WETLAND IMPACT ASSESSMENT FOR A WATER USE LICENCE APPLICATION FOR A PROPOSED DAM, IRRIGATION AND THE USE OF SLUDGE DAMS FOR THE DARTFORD FARMING TRUST

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Date:

January 2024

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HUNTS GREEN

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Required Client Review

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Quality	No			
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STRICTLY CONFIDENTIAL

EXECUTIVE SUMMARY

Hunts Green Consulting (Pty) Ltd was appointed by Emanzini WULA Consultants to conduct a wetland impact assessment for a Water Use License Application (WULA) for a proposed dam that will be utilised for irrigation purposes as well as the continued use of existing sludge dams for irrigation purposes. The dam, irrigation fields, sludge dams and 500m regulated area are located on 4 farm portions, within the Underberg area, Dr Nkosazana Dlamini-Zuma Local Municipality, Kwazulu-Natal (Figure 1-1) namely:

- Portion 0 of the Farm Lot FP 173 No. 8581,
- Portion 0 of the Farm Lot 1B No. 7604,
- Portion 0 of the Farm 7603 and
- Portion 0 of the Farm 9162,

It is the intention of the applicant to construct a storage dam with a capacity of 1 500 000m^3 to be used for the irrigation of existing cultivation fields including perennial grass pastures and vegetables. Furthermore, the applicant currently utilises two sludge dams for irrigation purposes and these form part of the WUL application.

The delineation exercise concentrated both within the area to be inundated by the proposed dam construction, the irrigation fields, the sludge dams, as well as the 500m regulated area around these sites. Based on the current identification of the four wetland indicators, fourteen HGM units were delineated within this project site. The HGM units were classified as thirteen seep systems and one floodplain wetland associated with the Ekamanzi River.

The fourteen HGM units were assessed with regards to their health according to the Wet-Health methodology (Level 2). HGM units were classified as Moderately Modified (PES Category C), and Largely Modified (PES Category D). A number of impacts have occurred within the wetland systems as well as their respective catchments as a result of various historic and current agricultural activities within the area. These impacts include cultivation practices, the presence of dams, tree plantations, and the construction of dirt roads to access cultivated fields.

Ecosystem goods and services were calculated for the HGM units. Scores depicted generally moderately functioning systems depending on the level of impact to the wetland. Highest scores received relate to flood attenuation, streamflow regulation, sediment trapping, filtration, and erosion control. All wetland systems provide ecosystem services for the maintenance of biodiversity within the agricultural landscape. The wetlands provide habitat for faunal, avifaunal and semi-aquatic species for feeding, breeding and foraging.

An Ecological Importance and Sensitivity (EIS) assessment was undertaken to rank the wetland in terms of the provision of goods and services or valuable ecosystem functions which benefit people; biodiversity support and ecological value as well as the reliance of subsistence users (especially basic human needs uses). The EIS scores received for all HGM units ranges

from low to moderate, depending on the level of impact to the wetland as well as the level of saturation within each individual wetland system. These wetlands, particularly during the summer wetter months, will provide habitat for faunal and floral species.

Any activities associated with a natural system, whether historic, current, or proposed, will impact on the surrounding environment, usually in a negative way. In order to minimise these impacts development planning should be based on ecological principles that promote sustainable development. This project includes the construction of a storage dam with a capacity of 1 500 000m^3 to be used for the irrigation of existing cultivation fields including perennial grass pastures and vegetables. Furthermore, the applicant currently utilises two sludge dams for irrigation purposes and these form part of the WUL application. The proposed dam will have a direct impact on a portion of HGM 1, HGM 2 and HGM 3. This will lead to the loss of 26.94ha of wetland area. The proposed irrigation will only occur within existing fields, and these occur outside of wetland systems. Furthermore, the sludge dams are located outside of all wetland systems, with the sludge used for irrigation.

A number of potential impacts on the wetland systems have therefore been identified. These relate to the direct loss of portions of wetland systems, the potential for soil erosion and sedimentation as a result of an increase in water flow from the irrigated fields to adjacent and downstream wetland systems, and thus the quantity of water entering into and flowing through the wetland systems; and the potential for pollution of the wetlands is increased if fertilisers and/or herbicides/pesticides are utilised on the cultivation fields.

