Freshwater Ecology Assessment for the proposed Harmony Mispah 1 TSF Reclamation and Proposed Pipelines Project

North-West Province and Free State Province, South Africa

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CLIENT

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1 Introduction

1.1 Background

The Biodiversity Company (TBC) was appointed to undertake a freshwater ecology assessment for the proposed Harmony Mispah 1 TSF Reclamation and Proposed Pipeline project.

Mine Waste Solutions (MWS), also known as Chemwes (Pty) Ltd (Chemwes), a subsidiary of Harmony Gold Mining Company, been in business since 1964, and conducts its operations over a large area of land to the east of Klerksdorp, within the area of jurisdiction of the City of Matlosana and JB Marks Local Municipalities (LM), which fall within the Dr Kenneth Kaunda District Municipality (DM) in the North-West Province.

MWS want to expand their reclamation activities to the Mispah 1 TSF through the construction of a reclamation pump station and installation of additional piping infrastructure to meet the planned Life of Mine (LOM) plan. The planned infrastructure will include a new process water and slurry pipeline and reclamation pump station.

In order to assess the baseline ecological state of the area and to present a detailed description of the receiving environment, a desktop assessment as well as a field survey was conducted during December 2022. Both levels of assessment entailed the detection, identification, and description of any locally relevant water resources. Furthermore, the manner in which these sensitive features may be affected by the proposed development was also investigated. A 500 m radius around of the proposed activities, which is the suggested regulation area for the identification of water resources in terms of the proposed project, has been demarcated and is referred to hereafter as the Project Area of Influence (PAOI).

This assessment was conducted in accordance with the amendments to the Environmental Impact Assessment Regulations, 2014 (No. 326, 7 April 2017) of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998). The approach has taken cognisance of the recently published Government Notice 320 in terms of NEMA dated 20 March 2020 as well as the Government Notice 1150 in terms of NEMA dated 30 October 2020: "Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation".

This assessment has also been completed in accordance with the requirements of the published General Notice (GN) 509 by the Department of Water and Sanitation (DWS). This notice was published in the Government Gazette (no. 40229) under Section 39 of the National Water Act (Act no. 36 of 1998) in August 2016, for a Water Use Licence (WUL) in terms of Section 21(c) & (i) water uses. The GN 509 process provides an allowance to apply for a WUL for Section 21(c) & (i) under a General Authorisation (GA), as opposed to a full Water Use Licence Application (WULA). A water use (or potential) qualifies for a GA under GN 509 when the proposed water use/activity is subjected to analysis using the DWS Risk Assessment Matrix (RAM). This assessment will implement the RAM and provide a specialist opinion on the appropriate water use authorisation.

The purpose of conducting the specialist study is to provide relevant input into the overall Environmental Authorisation application process, with a focus on the proposed project activities and their associated impacts. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Registered Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making as to the ecological viability of the proposed project.

1.2 Project description

The infrastructure planned is a new 600 mm slurry- and 500 mm low-pressure process water pipelines of almost 9 km from the East Pump Station to the Mispah 1 TSF Reclamation Pump Station, as shown in Figure 1-1. Both the slurry and process water pipeline to cross the Vaal River at Noligwa Bridge.

The slurry pipeline will be a flanged 600 mm NB steel pipeline with a concrete mortar or HDPE lining and flow rate of 472 L/s. The section across the Vaal River will be a continuous welded pipe with HDPE liner. While the low-pressure process water pipeline will be a flanged 500 mm NB steel pipeline and flow rate of 337 L/s. Both pipes will be installed on surface on prefabricated concrete plinths.

Figure 1-1 Figure illustrating the pipeline layout for the Mispah Reclamation Project

A new slurry reclamation pump station will be constructed west of the Mispah 1 TSF as shown in Figure 1-2. The area cleared for the pump station will be ~ 4 ha and consist of a series of slurry and high-pressure water pumps and associated infrastructure. The liquefied slurry from the TSF gravitate to the pump station where it is pumped to MWS processing plant, in Stilfontein, via the East pump station. From the East pump station, the slurry is pumped through the existing pipelines to MWS processing plant to extract gold before the tailings is disposed at Kareer and TSF. The pipelines will predominately follow existing pipeline corridors and vegetation clearance will be minimum.

A 100 mm NB potable waterline and 150 mm NB sewage line will also be installed to the reclamation pump station. The sewage from the change house and ablution will be pumped to the Moab Khotsong sewage work's as shown in Figure 1-2. The sewage pipeline will be flanged steel pipeline and installed above-ground on pre-cast concrete plinths and a 3.5 m wide access road, adjacent to the pipelines, will be cleared/graded to provide access for construction, maintenance and inspections.

Figure 1-4 illustrates the project area, which was delineated by creating a 50 m buffer on either side of the proposed pipeline and incorporates the Mispah 1 Reclamation Site where the pump station is to be constructed. Figure 1-3 illustrates the regional context of the proposed project area.

Figure 1-2 Figure showing the reclamation site and associated infrastructure

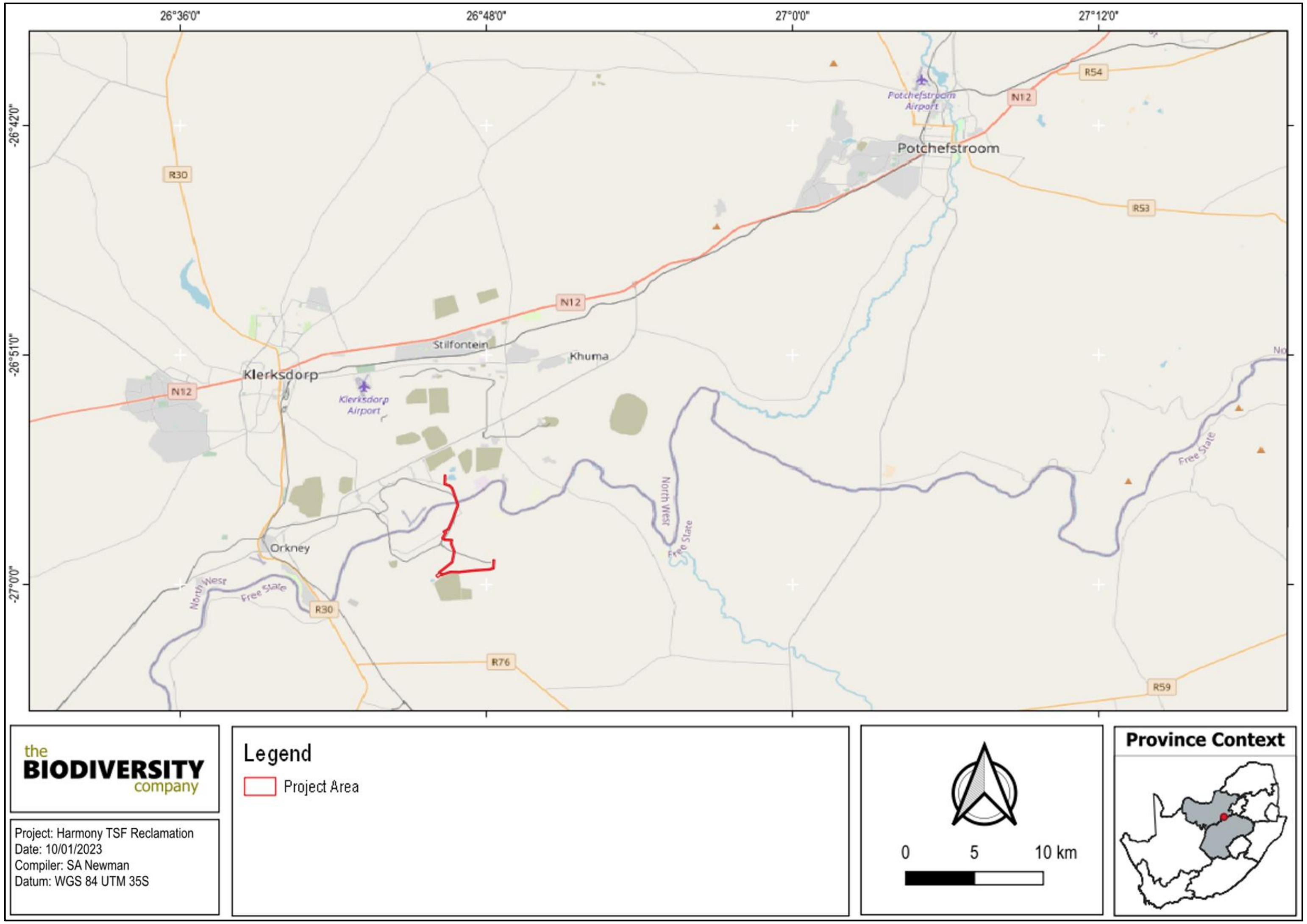

Figure 1-3 Map illustrating the regional context of the project area

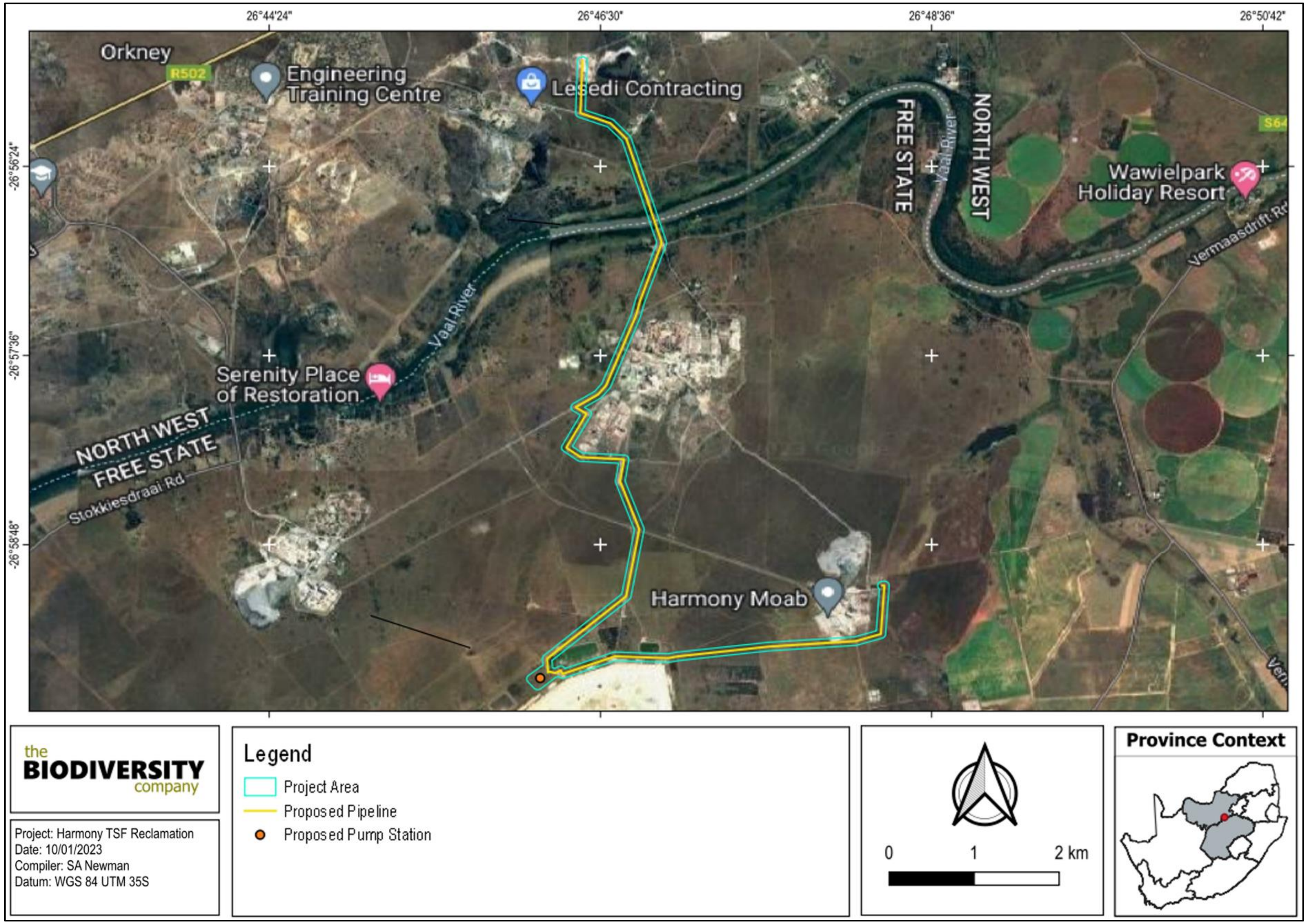

Figure 1-4 Map illustrating the project area which is made up of a 50 m buffer around the proposed pipeline

