proportion of the area has lost natural areas. Transformation of the areas has led to the introduction of invasive alien plants. The natural integrity of the wetland system for ecological importance is compromised and impacted to a minimum.

In this regard, there is a great possibility of sedimentation into the wetland, to some certain extent. The study suggests that the wetland system is not sensitive to the proposed pipeline construction, considering that all activities shall be taken in areas that are already modified. The importance of the wetland system is at the regional level and contributes to the local preservation of main birds and other small aquatic biotas.

Table 13: Environmental Importance and Sensitivity rating scale used for the estimation of EIS scores (DWAF, 1999).

Ecological Importance and Sensitivity Categories	Rating
Very High Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in major rivers	>3 and <=4
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers	>2 and <=3
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers	>1 and <=2
Low/Marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers	>0 and <=1

There are two wetland types (Table 14) that were identified on site which cover an area of 1.42 ha.

A 32m buffer around the edge of the wetland system should be applied and no machinery should be parked within the buffer (Figure 6).

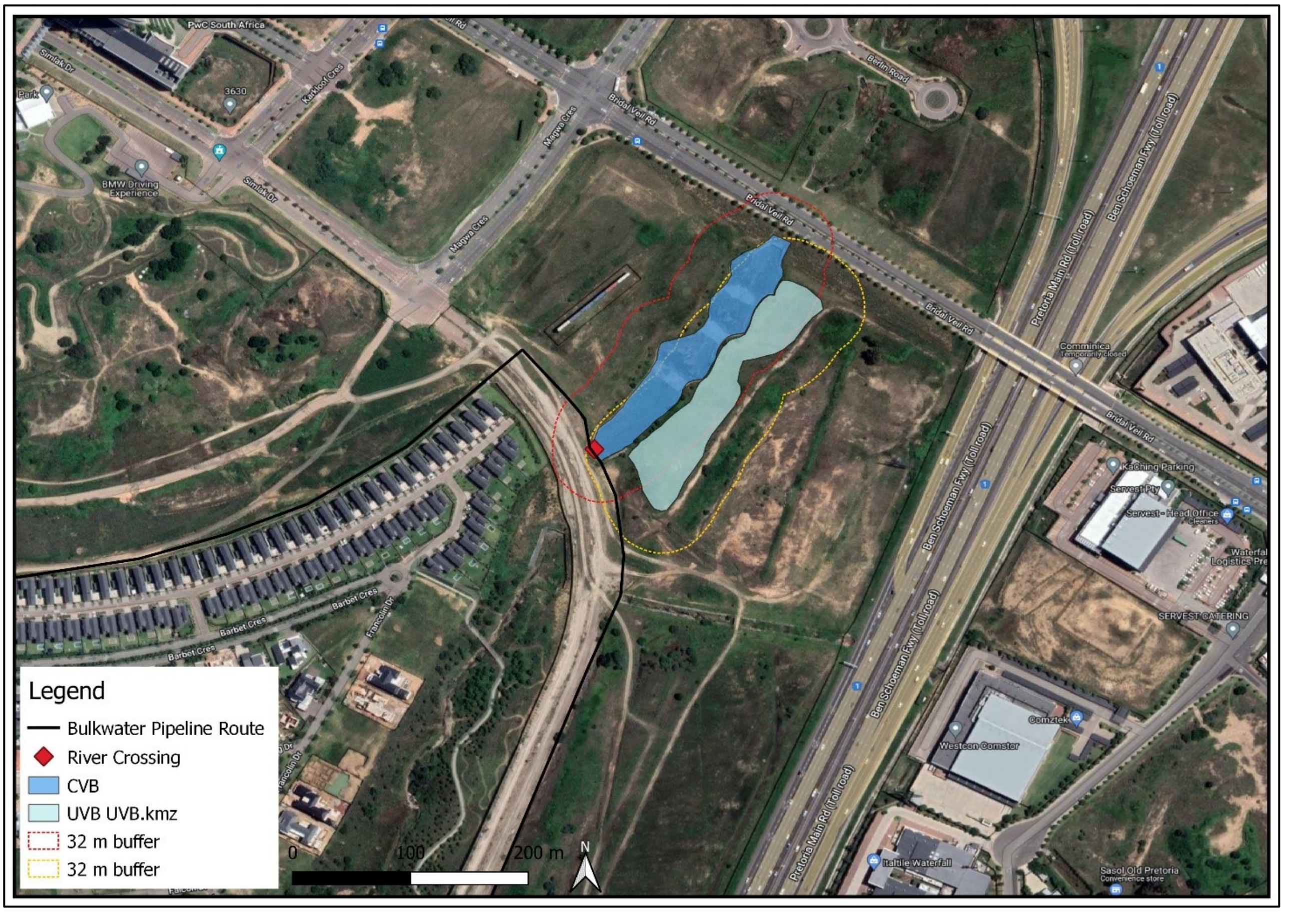


Figure 6: Delineated wetlands on site.