The Risk Assessment for the proposed construction of the dam, the irrigation, and the use of the sludge dams was undertaken in accordance with the General Authorisation in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21 (c) and (i) (Notice 509 of 2016). The risk assessment is provided in Appendix B. Impacts associated with the construction and operation of the dam and the associated loss of wetland area received a Moderate Risk Score. Impacts associated with the use of the dam for irrigation received Moderate Risk Scores and the continuation of the use of the sludge dams received a Low Risk Score.

Mitigation measures must therefore be aimed at the protection of the current services provided by the wetland systems. Several general and specific measures are proposed to mitigate impacts and it is recommended that these are adhered to. Furthermore, the loss of wetland area from portions of HGM 1, HGM 2 and HGM 3 (26.94ha) need to be offset through the use of a Wetland Offset Plan. An offset application must be conducted as per the Wetland Offsets Best Practice Guidelines for South Africa (Macfarlane et al, 2016) to compensate for the loss of wetland habitat. Provided this occurs and is approved, it is the author’s opinion that the project be approved.

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1. Introduction

Hunts Green Consulting (Pty) Ltd was appointed by Emanzini WULA Consultants to conduct a wetland impact assessment for a Water Use License Application (WULA) for a proposed dam that will be utilised for irrigation purposes as well as the continued use of existing sludge dams for irrigation purposes. The dam, irrigation fields, sludge dams and 500m regulated area are located on 4 farm portions, within the Underberg area, Dr Nkosazana Dlamini-Zuma Local Municipality, Kwazulu-Natal (Figure 1-1 and Figure 1-2) namely:

- Portion 0 of the Farm Lot FP 173 No. 8581,
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- Portion 0 of the Farm 7603 and
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It is the intention of the applicant to construct a storage dam with a capacity of 1 500 000m^3 to be used for the irrigation of existing cultivation fields including perennial grass pastures and vegetables. Furthermore the applicant currently utilises two sludge dams for irrigation purposes and these form part of the WUL application.

Surface water attributed to wetland systems, rivers and riparian habitats comprise an important component of natural landscapes. These systems are often characterised by high levels of biodiversity and fulfil various ecosystems functions. As a result, these systems are protected under various pieces of legislation including the National Water Act, 1998 (Act No. 36 of 1998) and the National Environmental Management Act, 1998 (Act No. 107 of 1998).

This report is undertaken in compliance with the WULA in terms of the National Water Act (Act 36 of 1998).