1.3 Specialist Details

Report Name	**Freshwater Ecology Assessment for the Proposed Harmony Mispah 1 TSF Reclamation and Proposed Pipelines Project**
Reference	**Harmony Mispah 1 TSF Reclamation**
Submitted to	EIMS Environmental Impact Management Services
Report Writer & Fieldwork	**Rian Pienaar**
	Rian Pienaar is an aquatic ecologist (Cand. Sci. Nat. 135544) with experience in wetland identification and delineations. Rian completed his M.Sc. in environmental science at the North-West University Potchefstroom Campus. Rian has been part of wetland studies for road and culvert upgrades, power station and dam construction.
Reviewer	**Andrew Husted**
	Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 13 years' experience in the environmental consulting field.
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

1.4 Terms of Reference

The following tasks were completed in fulfilment of the terms of reference for this assessment:

- The delineation, classification and assessment of wetlands within 500 m of the project area;
- Conduct risk assessments relevant to the proposed activity;
- Recommendations relevant to associated impacts; and
- Report compilation detailing the baseline findings.

1.5 Key Legislative Requirements

1.5.1 National Water Act (NWA, 1998)

The DWS is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998) (NWA) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means;

- A river or spring;

- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

1.5.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

2 Methods

A single wetland site visit was conducted on the 8th and the 9th of December 2022, constituting a wet season survey.

2.1 Identification and Mapping

The wetland areas were delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 2-1. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
    - The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

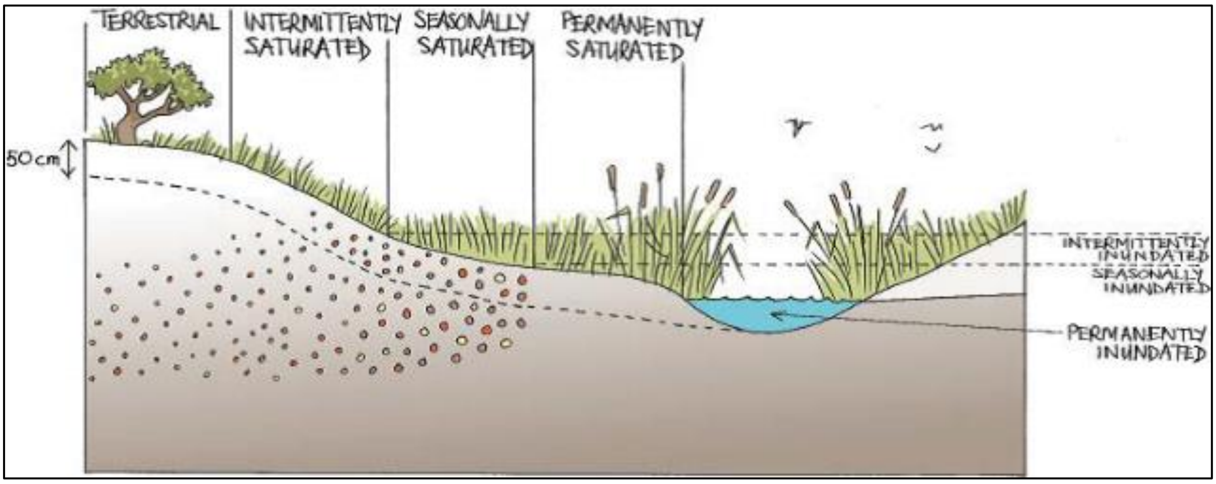

Figure 2-1 ***Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al. 2013)***

2.2 Delineation

The wetland indicators described above are used to determine the boundaries of the wetlands within the project area. These delineations are then illustrated by means of maps accompanied by descriptions.

2.3 Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands as well as humans. Eco Services serves as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al*. 2008). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 2-1).

Table 2-1 ***Classes for determining the likely extent to which a benefit is being supplied***

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

2.4 Present Ecological Status

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The Present State categories are provided in Table 2-2.

Table 2-2 The Present Ecological Status categories (Macfarlane, et al., 2008)

Impact Category	Description	Impact Score Range	PES
None	Unmodified, natural	0 to 0.9	A
Small	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.	1.0 to 1.9	B
Moderate	Moderately Modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2.0 to 3.9	C
Large	Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	D
Serious	Seriously Modified. The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	6.0 to 7.9	E
Critical	Critical Modification. The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.0 to 10	F

2.5 Importance and Sensitivity

The importance and sensitivity of water resources is determined to establish resources that provide higher than average ecosystem services, biodiversity support functions or are particularly sensitive to impacts. The mean of the determinants is used to assign the Importance and Sensitivity (IS) category as listed in Table 2-3.

Table 2-3 Description of Importance and Sensitivity categories

IS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

2.6 Ecological Classification and Description

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this study. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and then also includes structural features at the lower levels of classification (Ollis *et al.,* 2013).

2.7 Buffer Requirements

The "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries" (Macfarlane *et al.,* 2014) was used to determine the appropriate buffer zone for the proposed activity.

2.8 Assumptions and Limitations

The following assumptions and limitations are applicable for this assessment:

- The focus area was based on the spatial files provided by the client and any alterations to the area and/or missing GIS information would have affected the area surveyed;
- Only the outline area of the proposed site was provided to the specialist;
- The ecological integrity of the Vaal River and associated riparian area has been determined using the methodology presented herein; and
- The GPS used for the survey has a 5 m accuracy and therefore any spatial features may be offset by 5 m.

3 Results and Discussion

3.1 Desktop Baseline

3.1.1 Vegetation Type

The project area is situated within the grassland biome. This biome is centrally located in southern Africa, and adjoins all except the desert, fynbos and succulent Karoo biomes (Mucina & Rutherford, 2006). Major macroclimatic traits that characterise the grassland biome include:

a) Seasonal precipitation; and
b) The minimum temperatures in winter (Mucina & Rutherford, 2006).

The grassland biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. The topography is mainly flat and rolling but includes the escarpment itself. Altitude varies from near sea level to 2 850 m above sea level.

Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. The grassland biome experiences summer rainfall and dry winters with frost (and fire), which are unfavourable for tree growth. Thus, trees are typically absent, except in a few localized habitats. Geophytes (bulbs) are often abundant. Frosts, fire and grazing maintain the grass dominance and prevent the establishment of trees.

The project area is situated within the Vaal Reefs Dolomite Sinkhole Woodland and Vaal-Vet Sandy Grassland vegetation types of this biome (Figure 3-1).

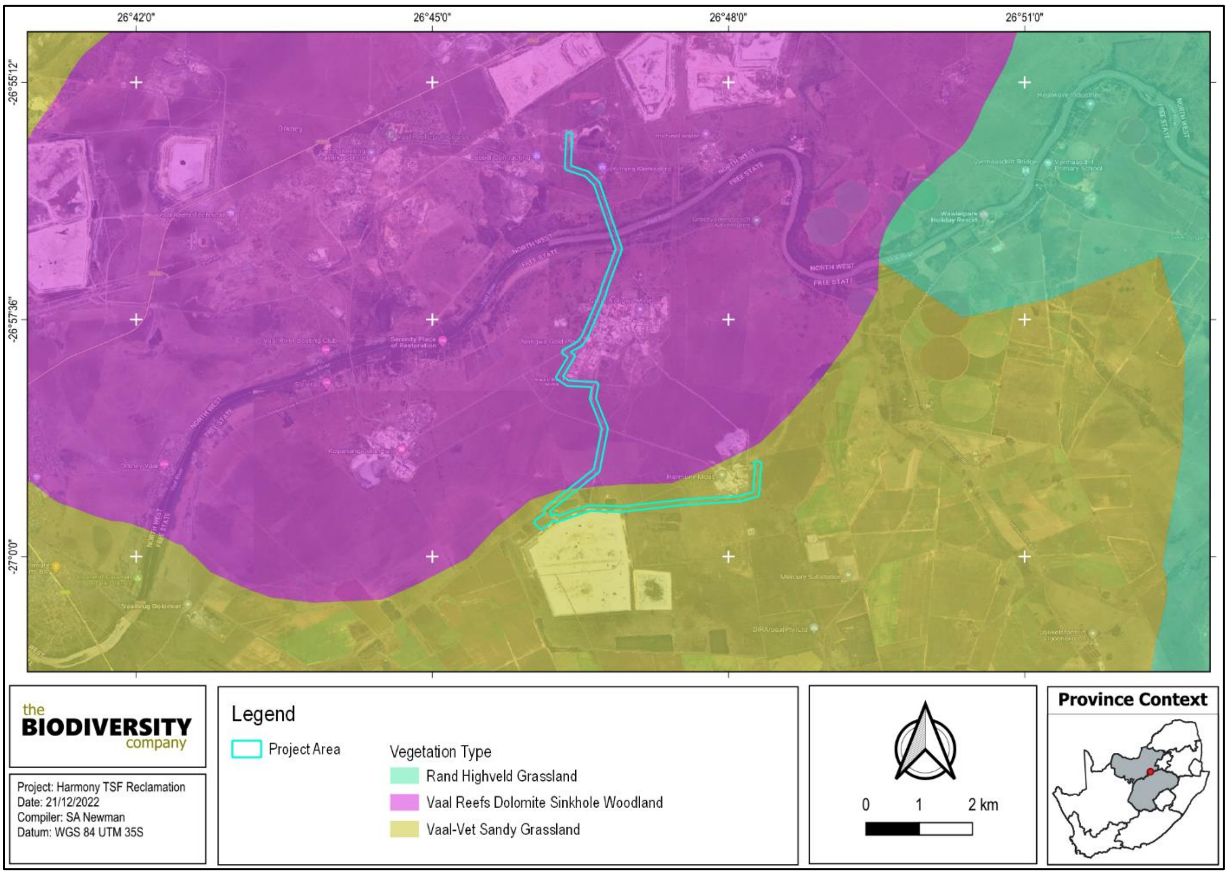

Figure 3-1 Map illustrating the vegetation types associated with the region

3.1.1.1.1 Vaal Reefs Dolomite Sinkhole Woodland

This vegetation type is a slightly undulating landscape dissected by prominent rocky chert ridges and supporting grassland-woodland vegetation complex. It is a small area associated with dolomite sinkholes in and around Stilfontein and Orkney (Vaal Reefs). The characteristic vegetation feature is woodland, which naturally occurs in clumps around sinkholes, especially in places of dolomite outcrops.