Vegetation and plants

The area falls within the Egoli Granite Grassland of the Highveld Grassland Biome (Figure 7). Species such as sedges (*Cyperus denudatus*) and reeds (*Phragmites australis*) are wetland species but can also be facultative species (occur even outside wetlands and in disturbed areas).

For this project, the natural vegetation associated with the wetlands was largely modified and transformed as a result of the existing housing development in close proximity and associated access roads. However, this is expected in urban settings.

.

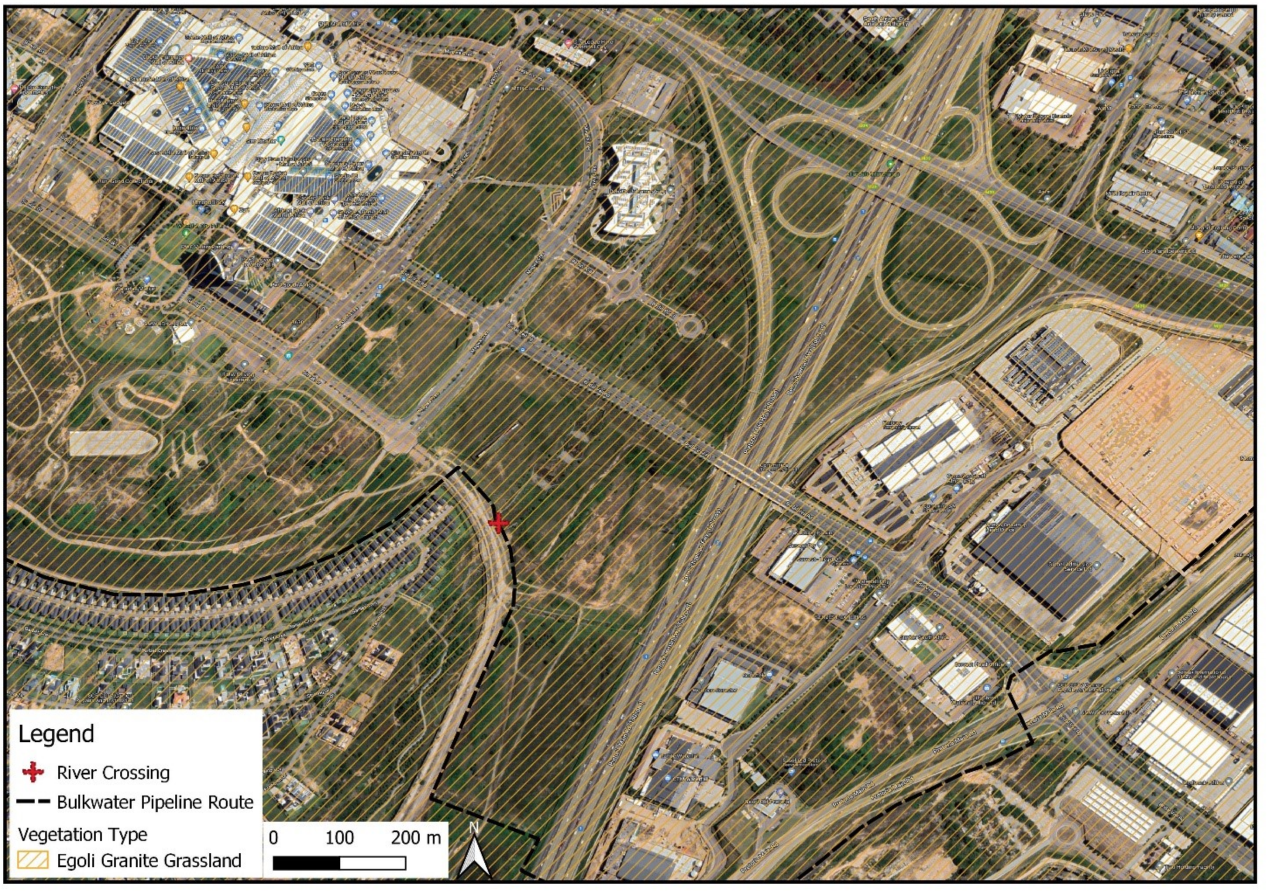


Figure 7: Vegetation type of the study area.