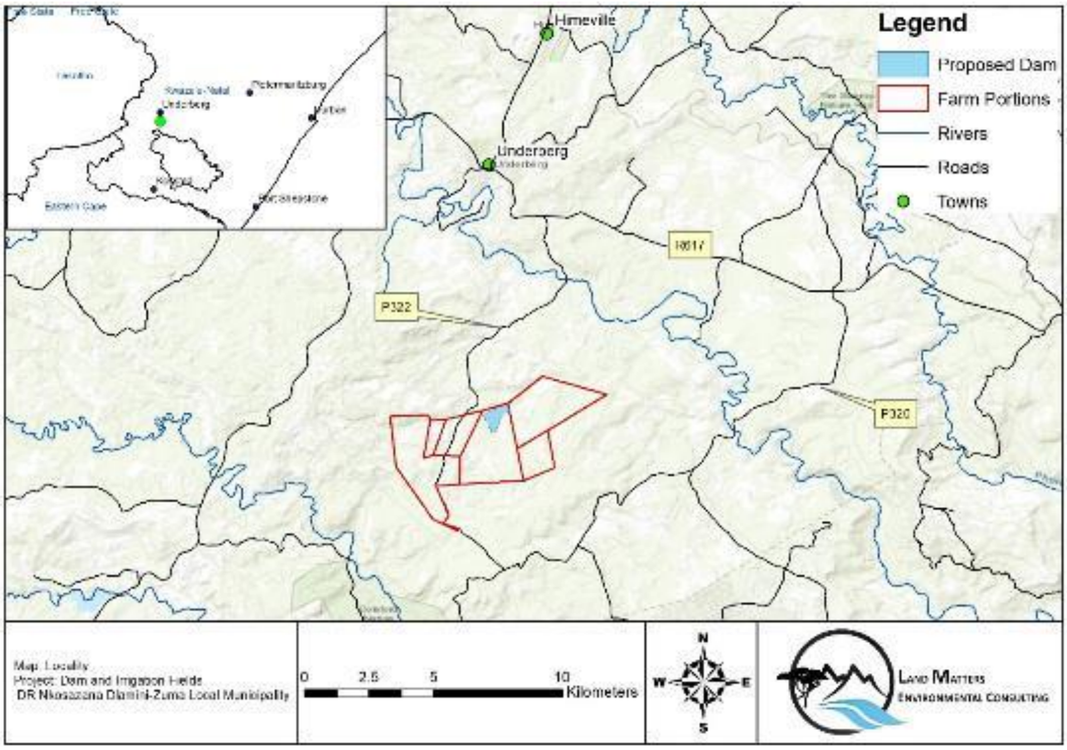

Figure 1-1: Local setting of the project area

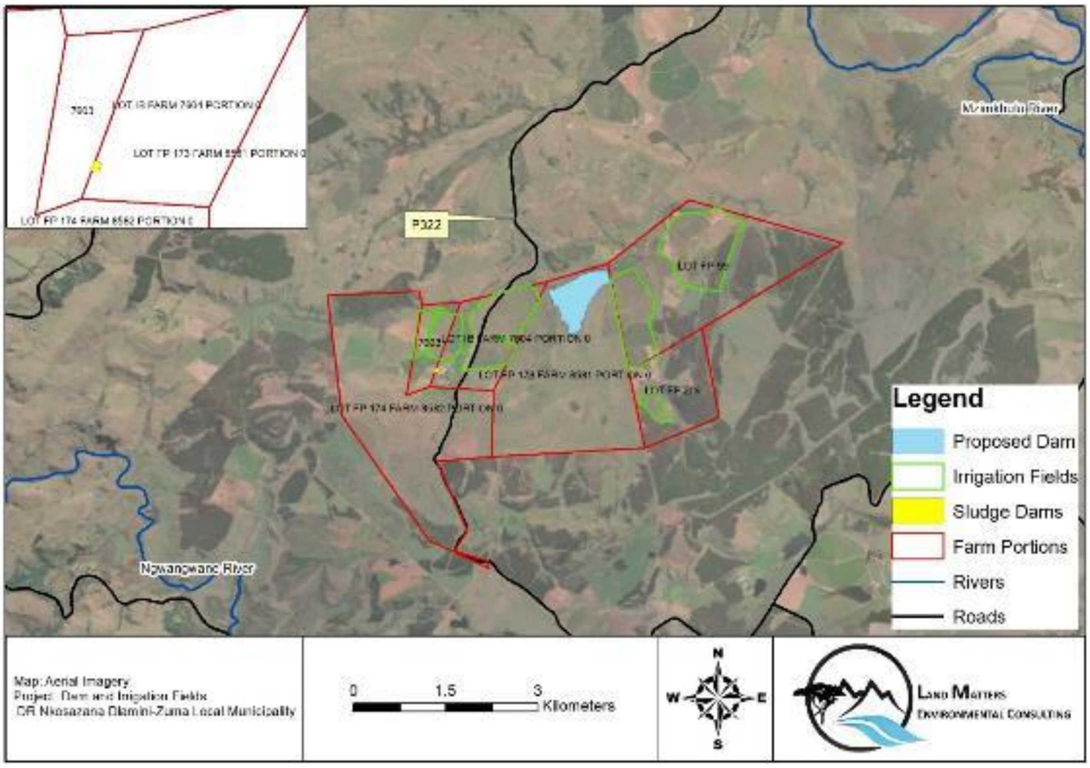

Figure 1-2: Description of the project site

2. Scope of Work

The scope of work required for the study includes the following:

1. To delineate any wetlands and watercourses.
    a. Delineated wetlands and watercourses within the study site (the proposed dam as well as the fields for irrigation and sludge dams)
    b. Delineate all wetlands and watercourses within the 500 m regulated area of the study site.
2. To classify the identified wetland habitats in accordance with the latest approach; 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (Ollis et al., 2013).
3. To assess the wetlands delineated
    a. Determine the Present Ecological State score (PES) using a Level 2 Wet-Health assessment
    b. Determine the Functional Integrity of the identified wetlands using a Level 2 Wet-EcoServices approach.
    c. Determine the Ecological Importance and Sensitivity (EIS) of the identified wetlands.
4. To identify negative impacts on the identified wetlands from the proposed project.
5. To recommend mitigation and suitable rehabilitation measures to lessen these impacts on the wetland systems.
6. Reporting – this report was compiled to present findings of the study as well as conclusions and recommendations considering the proposed dam and irrigation activities.

3. Legal and Administrative Framework

This wetland assessment was compiled in support of the Water Use License Application and is legislated under the;

- The Constitution Act (Act 108 of 1996) , Section 24 on environmental rights.
- National Environmental Management Act (Act 107 of 1998), (NEMA) as amended.
- Environmental Impact Assessment Regulations of 2010.
- National Water Act (Act 36 of 1998) (NWA).

4. Methodology

4.1. Assessment Techniques and Tools

The techniques and tools utilised for this assessment can be divided into baseline data and field investigations. Baseline data was utilised during the desktop assessment to determine the biophysical context of the site as well as National and Provincial legislation that governs the existing and proposed activities.

4.1.1. Baseline Data

- The study involved the examination of aerial photography and Geographical Information System (GIS) databases. The study made use of the following data sources:
- Google Earth™ satellite imagery was used at the desktop level.
- Relief dataset from the Surveyor General was used to calculate slope.
- Vegetation type dataset from Mucina & Rutherford (2006), with amendments by SANBI (NBA, 2018) were used in determining the vegetation type of the study area.
- National Wetland Map 5 (NBA, 2018) was utilised at a desktop level to determine if there are any wetlands on the site and the classification of these wetland systems.
- The National Freshwater Ecosystem Priority Areas (NFEPA) were used in determining any priority wetlands.

4.1.2. Site Investigation

In field data collection was taken on the 27th and 28th of November 2023. This included the delineation exercise, topographical setting, soil sampling techniques, identification of current land use, and the identification of impacts and dominant vegetation units present.

4.2. Wetland Definition & Delineation

South Africa has a strong legislative framework enforcing the country's obligations to numerous international conservation agreements for the protection of freshwater/wetland resources. These frameworks include several Acts, Ordinances and Treaties.

For the purpose of this assessment, wetlands are considered as those ecosystems defined by the National Water Act 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."

Furthermore, the Ramsar Convention[1] defines wetlands as:

"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6m"

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. Further to this, wetlands occur in areas where groundwater or surface water discharges to the surface forming seeps and springs. Soil wetness and vegetation indicators change as the gradient of wetness changes (Figure 4-1).

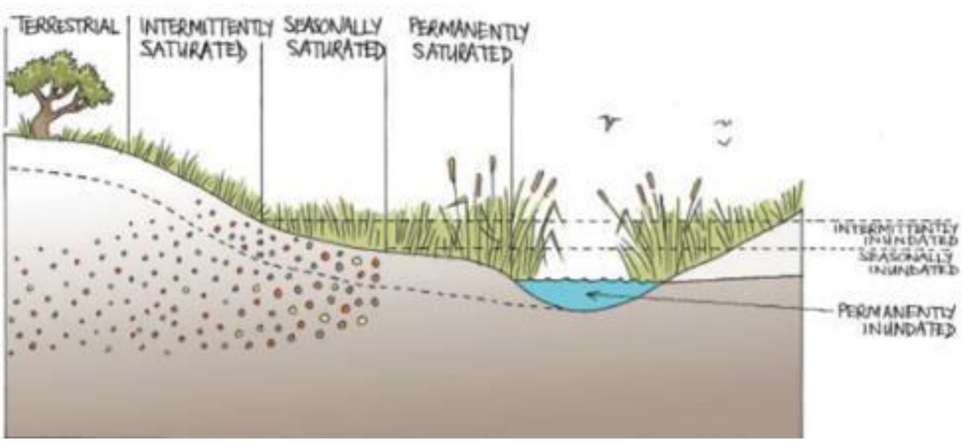

Figure 4-1: Increasing soil wetness zones identified within various wetland systems

Based on definition presented in the National Water Act, three vital concepts govern the presence of a wetland namely:

1. Hydrology- Land inundated by water or displays saturated soils when these soils are biologically active (the growth season).
2. Hydric soils- Soils that have been depleted of oxygen through reduction resulting in the presence of redoximorphic features.