Conservation status

This vegetation type is classified as Vulnerable according to Mucina and Rutherford (2006). The conservation target for this vegetation type is 24% with only a small portion statutorily conserved around the Sterkfontein Caves. The proposed 'Highveld National Park' is supposed to conserve a considerable area of this vegetation unit. Almost a quarter has already been transformed, predominantly by mining, cultivation, urban sprawl and roadbuilding.

3.1.1.1.2 Vaal-Vet Sandy Grassland

This vegetation type is a plains-dominated landscape with some scattered, slightly undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element occurs here. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall (Mucina & Rutherford, 2006).

Conservation status

This vegetation type is classified as Endangered according to Mucina and Rutherford (2006). The conservation target for this vegetation type is 24% with only 0.3% statutorily conserved in the Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves. More than 63%has been transformed for cultivation (ploughed for commercial crops) and the rest under strong grazing pressure from cattle and sheep.

3.1.2 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by two land types namely Fa 13 and Bd 13. The Fa land type is characterised by Glenrosa and/or Mispah soil forms which are common in this area, however, other soils may occur. Lime is rare or absent throughout the entire landscape. The Bd land type consists of plinthic catena as well as upland duplex and margalitic soils which rarely occur. Eutrophic, red soils are not widespread without the project area.

The geology of this area is characterised by aeolian and colluvial sand which overlies mudstone, sandstone and shale of the Karoo Supergroup. Older Ventersdorp Supergroup basement gneiss and andesite is located to the north. Soil forms associated with the project area includes the Bd, Bc, Ae and Ba land types, which correlates with the findings from the land type database (Mucina and Rutherford, 2006).

3.1.3 Climate

This region is characterised by a warm-temperate summer rainfall climate with the average annual precipitation being approximately 530 mm (see Figure 3-2). High summer temperatures are common for this region with severe frost occurring throughout the winter (on average 37 days per year) (Mucina & Rutherford, 2006).

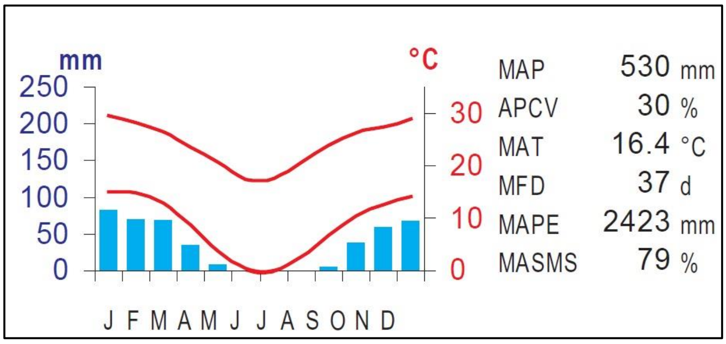

Figure 3-2 Climate for the Vaal-Vet Sandy Grassland (Mucina & Rutherford, 2006)

3.1.4 South African Inventory of Inland Aquatic Ecosystems

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) wetland dataset is a recent outcome of the National Biodiversity Assessment (NBA, 2018) and, was a collaborative project by the South African National Biodiversity Institute (SANBI) and the Council for Scientific and Industrial Research (CSIR). The SAIIAE dataset provides further insight into wetland occurrences and extents building on the information from the NFEPA, as well as other datasets.

Two wetland types were identified by means of this dataset which incorporate a single depression just north of the TSF and the Vaal River (Figure 3-2).

3.1.5 National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) wetland dataset is a collaborative project between multiple stakeholders such as CSIR, the WRC and SANBI. The objective of the project was to identify priority areas to conserve and protect as well as to promote sustainable water use, thereby assisting in meeting the biodiversity goals for freshwater habitats set out in all levels of government (Nel et al. 2011).

The NFEPA dataset represents four wetland types classified as wetland flats, floodplain wetland, unchannelled valley bottoms and valley head seeps (Figure 3-3).

3.1.6 Topographical Inland Water and River Lines

The topographical inland and river line data for “2626” and “2726” quarter degree was used to identify potential wetland areas within the PAOI. This data set indicates multiple inland water areas classified as dams, large reservoirs, marsh vlei, non-perennial pans and, sewerage works (Figure 3-4). Furthermore, a single perennial river (Vaal River) and two non-perennial streams have been identified.

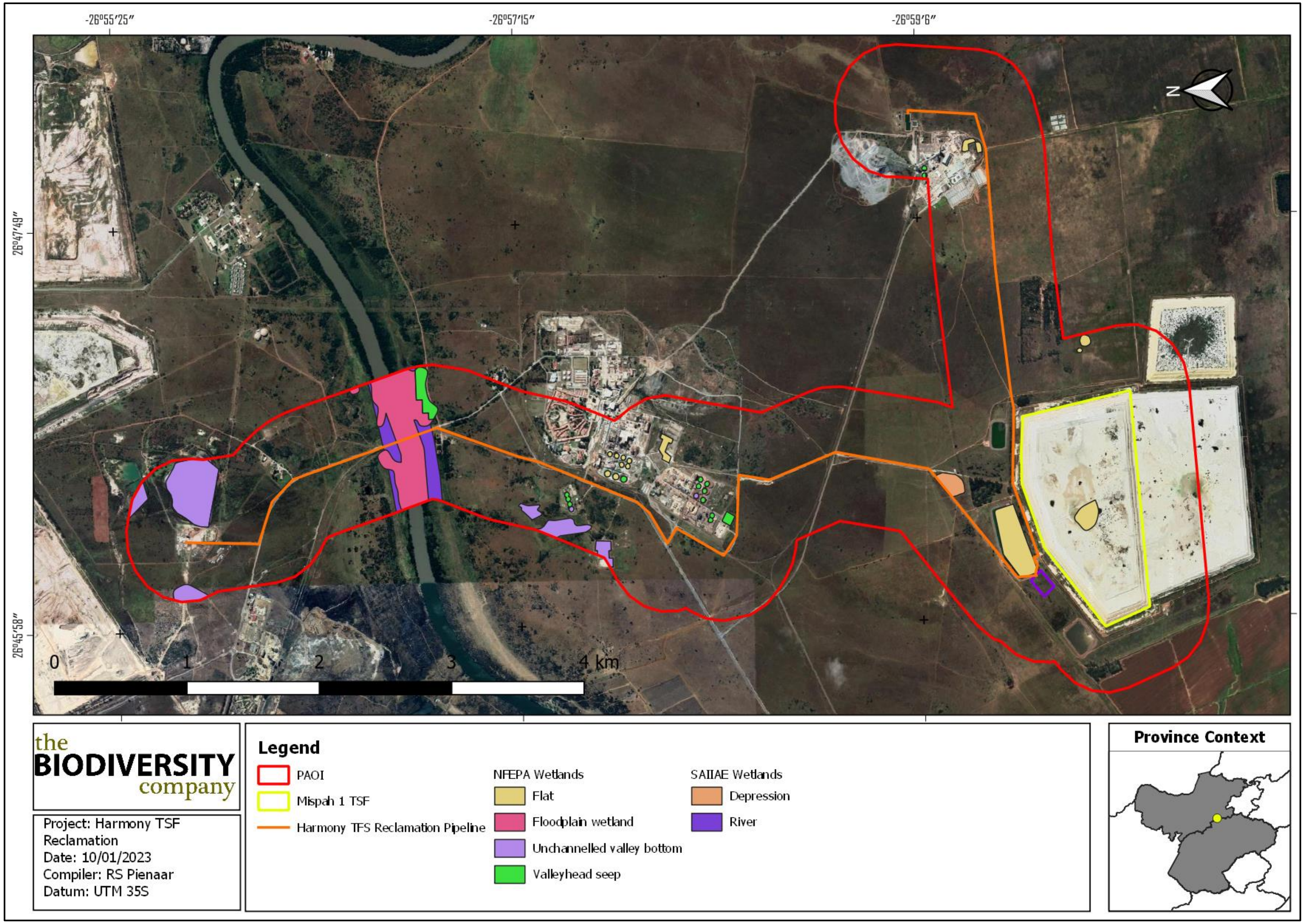

Figure 3-3 NFEPA and SAIIAE wetlands located within PAOI

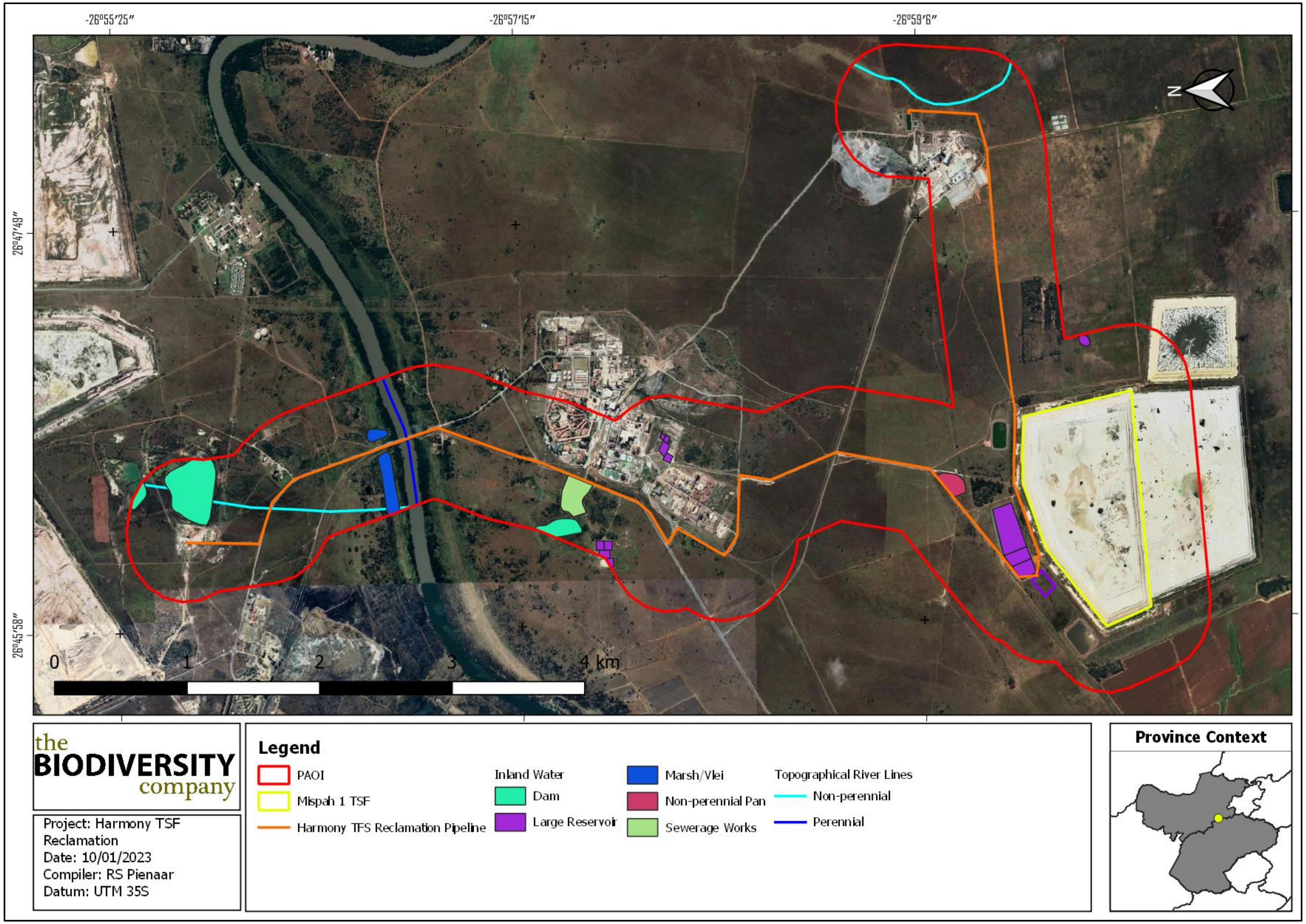

Figure 3-4 Topographical River line and inland water areas located within the PAOI

3.1.7 Terrain

The terrain of the PAOI has been analysed to determine potential areas where water is more likely to accumulate (due to convex topographical features, preferential pathways, or more gentle slopes).