Gauteng Conservation Plan

According to the C-Plan, the site falls within an Important Area (Figure 8). However, ground-truthing revealed that the majority of the Important Area has been permanently transformed by housing, roads, and business development.

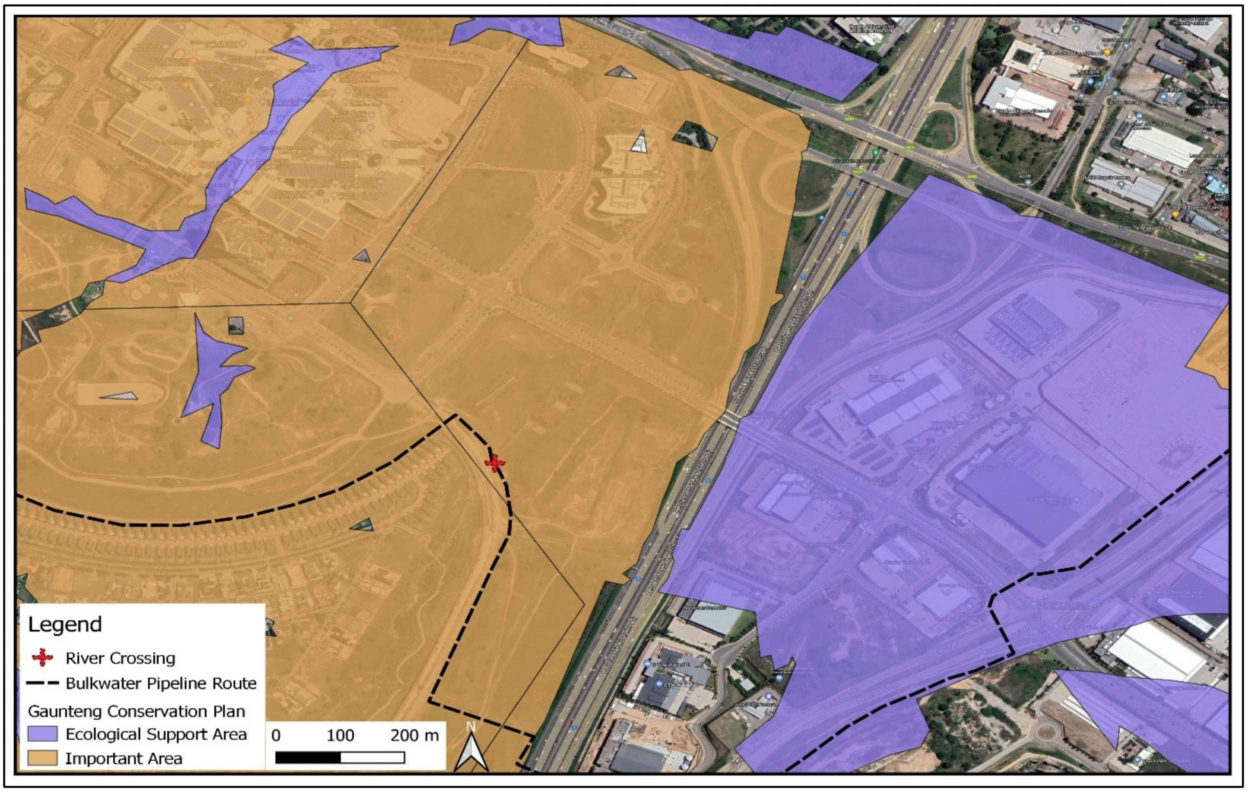


Figure 8: Conservation priority areas as classified by the Conservation Plan of Gauteng Province.

Table 14 below shows the type of wetlands present in the area as highlighted in green. These are channeled valley bottom and unchanneled valley bottom.

Table 14: Wetland hydro-geomorphic types typically support inland wetlands in South Africa.