[1] The Ramsar Convention is legally named the Convention on Wetlands of International Importance Especially as waterfowl Habitat and was adopted by the International Conference on the Wetlands and Waterfowl at Ramsar, Iran, 2 February 1971 in order to recognise amongst others that wetlands constitute a resource of great economic, cultural, scientific, and recreational value, the loss of which would be irreparable.

3. Hydrophytic vegetation- Plant species that are adapted to growing in saturated soils and subsequent anaerobic conditions (hydrophytes).

The conservation of wetland systems is vital as these habitats provide numerous functions that benefit not only biodiversity but provide an array of ecosystem services. These services are further divided into direct and indirect and are detailed in Table 4-1. These transitional habitats also provide refugia for a variety of terrestrial and semi-aquatic fauna, plants, and invertebrates.

Table 4-1: Direct and indirect benefits of wetland systems (Kotze et al. 2005)

Wetland Goods and Services	
Direct	**Indirect**
Hydrological Water purification Flood reduction Erosion control Groundwater discharge	*Socio-economic* Socio-cultural significance Tourism and recreation Education and Research
Biodiversity conservation	Water supply
Chemical cycling	Provision of harvestable resources

The study site was assessed with regards to the determination of the presence of wetland and watercourse areas according to the procedure described in 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas –Edition 1' (DWAF, 2005).

4.3. Wetland Health and Functional Integrity Assessment Techniques

A Wet-Health Assessment to determine the Present Ecological State (PES) was undertaken. The Wet-Health (Version 2.0) (MacFarlane et al. 2020) was utilised for the PES of the wetlands. This version takes into account impacts on the hydrology, geomorphology, vegetation and water quality of both the individual wetland unit as well as each wetland's catchment. A level 2 assessment as undertaken on the units delineated.

A Level 2 Wet-EcoServices (Version 2) (Kotze et al. 2021) assessment to determine the functional integrity of the identified wetland was carried out. Further to this, the Ecological Importance and Sensitivity of each delineated wetland unit was ascertained.

Detailed methodology for the wetland delineation, health, and the provision of ecosystem goods and services (functional integrity), is given in Appendix A.

5. Assumptions and Limitations

The following assumptions and limitations are applicable to this assessment:

- Modelled biodiversity databases have accuracy limitations and as a result, must be ground-truthed for verification. The information obtained from various databases as included in Section 7 of this report is however considered to be useful as background to the assessment, and the data were also used to inform the field assessment.
- The wetlands and watercourses within the study site were delineated based on GPS coordinate waypoints taken of onsite indicator features. The accuracy of the GPS device used was 3 - 6 m and thus this may affect the accuracy of the maps produced.
- In order to obtain definitive data regarding the biodiversity, hydrology and functioning of water resources, studies should ideally be conducted over a number of seasons and over a number of years. The present study was undertaken during a two-day field investigation conducted on the 27th and 28th of November 2023. Once-off assessments such as this may potentially miss certain ecological information, thus limiting accuracy and detail.

6. Biophysical Characteristics

6.1. Climate

The Underberg area is characterised by a warm and temperate climate, with a summer rainfall pattern with intermittent rainfall events in the winter months. The mean annual precipitation according to the BioResource Unit information for the area (BRU – Xd5 Coleford) is approximately 886mm with 74% occurring between November and March. The seasonality of precipitation is a driving factor behind the hydrological cycles of rivers and drainage lines within the area. Typically, rivers and drainage lines have a higher flow rate during the summer months. The high intensity rainfall conditions experienced in the area are conducive to high levels of surface runoff and subsequent erosion where soils are shallow, occur on steep slopes or are overgrazed (Mucina and Rutherford, 2006). Temperatures vary throughout the year, with the annual average of 14.6°C. Maximum temperatures range from 17.6°C in June to 25.8°C in January. The region is coldest in June and July with average minimum temperatures of 0.5°C on average (Table 6-1).