Majority of the PAOI consists of mild gradient land, with the exception of some hillier and steeper terrain located in the north-east and south of the proposed pipeline.

3.1.7.1 Digital Elevation Model (DEM)

A Digital Elevation Model (DEM) has been created to identify lower laying regions as well as potential convex topographical features which could point towards preferential flow paths. The PAOI ranges from 1 285 to 1 355 meters above sea level (MASL). The lower lying areas (generally represented in dark blue) represent the area that will have the highest potential to be characterised as wetlands (see Figure 3-4).

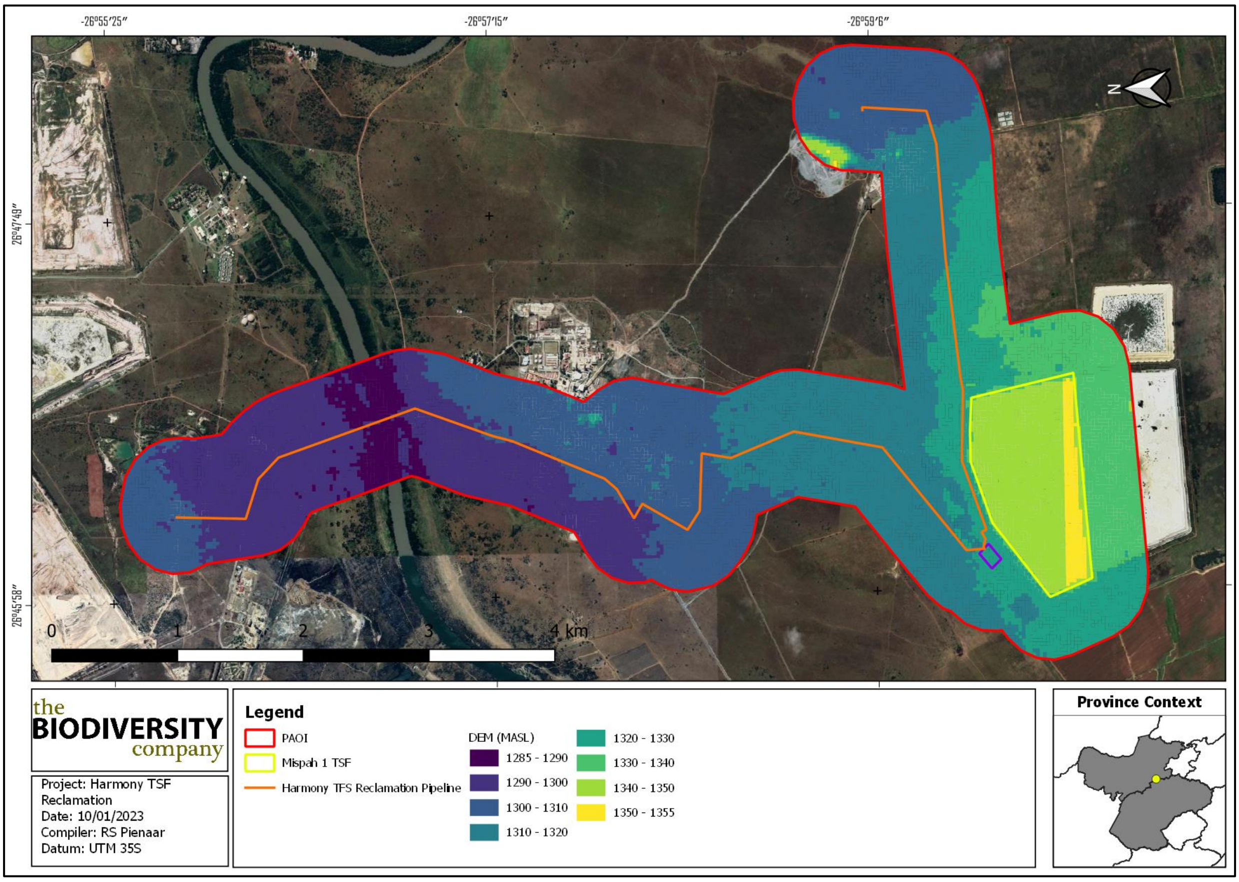

Figure 3-4 Digital Elevation Model of the PAOI

4 Field Assessment

4.1 Delineation and Description

During the site visit, four HGM units were identified within the PAOI that relate to the proposed development (Figure 4-2). The wetland types were classified as unchannelled valley bottoms (HGM 1 and 3), the Vaal River (HGM 2) and a depression (HGM 4) (Figure 4-1). Multiple artificial wetlands, namely dams were identified to the within the PAOI. According to Ollis *et al* (2013) a dam is classified as '*an artificial body of water formed by the unnatural accumulation of water behind an artificial barrier that has been constructed across a river channel or an unchannelled valley bottom wetland'*. Although these systems do not classify as a natural wetland system it is important to note where the dams are for any planned development in the area. The delineation of the wetland systems and functional assessment have been completed for the unchanneled valley bottom wetland in which the dam is located. A riparian zone was delineated for the active channel of the Vaal River. The riparian zone was characterised by robust vegetation comprising woody / tree species and the Dundee soil form. Riparian areas commonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands generally display more diffuse flow and are lower energy environments (DWAF, 2005).

The Vaal River reach proximal to the project is a wide (> 100 m) uniform channel with sandbars throughout the reach due to sedimentation which were subsequently vegetated. The reach is wadeable in sections, dominated by rocky substrates with the banks dominated by sandy and muddy substrates. The riparian area is dominated by large tree species. Influence on the system is predominantly from agriculture as well as urban influences.

Drainage features (or lines) were also identified throughout the PAOI. These features are referred to as 'A' Section channels that convey surface runoff immediately after a storm event and are not associated with a baseflow (DWAF, 2005).

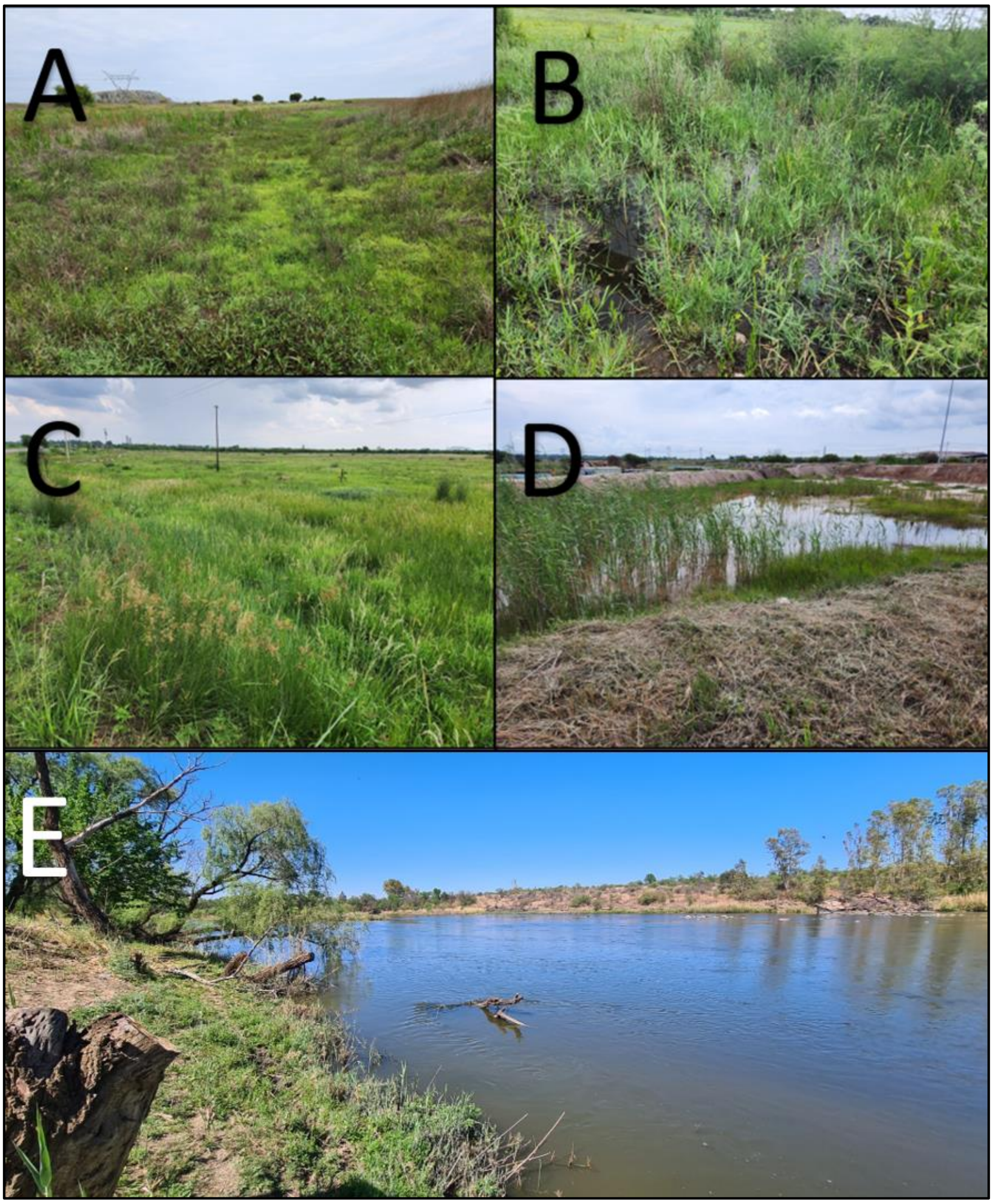

Figure 4-1 Photographical evidence of the different HGM units found within the PAOI. A) HGM 1., B) Banks of HGM 2., C) HGM 3, D) Artificial Wetlands and E) Vaal River

4.2 Status of sub-quaternary reach C24B-1868

Desktop information for SQR's was obtained from DWS, 2020. The PES category of the reach is classed as largely modified (class D) (Table 4-1). The modifications of the reach are due to impacts to instream habitat, wetland and riparian zone continuity, flow modifications and moderate potential impacts on physico-chemical conditions (water quality). Anthropogenic impacts identified within the sub-quaternary catchment include settlements, farming, road crossings, abstraction, alien invasive plants in the riparian zone. The mean ecological importance is "Moderate" and sensitivity has been determined to be "High" (DWS, 2020) with the default ecological category rated as "B".