Hydro-geomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
Floodplain	Valley bottom areas with a well-defined stream channel, gently sloped & characterised by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.	***	*/***

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 characterised by alluvial sediment deposition, generally leading to accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/***
Hillslope seep with stream channel	Slopes on hillsides which are characterised by colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***
Isolated hillslope seepage	Slopes on hillsides which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes pans)	A basin shaped area with a closed elevation contour that allows for accumulation of surface water (i.e., it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/***	*/***

[1] Precipitation is an important water source and evapotranspiration an important output

Water source:

* Contribution usually small

** Contribution usually large

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

Table 15 below, gives details and a description of the PES scores and their interpretation. This is to guide and assist in the interpretation of how the wetlands were scored following their assessment. Also, the wetlands were found to be moderately modified.

Table 15: Relation between scores given and ecological categories.

Scoring Guidelines	Interpretation of Mean* of Scores: Rating of Present Ecological Status Category (PESC)
Natural, unmodified - score=5	Within general acceptable range. CATEGORY A >4; Unmodified or approximates natural condition.
Largely natural - score=4	CATEGORY B >3 and <4; Largely natural with few modifications, but with some loss of natural habitats

Moderately modified score=3.	CATEGORY C >2 and <3; moderately modified, but with some loss of natural habitats.
Largely modified - score=2.	CATEGORY D <2; largely modified. Large loss of natural habitat & basic ecosystem function has occurred. OUTSIDE GENERALLY ACCEPTABLE RANGE
Seriously modified - rating=1	CATEGORY E >0 and <2; seriously modified. Losses of natural habitat & ecosystem function are extensive.
Critically modified - rating=0.	CLASS F 0; critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

13. IMPACT DESCRIPTION, ASSESSMENT, AND MITIGATION

Any development activity in a natural system will have an impact on the surrounding environment, usually in a negative way. It is vitally important for any development to happen or recommended to take place in areas that are already fragmented or modified, (Edwards, *et al*., 2018).

Table 16 are some of the significance of the impacts that may occur as a result of the proposed activities and a description of the mitigation required to limit the identified negative impacts on the wetlands.

The potential impacts and risks of the proposed bulk water pipeline are considered to be very low and have minimal impact on the wetland system.

1.1. Pollution of surrounding waterbodies and soil/hydropedological formation

Table 16: Impacts associated with the activities

Impacts associated with soil erosion and sedimentation										
Potential impact	Probability		Duration		Extent		Magnitude		Significance scoring without mitigation	Significance scoring with mitigation
	Without	With	Without	With	Without	With	Without	With		
Construction Phase										
Disturbance to or loss of the waterbodies and soil/hydropedological formation	3	2	5	5	2	1	6	4	39 (Moderate)	24 (Low)

<u>Description of the impact</u>

Sediment release and discharge into aquatic ecosystems are one of the most common forms of waterborne pollution.. Such pollutants, include hydrocarbons and other hazardous chemicals which have the potential to pollute sensitive natural aquatic environments. These pollutants will enter the systems either directly through surface runoff during rainfall events, or subsurface water movement during soil erosion. Soil erosion is one of the natural processes which contribute to sedimentation. The probability of this impact is moderate during the construction phase of the project.

Mitigation Options

- Waste disposal during the construction phase must ensure no litter or other contaminants on site are deposited in the wetland system or remaining natural areas.
- The ECO must be notified of any spills or leakages in these sections. These spills/leaks should be treated with hydrocarbon-degrading bacteria (products such as or similar to biologX or Oil Spill Gobbler™).
- Spillages of fuels, oils, and other potentially harmful chemicals must be cleaned up immediately and contaminants properly drained and disposed of using proper solid/hazardous waste facilities. Any contaminated soil must be removed, and the affected area rehabilitated immediately.

1.2. Soil erosion, sedimentation, and degradation

Impacts associated with soil erosion and sedimentation										
Potential impact	Probability		Duration		Extent		Magnitude		Significance scoring without mitigation	Significance scoring with mitigation
	Without	With	Without	With	Without	With	Without	With		
Construction Phase										
Degradation of waterbodies	3	2	5	4	2	1	5	5	40 (Moderate)	22 (Low)

Description of impact

Excavations and vegetation clearing expose soil to environmental factors including rainfall and wind. Exposure to these factors will result in the removal of topsoil and the deposition of this sediment in the downslope watercourse system. This increased high-suspended particulate matter within the watercourse can accumulate particularly during the summer months leading to the sedimentation of this system.