Table 6-1: Mean annual rainfall and temperature data for Underberg (BRU – Xd5 Coleford)

	January	February	March	April	May	June	July	August	September	October	November	December
Precipitation (mm)	154	148	122	53	21	12	11	23	38	69	101	134
Mean monthly maximum temperature (°C)	24.8	24.6	23.5	21.3	19.5	17.6	18.4	20.1	22.0	21.9	23.0	24.3
Mean monthly minimum temperature (°C)	12.9	12.8	11.1	7.6	3.6	0.5	0.5	2.9	6.1	8.4	10.3	11.9

6.2. National Vegetation Types

The study area is situated within the Grassland Biome, the second largest of the nine biomes in South Africa, occupying an area of approximately 355 000km^2 (Mucina and Rutherford, 2006). This biome is subdivided into broad scale vegetation units and natural vegetation that is the Drakensberg Foothill Moist Grassland vegetation (Mucina & Rutherford, 2006; updated 2018 on BGIS) (Figure 6-1). This vegetation type is distributed within the KwaZulu-Natal and Eastern Cape Provinces at altitudes between 880 and 1680m asl. Drakensberg Foothill Moist Grassland vegetation is comprised of moderately rolling and mountainous terrain covered in forb-rich grasslands dominated by short bush grasses including *Themeda triandra* and *Tristachya leucothrix*. This habitat unit is often incised by river gorges of drier vegetation types and forested systems. Drakensberg Foothill Moist Grassland is classified as Least Threatened and statutorily conserved in the uKhahlamba Drakensberg Park, Ntsikeni Wildlife Reserve as well as in the Karkloof, Mount Currie, Coleford, Fort Nottingham, Impendle, Ngeli, and Umgeni Vlei Nature Reserves. Threats to this vegetation unit include loss of habitat for cultivation, plantations and urban sprawl. Woody invasive alien vegetation threatens remaining patches and common species noted include *Rubus* species, *Acacia dealbata* and *Solanum mauritianum*.