Table 4-1 Summary of the status of sub-quaternary reach

Present Ecological Status	**Largely Modified (D)**

Mean Ecological Importance	Moderate
Mean Ecological Sensitivity	High
Default Ecological Category	B

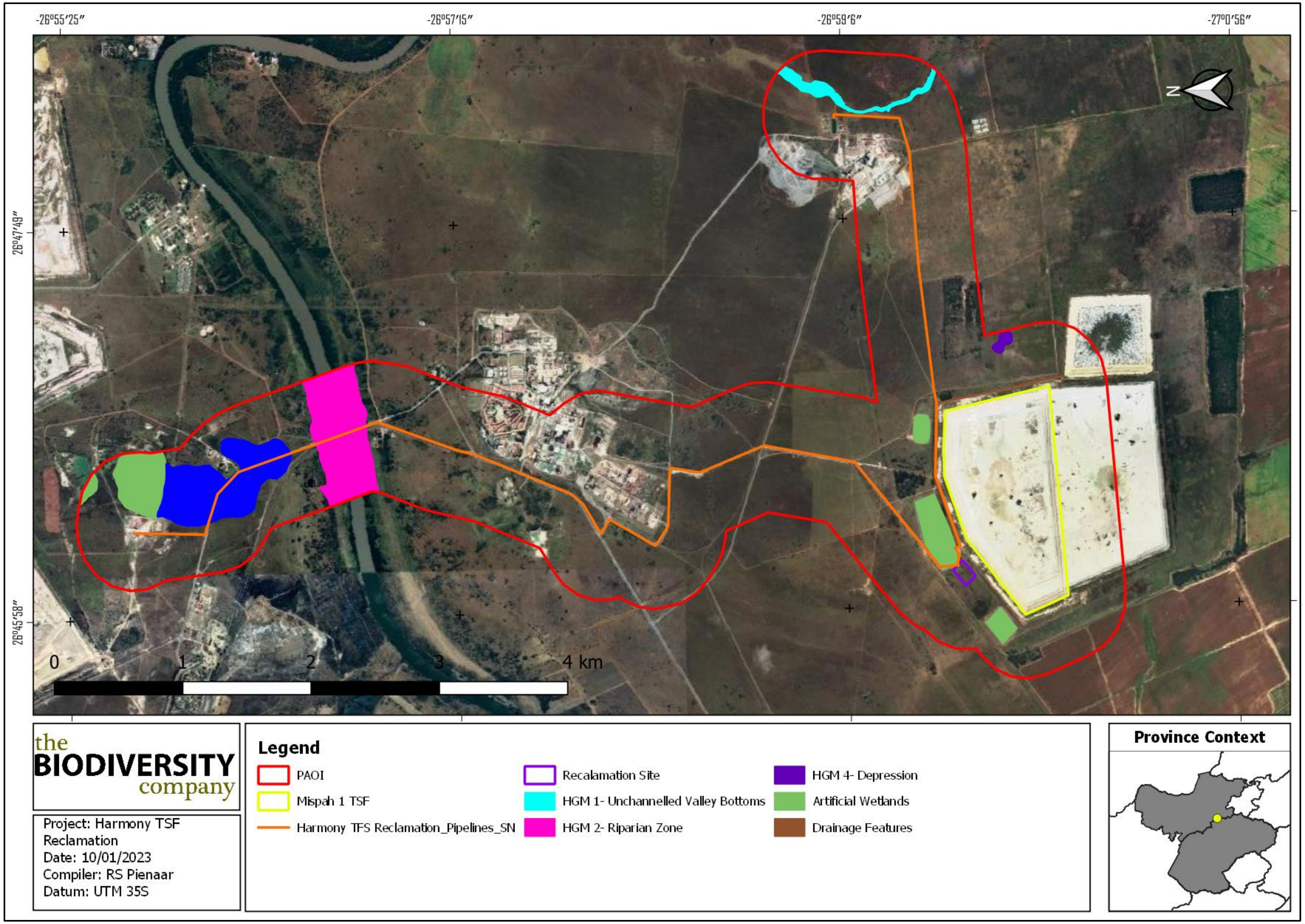

Figure 4-2 Delineation and location of the different HGM units identified within the PAOI

4.3 Unit Setting

Unchannelled valley-bottom wetlands are typically found on valley floors where the landscape does not allow high energy flows and supports the diffuse flow of water. Figure 4-4 presents a diagram of a typical unchannelled valley-bottom wetland, showing the dominant movement of water into, through and out of the system.

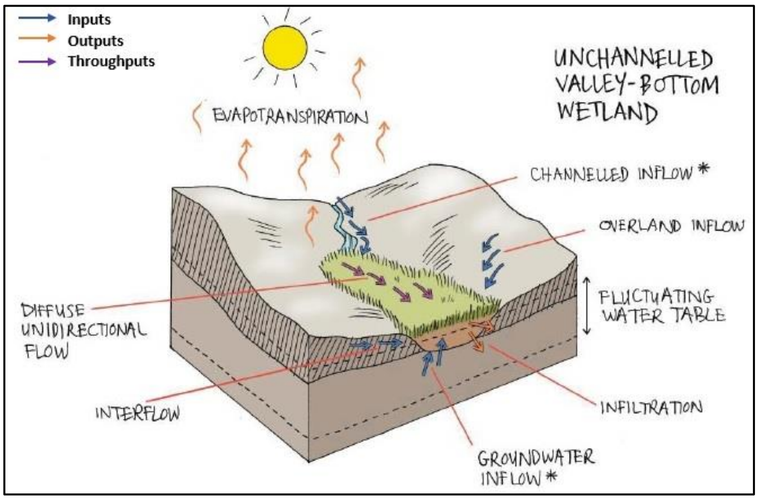

Figure 4-4 Amalgamated diagram of a typical unchannelled valley-bottom, highlighting the dominant water inputs, throughputs, and outputs, SANBI guidelines (Ollis et al. 2013)

Rivers are a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit (Figure 4-3). Rivers can be divided into the 'active channel' and 'riparian zone'.

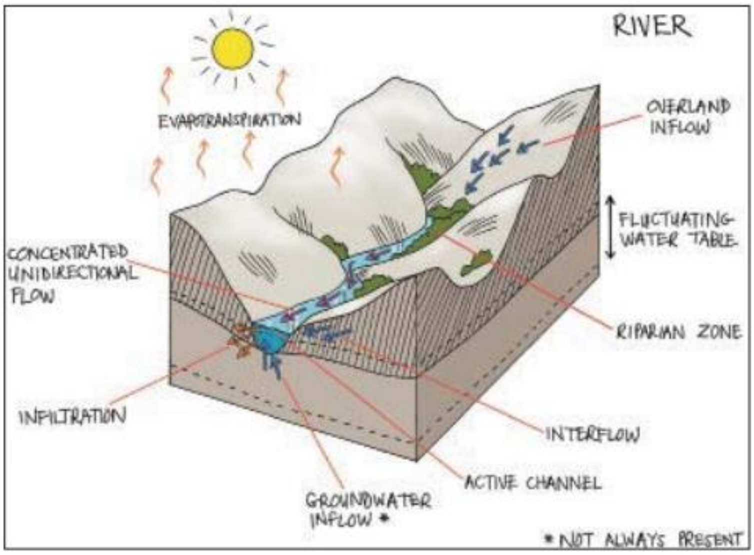

Figure 4-3 Amalgamated diagram of the HGM types, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)

Channelled valley-bottom wetlands are typically found on valley floors with a clearly defined, finite stream channel and lacks floodplain features, referring specifically to meanders. Channelled valley-bottom wetlands are known to undergo loss of sediment in cases where the wetlands' slope is steep and the deposition thereof in cases of low relief. Figure 4-4 presents a diagram of a typical channelled valley-bottom, showing the dominant movement of water into, through and out of the system.

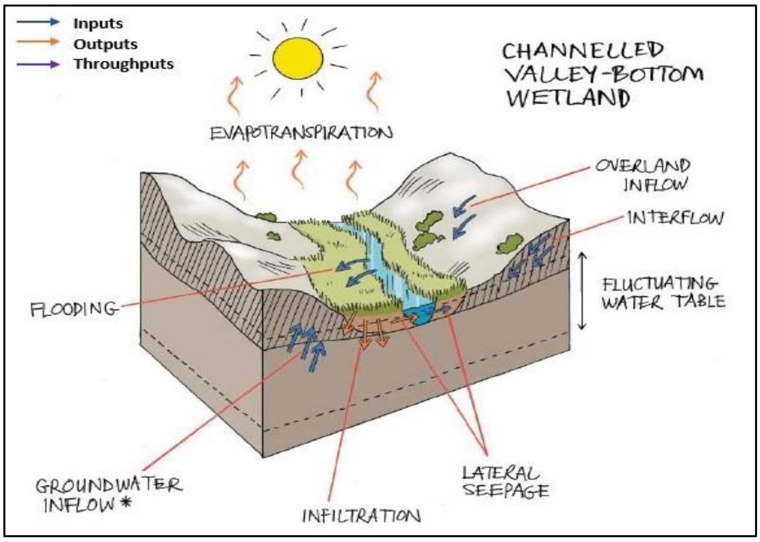

Figure 4-4 ***Amalgamated diagram of a typical channelled valley bottom, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)***

Depression wetlands are located on the "slope" landscape unit. Depressions are inward draining basins with an enclosing topography which allows for water to accumulate within the system. Depressions, in some cases, are also fed by lateral sub-surface flows in cases where the dominant geology allows for these types of flows. Figure 4-5 presents a diagram of a typical depression wetland, showing the dominant movement of water into, through and out of the system.

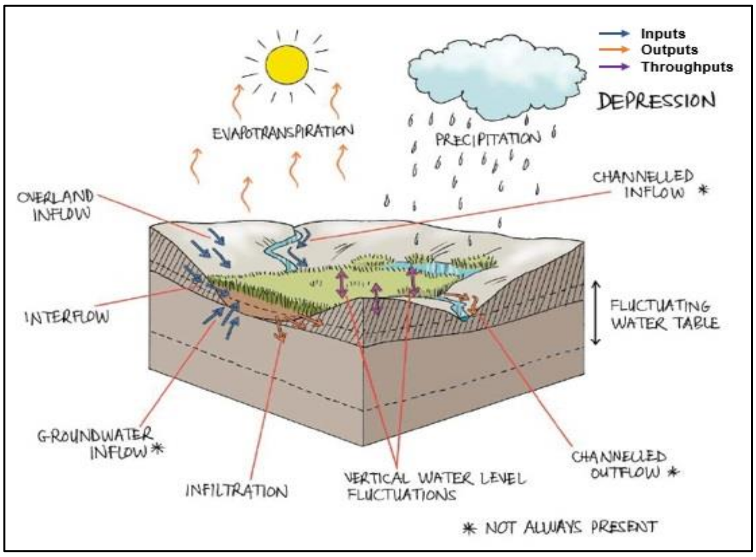

Figure 4-5 ***Amalgamated diagram of atypical depression wetland, highlighting the dominant water inputs, throughputs and outputs, SANBI guidelines (Ollis et al. 2013)***

The DWAF (2005) manual separates the classification of watercourses into three (3) separate types of channels or sections defined by their position relative to the zone of saturation in the riparian area. The classification system separates channels into:

- those that do not have baseflow ('A' Sections);
- those that sometimes have baseflow ('B' Sections) or non-perennial; or
- those that always have baseflow ('C' Sections) or perennial.