However, the proposed site has less natural vegetation to clear except for the local green parks which may not be affected. Landscaping of the area on the sites of the roads and open spaces contributes to the great spread proportion of invasive alien plants. Chances of erosion are likely to happen during construction phase and this will result in sedimentation into the water bodies. This will pose a further risk to the functional integrity of the water resource system, reducing its ecological integrity.

Mitigation Options

- Soil erosion measures and plans should be in place from the onset of the project.
- Activities of the project be restricted only on the project site and avoid trampling of the outside areas
- Where possible, if natural vegetation is removed an immediate recovery or replanting of the vegetation should be implemented.
- Attenuation of stormwater from the development site is important to reduce the velocity of runoff. Management of the current stormwater should be managed accordingly with the newly developed one if any.

14. Conclusion and recommendations

Desktop and field assessment revealed that the wetland has been subjected to continuing anthropogenic activities from urbanization. The ecological significance of the wetland is moderate but may contribute to the local footprint by providing foraging and breeding habitats for migratory and seasonal species.

The ecological importance of these is regarded as moderate due to the ongoing urbanization and human activities. The impact of the development is expected to be local (small footprint) with minimal destruction to the wetland.

The proposed upgrade is likely to have minimum impact on the wetland. A 32m buffer around the wetland shall be a barrier to prevent undesired activities. However, all indirect and direct impacts to the wetlands shall be managed accordingly to allow a natural flow of surface water that will maintain the wetland current status. Considering all the gathered information, it is recommended that the rehabilitation plan which will include erosion control be developed to respond to any impact caused.

- Before the commencement of any construction activities, the outer edge of the approved construction footprint must be staked out by a surveyor and demarcated using brightly-colored shade cloth.
- All foreign and toxic materials must be removed from the site and managed accordingly.
- Any portion of land cleared off of vegetation must be regraded/ re-shaped/rejuvenated and topsoils must be reinstated.
- Compacted soils must be adequately ripped/loosened where compacted, as informed by the ECO.
- Topsoil should be pilled and reinstated back to where possible to recover the areas back to nature.

It is the specialist's opinion, based on the experience, knowledge and evidence shown in this report, that this proposed development be considered.

15. References

Acocks, J.P.H. 1988. *Veld types of South Africa.* 3rd ed. Memoirs of the Botanical Survey of South Africa 57: 1–146.

Barnes, K.N. 2000. *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland.* Birdlife South Africa, Johannesburg.

Brown, L.R., and Cook, C.L. 2015. PRELIMINARY ECOLOGICAL HABITAT ASSESSMENT FOR THE PROPOSED SASOL CHARLIE 1 OPTIMISATION AND STORMWATER MANAGEMENT PROJECT, SECUNDA; MPUMALANGA PROVINCE

Cherry, J. A. 2011. Ecology of Wetland Ecosystems: Water, Substrate, and Life. *Nature Education Knowledge* 3(10):16

Department of Water Affairs and Forestry (DWAF). 1999. Resource Directed Measures for Protection of Water Resources; Volume 4: Wetland Ecosystems; Version 1.0. Department of Water Affairs and Forestry, Pretoria. Pp. W4/1-W4/6.

DWAF (Department of Water Affairs and Forestry). 2005. A practical field procedure for identification and delineation of wetland and riparian areas. DWAF, Pretoria.

Department of Water Affairs and Forestry (DWAF). 2007. Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channeled valley bottom wetland types. RQS Report No.N/0000/00/WEI/0407. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria.

DWAF. 2008. Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas, prepared by M. Rountree, A. L. Batchelor, J. MacKenzie, and D. Hoare. Report no. XXXXXXXXX. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa

Edwards, R., Macfarlane, D., Robinson, K., Israel, A., de Groen, M., and Dunsomore, S. 2018. Wetland Management Guidelines: Building Capacity and Supporting Effective Management of Wetlands within South African Municipalities

Eco-Pulse. 2018. ICLEI Wetland Management Guidelines: Building Capacity and Supporting effective management of wetlands within South African municipalities. *Preliminary Version.*

FERRAR, A. F. and LOTTER, M. C. 2007. Mpumalanga Biodiversity: Conservation Plan Handbook. Mpumalanga Tourism and Park Agency, Scientific services. Mpumalanga Provincial Government, Nelspruit. 2007

Kotze, D.C., Marneweck, G.C., Batchelor, A.L., Lindley, D.S. & Collins, N.B. 2007. Wet EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands, WRC Report No. TT 339/09, Water Research Commission, Pretoria.