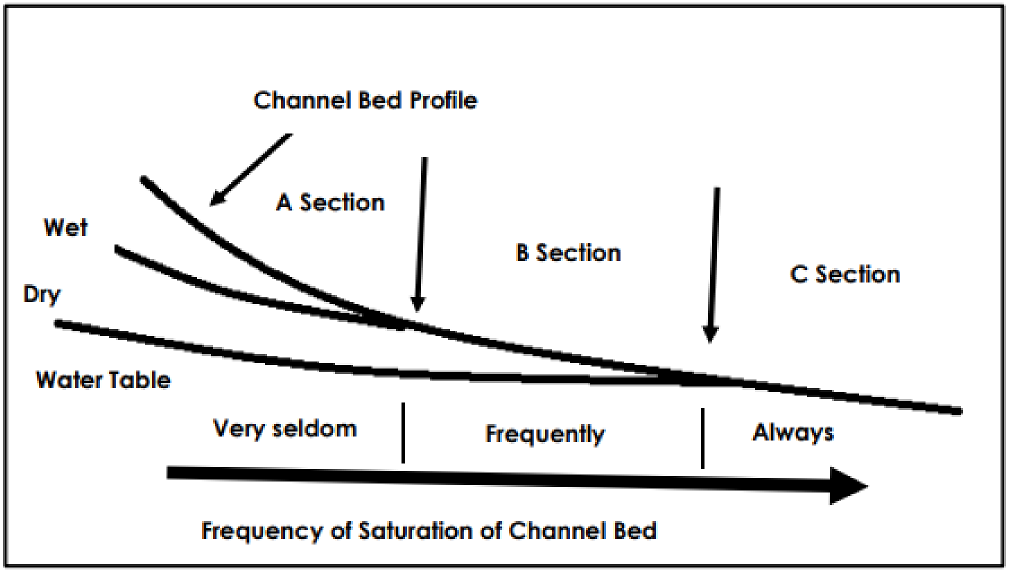

Figure 4-6 The watercourse classifications (DWAF, 2005)

4.4 General Functional Description

Unchanneled valley-bottoms are characterised by sediment deposition, a gentle gradient with streamflow generally being spread diffusely across the wetland, ultimately ensuring prolonged saturation levels and high levels of organic matter. The assimilation of toxicants, nitrates and phosphates are usually high for unchanneled valley-bottom wetlands, especially in cases where the valley is fed by sub-surface interflow from slopes. The shallow depths of surface water within this system adds to the degradation of toxic contaminants by means of sunlight penetration.

Channelled valley bottom wetlands tend to contribute less to sediment trapping and flood attenuation than other systems. However, they are well known for their potential to assimilate toxicants, nitrates and sulphates, especially in cases where sub-surface flows contribute to the system's water source (Kotze et al., 2009).

The generally impermeable nature of depressions and their inward draining features are the main reasons why the streamflow regulation ability of these systems is mediocre. Regardless of the nature of depressions in regard to trapping all sediments entering the system, sediment trapping is another Eco Service that is not deemed as one of the essential services provided by depressions, even though some systems might contribute to a lesser extent. The reason for this phenomenon is due to winds picking up sediments within pans during dry seasons which ultimately leads to the removal of these sediments and the deposition thereof elsewhere. The assimilation of nitrates, toxicants and sulphates are some of the higher rated Eco Services for depressions. This latter statement can be explained the precipitation as well as continues precipitation and dissolving of minerals and other contaminants during dry and wet seasons respectively, (Kotze et al., 2009).

It is however important to note that the descriptions of the above-mentioned functions are merely typical expectations. All wetland systems are unique therefore, the ecosystem services ratings for the wetlands on site may differ slightly to the general expectation given by the nature of the wetland type in relation to its topographic setting.

4.5 Ecological Functional Assessment

The ecosystem services provided by the wetland units identified on site were assessed and rated using the WET-EcoServices method (Kotze *et al.,* 2008). The average ecosystem service scores for the delineated systems are illustrated in Table 4-2 and Figure 4-7. The ecosystem services scores of the delineated wetlands ranges from intermediate to moderately high. Ecosystem services contributing to these scores include flood attenuation, streamflow regulation, sediment trapping, phosphate assimilation, nitrate assimilation, toxicant assimilation and, erosion control.

Table 4-2 Average ecosystem service scores for delineated wetlands

Moderately High	Intermediate
HGM 2	HGM 1
HGM 4	HGM 3

HGM 2 scored “Moderately High” on the provision of ecosystem services due to the nature of the wetland, being a channelled valley-bottom system and its supportive functional capabilities in relation to its surroundings. The channelled valley bottom helps with flood attenuation, and streamflow regulation as well as sediment trapping. The vegetation is most undisturbed parts of the wetland is intact and dense, therefore the benefits from this are likely. For instance, the channel of the wetland is densely vegetated with hydrophytic reeds which assist in erosion prevention and water purification related to toxicant alleviation. Water quality improvement through toxicant removal is an essential service provided by this wetland because of the numerous inputs into the system from stormwater discharges and treated outputs from the mines through trenches and a canal system that feeds directly into the wetland

HGM 4 scored “Moderately High” for the ecosystem services score due to the high volumes of hydrophyte vegetation present inside the wetland. The hydrophytes help with the accumulation of toxicants as well as phosphates and nitrates from the environment. The depression is located close to the TSF where runoff from the TSF after rain will flow into the depression where the water can be clean. The depression will also provide water during the dry seasons and other resources for human use.

HGM 1 and 3 scored “Intermediate” ecosystem services scores. The wetlands have been modified to such an extent that they have lost some of their function. The wetlands have loss many of their hydrophyte vegetation with only a few hydrophyte species present within the wetlands. The wetlands do still play an important role in flood attenuation and streamflow regulation. The wetlands will also still purify the water flowing through them. This is attributed to much of the wetland being modified, leaving only a narrow spans of wetland vegetation intact in some reaches of the wetland.

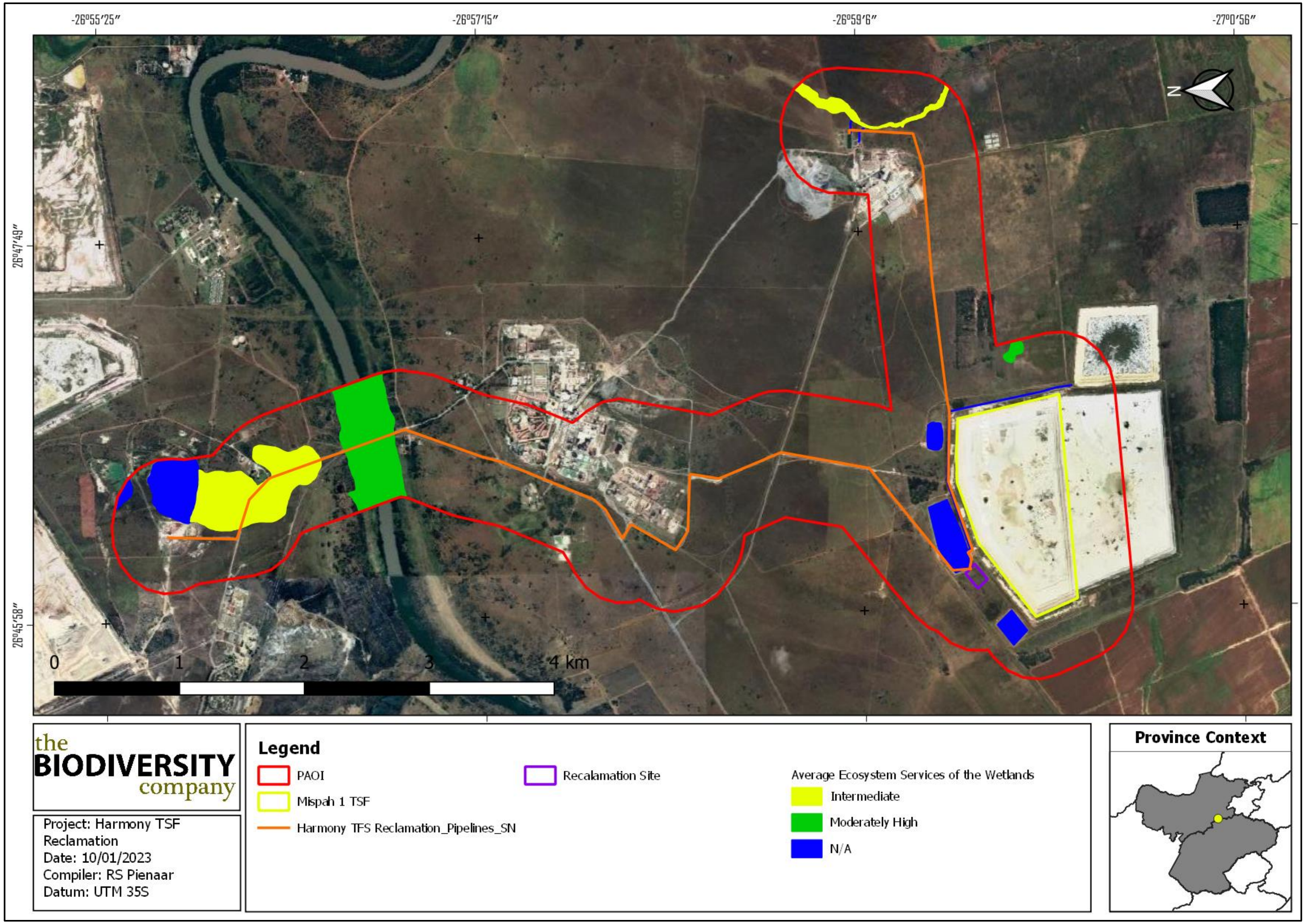

Figure 4-7 Average ecosystem services scores for the delineated wetlands

4.6 Ecological Health Assessment

The PES for the assessed HGM units is presented in Figure 4-8. The ecological state of the wetlands ranges from “C” -Moderately Modified to “E”- Largely Modified. These scores are due to the magnitude of anthropogenic impacts on the wetlands.

HGM 3 scored the lowest present ecological score with a “seriously modified” score. This is due to the fact that the wetland is subjected to a lot of anthropogenic water inputs into the system. The wetland also has a building and roads within the wetland area which alters the flow of water within the wetland. The wetlands are subjected to grazing and trampling through livestock.

HGM 1 and 2 scored “largely Modified” ecological scores due to the impacts on their vegetation through anthropogenic activities. HGM 1 underwent channelling in parts of the wetland to reduce the width of the wetland and historic agricultural activities reduced the volumes of hydrophytes within the wetland.

HGM 4 has the best present ecological state of all the wetlands, the wetland is located within the mines property where very few people are present. No agricultural activities take place within the wetlands or wetland buffer, the only impacts on the wetlands are from the TSF flowing down into the wetland.