KOTZE, D.C., ELLERY., W.N., MACFARLANE, D, M., and JEWITT, G.P.W. 2012. A rapid assessment method for coupling anthropogenic stressors and wetland ecological condition. Ecological Indicators 13, 284-293.

Low, A.B. & Rebelo, A.G. (Eds.) 1996. Vegetation of South Africa, Lesotho, and Swaziland. Pretoria: Department of Environmental Affairs and Tourism.

Macfarlane, D., Kotze, D., Ellery, W., Walters, D., Koopman, V., Goodman, P., and Goge, C. 2007. WET-Health: A technique for rapidly assessing wetland health. WRC Report No. TT 340/08. Water Research Commission, Pretoria.

Macfarlane, D.M., Lagese, J.V., Ollis, D., Du Toit, D., and Pollard, S. 2021. National Wetland Management Framework for South Africa. Report prepared for the Departments of Environment, Fisheries and Forestry, Water and Sanitation and Agriculture, Land Reform, and Rural Development. Report No. EP510-05. November 2021.

Mucina, L. & Rutherford, M.C. eds. 2006. *The vegetation of South Africa, Lesotho, and Swaziland*. Strelitzia 19. Pretoria: South African National Biodiversity Institute. 807 p.

Nel, J.L., Driver A., Strydom, W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J., Nienaber, S., van Deventer, H., Swartz, E. and Smith-Adao, A.B. (2011). ATLAS of FRESHWATER ECOSYSTEM PRIORITY AREAS in South Africa: Maps to support the sustainable development of water resources. Report to the WRC. No. TT 500/11.

Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.

Ollis, D.J and Malan, H.L. 2014. Volume 1: Review of available methods for the assessment of the ecological condition of wetlands in South Africa (Water Research Commission) Report No. TT 608/14).

Pospescu, V.D., Rozylowicz, L., Niculae, I.M., Cucu, A.L. and Hartel, T. 2014. Species, Habitats, Society: An Evaluation of Research Supporting E.U.'s Natura 2000 Network. PLoS ONE 9(11): e113648. doi:10.1371/journal.pone.0113648

SANBI. 2013. Grasslands Ecosystem Guidelines: landscape interpretation for planners and managers. Compiled by Cadman, M., de Villiers, C., Lechmere-Oertel, R. and D. McCulloch. South African National Biodiversity Institute, Pretoria. 139 pages.

SANBI. 2014. Grazing and Burning Guidelines: Managing Grasslands for Biodiversity and Livestock Production. Compiled by Lechmere-Oertel, R.G. South African National Biodiversity Institute, Pretoria. 42 pages

SANBI. 2020. Statistics: Red List of South African Plants version 2020.

Schoeman, F., Newby, T.S., Thompson, M.W. and Van den Berg, E.C. 2013. South African National Land-cover Change Map. *South African Journal of Geomatics* 2:94-105.

Taylor, M.R., Peacock, F. & Wanless, R.M. 2015 (eds.). *The Eskom Red Data Book of Birds of South Africa, Lesotho, and Swaziland*. Johannesburg: Birdlife South Africa.

van Oudtshoorn, F. 2012. *Guide To Grasses Of Southern Africa.* Pretoria, Briza Publications

Walters, D., Kotze, D.C., Rebelo, A., Pretorius, L., Job, N., Lagesse, J.V., Riddell, E., and Cowden, C. 2021. Validation of a rapid wetland ecosystem services assessment technique using the Delphi method. *Ecological Indicators 125*

Whittington-Jones, C.A. and Peacock, F. 2015. African Grass Owl *Tyto capensis*. In: **Taylor, M.R., Peacock, F. & Wanless, R.M. (eds.)**. *The 2015 Eskom Red Data*

Book of Birds of South Africa, Lesotho, and Swaziland. Johannesburg: BirdLife South Africa, pp. 240-242.

Wright, D.R., Stevens, C.M.D., Marnewick, D., and Mortimer, G. 2018. Privately Protected Areas and Biodiversity Stewardship in South Africa: Challenges and Opportunities for Implementation Agencies. Parks Volume 24.2 November 2018.