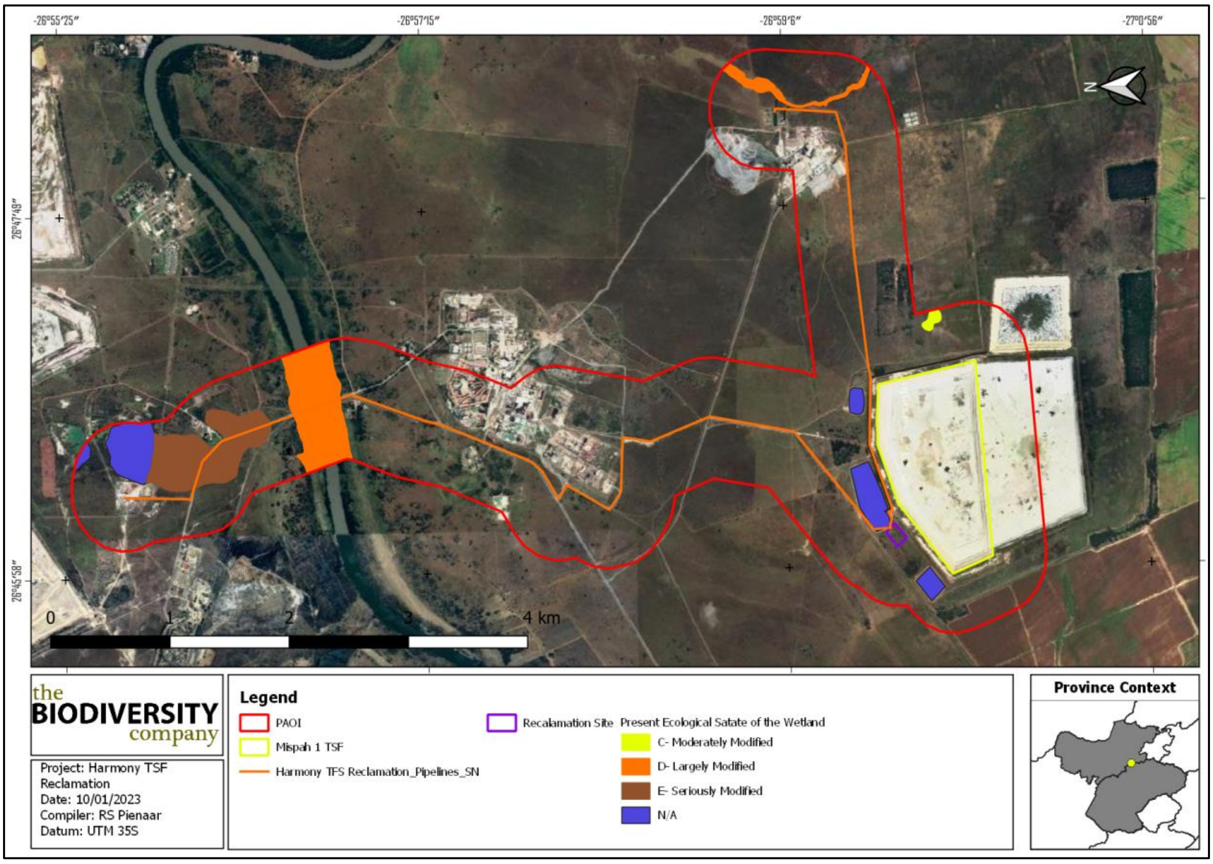

Figure 4-8 Overall present ecological state of delineated wetlands

4.7 Importance & Sensitivity Assessment

The results of the ecological IS assessment are shown in Table 4-. Various components pertaining to the protection status of a wetland are considered for the IS, including Strategic Water Source Areas (SWSA), the NFEPA wetland vegetation (wet veg) threat status and the protection status of the wetland. The IS for all the wetlands were calculated to be “Moderate”, which combines the low threat status and the low protection levels of the wetland.

Table 4-3 The IS results for the delineated HGM units

	NFEPA Wet Veg			NBA Wetlands				
HGM Type	Type	Ecosystem Threat Status	Ecosystem Protection Level	Wetland Condition	Ecosystem Threat Status 2018	Ecosystem Protection Level	SWSA (Y/N)	Calculated IS
Unchannelled Valley Bottom	Dry Highveld Grassland Group 3	Least Threatened	Not Protected	N/A	N/A	Not Protected	N	Moderate
Channelled Valley Bottom	Dry Highveld Grassland Group 3	Least Threatened	Not Protected	N/A	N/A	Not Protected	N	Moderate
Depression	Dry Highveld Grassland Group 3	Least Threatened	Not Protected	N/A	Least Concern	Not Protected	N	Moderate

4.8 Buffer Requirements

It is worth noting that the scientific buffer calculation (Macfarlane *et al*., 2014) was used to determine the size of the buffer zones relevant to the proposed project. A pre-mitigation buffer of 32 m and a post-mitigation wetland and watercourse buffer of 15 m (Figure 4-9) is recommended for the delineated systems. This is attributed to pre-existing modifications of the and around the wetlands and the nature of the project which has the potential of minimally impacting on the wetland systems.

The suggested buffer in this report does not qualify as a relaxation to any other legislated buffers managed by the respective authorities (e.g., DEA and DWS). Therefore, the relevant authorisations are still a requirement prior to project commencement.

4.9 Regulatory Zone

The following regulatory zones are applicable and pertains to the project area being within 100 m from the Vaal River and wetland systems (Table 4-3).

Table 4-3 The zone of regulation for the project

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). Department of Water and Sanitation (DWS)	Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) in accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21c and 21i is defined as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation.

5 Risk Assessment

5.1 Potential Impacts

The impact assessment considered the anticipated direct and indirect impacts to the wetland systems as a result of the proposed pipeline (Table 5-1). The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment. In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology and project/activity phasing to avoid impacts.

Three levels of risk have been identified and considered for the overall risk assessment, these include high, medium and low risks. Due to relatively non-destructive characteristics of a pipeline to the hydrodynamics of a wetland, no High risks are expected for the project. Medium risk refers to wetland areas as well as their buffers that are transverse by the pipelines. Low risks are wetland systems beyond the pipelines that would be avoided, or wetland areas that could be avoided if feasible. The Medium risks were the priority for the risk assessment, focussing on the expected potential for these direct risks.

Due to the fact that direct impacts to the wetlands (and buffers) will not be avoided, the risk assessment will consider all direct and indirect risks posed to these systems as a result of the project. The figure below illustrates various aspects that are expected to impact upon the delineated wetlands during the respective project phases.

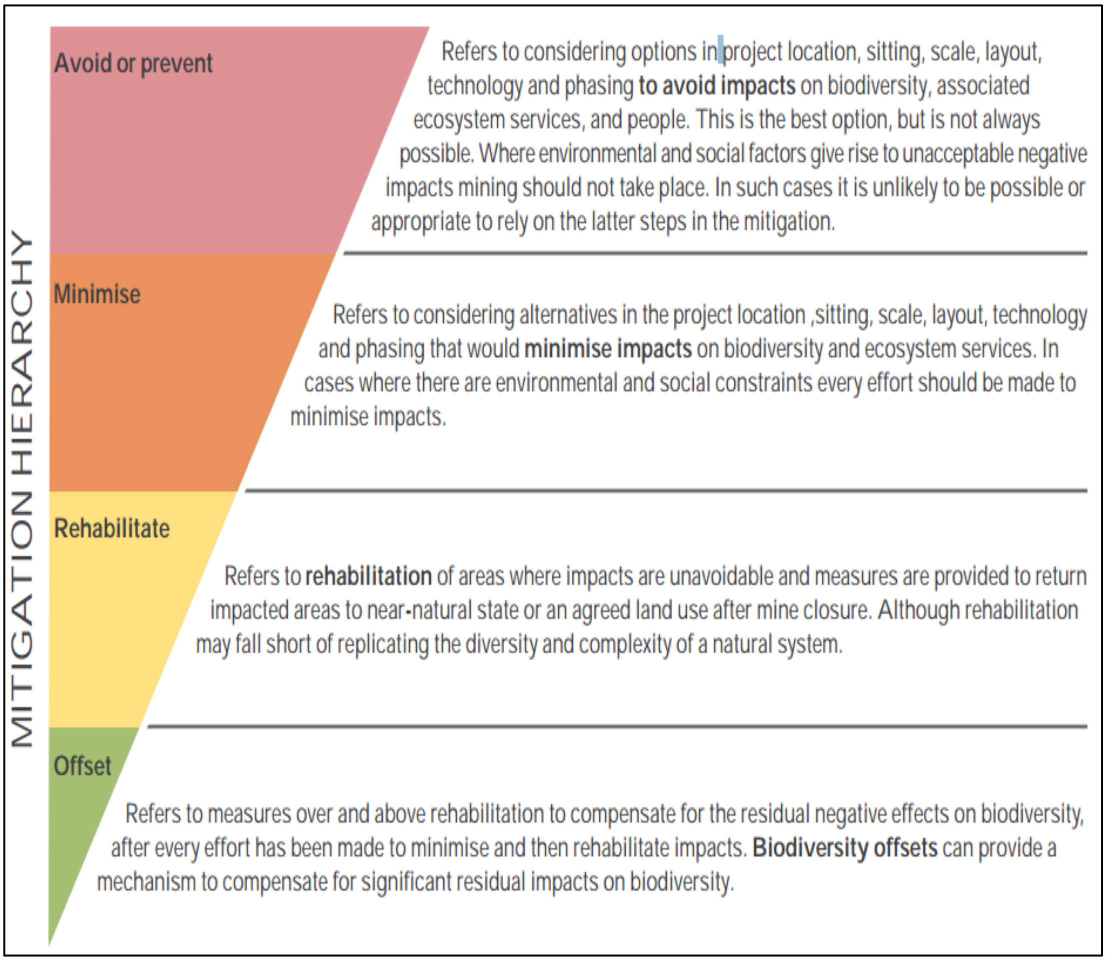

Figure 5-1 The mitigation hierarchy as described by the DEA (2013)

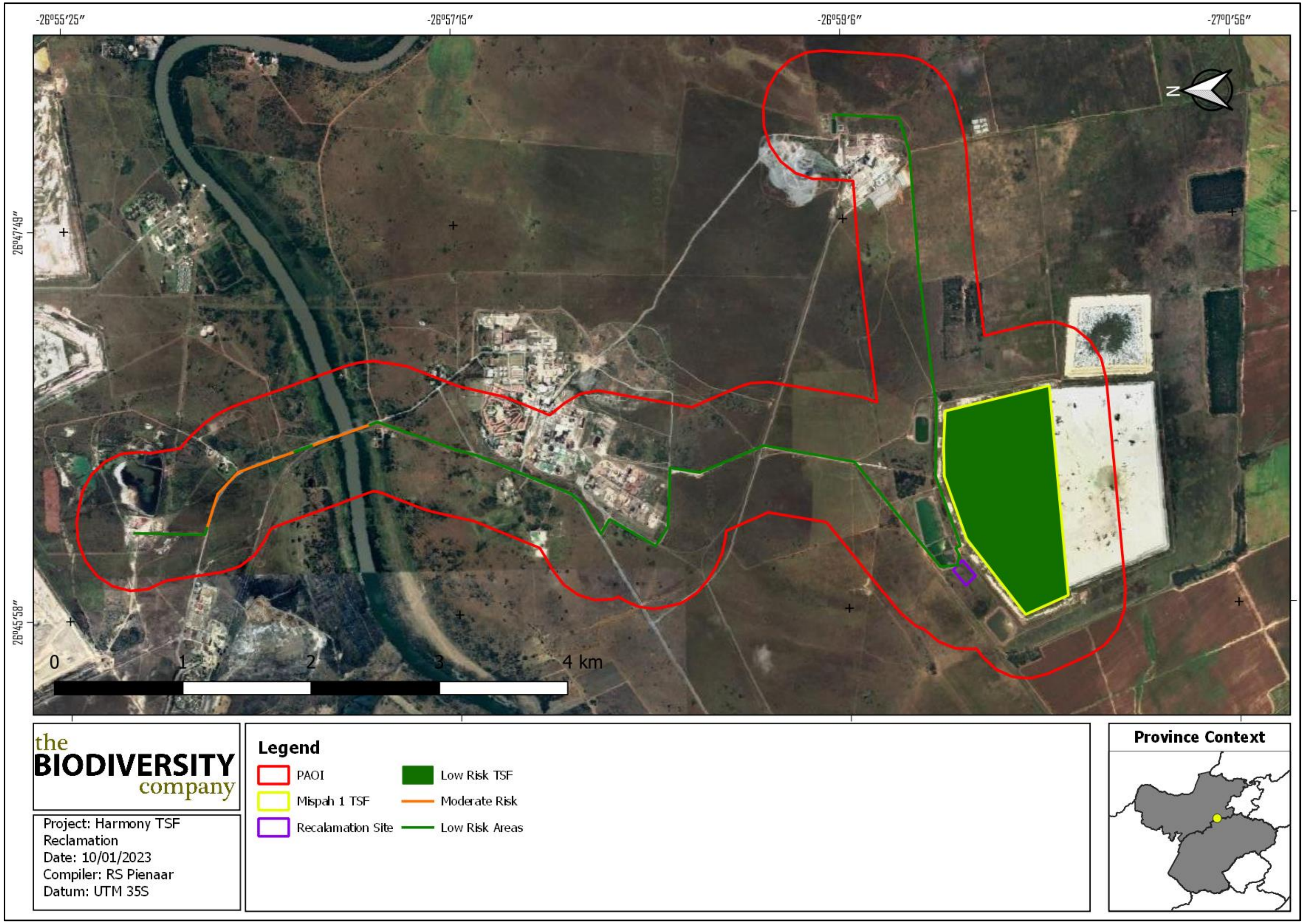

Figure 5-2 The identified risk areas within the PAOI

Table 5-1 DWS Risk Impact Matrix for the proposed pipelines (Andrew Husted Pr Sci Nat 400213/11)

Activity	Aspect	Impact	Mitigation Scenario	Severity: Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
Construction																			
Site clearing and preparation	Clearing of vegetation and stripping and stockpiling topsoil as well as storage of equipment.	Direct loss, disturbance and degradation of wetlands.	Without	2	2	3	3	5	2	2	9	2	2	5	1	10	90	M	• Use existing pipeline servitudes as far as possible. • Adhere to the prescribed wetland buffers. Restrict all non-essential activities (e.g. cement mixing and equipment wetland machinery storage) to outside of wetlands and their prescribed buffers. • Continue to opt for above ground crossings over wetland areas. • Request the wetland spatial data, load it onto a GPS and use it to mark out the positions where the pipeline will enter and exits the prescribed 15 m buffer on the boundary of a wetland. Try to reduce the disturbance footprint and the unnecessary clearing of vegetation on either side of the trench as far as possible when traversing wetlands. • At crossing points restrict all construction activities to a 10 m corridor on either side of the pipeline route. • Demarcate the 10 m construction corridor as well as the prescribed m buffer on the ground (e.g. pained wooden poles). • Construct as far as possible during winter when flow volumes are lowest, prioritise this for crossing sites. This will reduce impacts to wetlands due to soil poaching and vegetation trampling under peak saturation levels. Additionally, the risk of vehicles getting stuck and further degrading the vegetation integrity is lowest during this time.
			With	1	1	1	1	1	1	1	3	1	1	1	1	4	12	L	
		Increased bare surfaces, runoff and potential for erosion	Without	3	3	3	3	3	2	2	7	3	3	1	1	8	56	M	• Keep the trench excavation neat and tidy. Only stockpile on one side of the trench (the same side as the excavator tracks). Separate topsoil and sub-soil, and backfill in same order. • Ensure soil stockpiles and concrete / building sand are sufficiently safeguarded against rain wash. • Mixing of concrete must under no circumstances take

Activity	Aspect	Impact	Mitigation Scenario	Severity				Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
				Flow Regime	Water Quality	Habitat	Biota												
			With	1	1	1	1	1	2	2	5	3	1	1	1	6	30	L	place in any wetland or their buffers. Scrape the area where mixing and storage of sand and concrete occurred to clean once finished. • Do not situate any of the construction material laydown areas within any wetland. • No machinery should be allowed to parked in any wetlands. • Ensure topsoil is spread back over trench area. • Flatten and lightly till (no deeper than 30 cm) excavated / cleared areas to encourage vegetation establishment as soon as possible.
		Degradation of wetland vegetation and the introduction and spread of alien and invasive vegetation	Without	1	1	3	1	1.5	1	2	4.5	3	3	5	1	12	54	L	• Promptly remove all alien and invasive plant species that may emerge during construction (i.e. weedy annuals and other alien forbs) must be removed. • The use of herbicides is not recommended in or near wetlands (opt for mechanical removal). • Appropriately stockpile topsoil cleared from the project area. This can be used for rehabilitation of the servitude. • Clearly demarcate construction footprint, and limit all activities to within this area. • Minimize unnecessary clearing of vegetation. • Landscape and re-vegetate all denuded areas as soon as possible.
			With	1	1	2	1	1.25	1	2	4.25	3	1	5	1	10	43	L	
Installation of infrastructure	Trench excavation	Increased sediment loads to downstream reaches	Without	2	2	2	2	5	2	2	9	3	3	1	1	8	72	M	• See mitigation for increased bare surfaces, runoff and potential for erosion • Re-instate topsoil and lightly till disturbance footprint. • At all crossings install sandbags on downstream side of the footprint to trap sediment until the site has been constructed and vegetation has re-established.
			With	1	1	1	1	5	2	2	9	3	1	1	1	6	54	L	
		Contamination of wetlands with hydrocarbons due to machinery leaks and eutrophication of	Without	2	2	2	3	2.25	2	2	6.25	3	2	5	1	11	69	M	• Make sure all excess consumables and building materials / rubble is removed from site and deposited at an appropriate waste facility. • Appropriately contain any generator diesel storage tanks, machinery spills (e.g. accidental spills of hydrocarbons oils, diesel etc.) or construction materials

Activity	Aspect	Impact	Mitigation Scenario	Severity															
				Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
		wetland systems with human sewerage and other waste.	With	1	2	1	2	1.5	2	2	5.5	3	1	5	1	10	55	L	on site (e.g. concrete) in such a way as to prevent them leaking and entering the north-western seep. • Regularly maintain stormwater infrastructure, pipes, pumps and machinery to minimise the potential for leaks. Check for oil leaks, keep a tidy operation, install bins and promptly clean up any spills or litter. • Provide appropriate sanitation facilities during construction and service them regularly.
	Backfilling of trench	Disruption of wetland soil profile and alteration of hydrological regime	Without	3	2	2	2	5	2	3	10	3	3	5	3	14	140	M	• Ensure that topsoil is appropriately stored and re-applied during trench backfilling. • Make sure that the soil is backfilled and compacted to accepted geotechnical standards to avoid conduit formation along the trench.
			With	1	1	1	1	5	2	3	10	2	1	5	1	9	90	L	
Operation																			
Routine operation and monitoring	Pipeline leaks	Increased water inputs (clean) to downstream wetlands	Without	1	1	1	1	1	2	1	4	3	1	5	1	10	40	L	• Conduct regular inspections along the pipeline route and fix leaks timeously.
			With	1	1	1	1	1	2	1	4	3	1	5	1	10	40	L	
Decommissioning																			
Removal of pipeline infrastructure	Vehicle access	Degradation of wetland vegetation and proliferation of alien and invasive species	Without	2	2	2	2	2	1	2	5	3	2	5	1	11	55	L	• See mitigation for the impacts on direct loss, disturbance and degradation of wetlands and spread of alien and invasive plants.
			With	2	2	2	2	2	1	2	5	3	1	5	1	10	50	L	
	Re-excavation of trench and backfilling of wetland soils	Disruption of wetland soil profile, hydrological regime and increased sediment loads	Without	3	2	2	2	2.25	2	1	5.25	3	2	5	2	12	63	M	• See mitigation for increased bare surfaces, runoff and potential for erosion and increased sediment loads during construction. • See mitigation for Disruption of wetland soil profile and alteration of hydrological regime.
			With	1	1	1	1	1	2	1	4	3	1	5	2	11	44	L	

Activity	Aspect	Impact	Mitigation Scenario	Severity: Flow Regime	Severity: Water Quality	Severity: Habitat	Severity: Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
Cumulative																			
Cumulative Impact	Wetland integrity	Deterioration in wetland integrity beyond the pipeline servitude	Without	2	2	3	2	2.25	1	3	6.25	3	2	2	1	8	50	L	• Adhere to the mitigation listed above • Continue to opt for above ground crossings approach • Remain within the existing pipeline servitude.
			With	2	2	2	2	2	1	2	5	3	1	2	1	7	35	L	

6 Conclusion and Recommendation

6.1 Baseline Ecology

During the site assessment, four HGM units were identified and assessed within the project area of influence. These comprise of two unchannelled valley bottoms, the Vaal River and associated riparian area and one depression wetland. The systems scored an overall PES score ranging from C – “Moderately Modified” to E – “Seriously Modified”, due to the modifications arising from anthropogenic influences and surrounding mining activities. The systems scored “Moderate” importance and sensitivity scores due to the Low threat status of the wetland vegetation and units in combination with them being minimally protected. The average ecosystem service score was determined to ranges between “Intermediate” and “Moderately High”. A post-mitigation buffer of 15 m was assigned to the systems.

6.2 Risk Assessment

A risk assessment was conducted in line with Section 21 (c) and (i) of the National Water Act, 1998, (Act 36 of 1998) to investigate the level of risk posed by proposed project. No high risks are expected for either the TSF or the pipelines. The overall residual risks for the TSF are expected to be low with no systems identified in close proximity. The pipelines do transverse 2 HGM units and will thus have a medium pre-mitigation risk score. These overall residual risk was determined to be low if all the mitigations are adhered to.

6.3 Specialist Recommendation

Considering the above-mentioned information, no fatal flaws are evident for the proposed project. It is the opinion of the specialist that the project may be favourably considered, on condition all prescribed mitigation measures and supporting recommendations are implemented.

In accordance with the GA in terms of section 39 of the NWA, for water uses as defined in section 21 (c) or section 21 (i) a GA does not apply *“to any water use in terms of section 21 (c) or (i) of the Act associated with the construction, installation or maintenance of any sewer pipelines, pipelines carrying hazardous materials and to raw water and waste water treatment works”.* Owing to the fact that this project will include the installation of pipelines to accommodate the flow of hazardous materials, a water use license may be required.

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