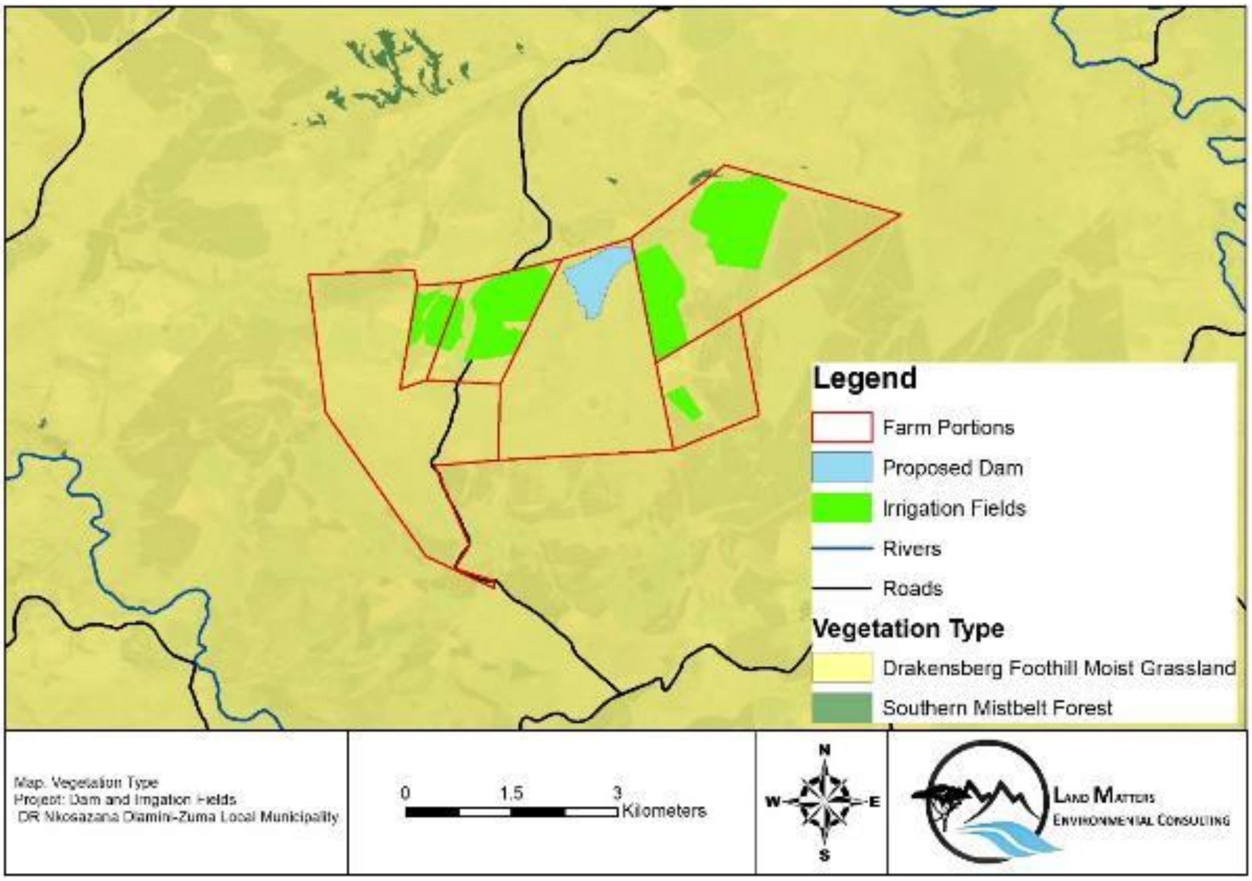

Figure 6-1: National vegetation type associated with the project site

6.3. Conservation Planning Frameworks

Systematic conservation planning is a globally recognised practice which identifies priorities for biodiversity conservation and informs legislation to facilitate the long-term conversion of identified biodiversity (Jewitt, 2018). The biodiversity sector is centred on a data-driven approach and is continually refining the outputs by improving input data (Dayaram et al., 2019).

NEMBA National List of Ecosystems that are Threatened and in Need of Protection

The NEMBA lists Threatened or Protected ecosystems in one of four categories: Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Protected. The main purpose of listing Threatened Ecosystems is to reduce the rate of ecosystem and species extinction which includes the prevention or further degradation and loss of structure, function, and composition of threatened ecosystems.

According to the 'Schedule of Threatened Terrestrial Ecosystems in South Africa' (promulgated under NEMBA, Government Notice 1002 of 2011), the extent of the project area is located within a Threatened Terrestrial Ecosystem.

National Biodiversity Assessment (NBA; 2018)

The most recent National Biodiversity Assessment (NBA), dated 2018, is a collaborative effort to synthesise the best available science on South Africa's biodiversity. The NBA is used to inform policy in the biodiversity sector and other sectors that rely on or impact on natural resources, such as water, agriculture, mining, and human settlements. The NBA provides information to help prioritise resources for managing and conserving biodiversity and provides context and information that underpins biodiversity inputs to land use planning processes (Skowno et al., 2019).

The NBA has seven technical reports (of which only the terrestrial component is discussed within this assessment) and relies on two headline indicators:

- **Threat Status**: Degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function and composition, on which their ability to provide ecosystem services depends. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Concern (LC), based on the proportion of each ecosystem type that remains in good ecological condition relative to a series of thresholds (Skowno et al., 2019).
- **Protection Level**: Addresses the extent to which ecosystems and species are protected. Ecosystem types are categorised as Not Protected, Poorly Protected, Moderately Protected or Well Protected, based on the proportion of each ecosystem type that occurs within a protected area recognised in the NEMPAA (Skowno et al., 2019).

These headline indicators provide important links for data comparison as well as providing a standardised framework that links with policy and legislation. Furthermore, comparing threat status and protection levels for terrestrial ecosystems is useful for identifying ecosystems in particular need of protection (Skowno et al., 2019).

Analysis of the NBA (2018) dataset indicated that the study site is associated with the Drakensberg Foothill Moist Grassland and the threat status of this ecosystem is considered to be Least Concern. The ecosystem is classified as endemic as well as poorly protected due to the ecosystem type being poorly represented within protected areas (Figure 6-2).

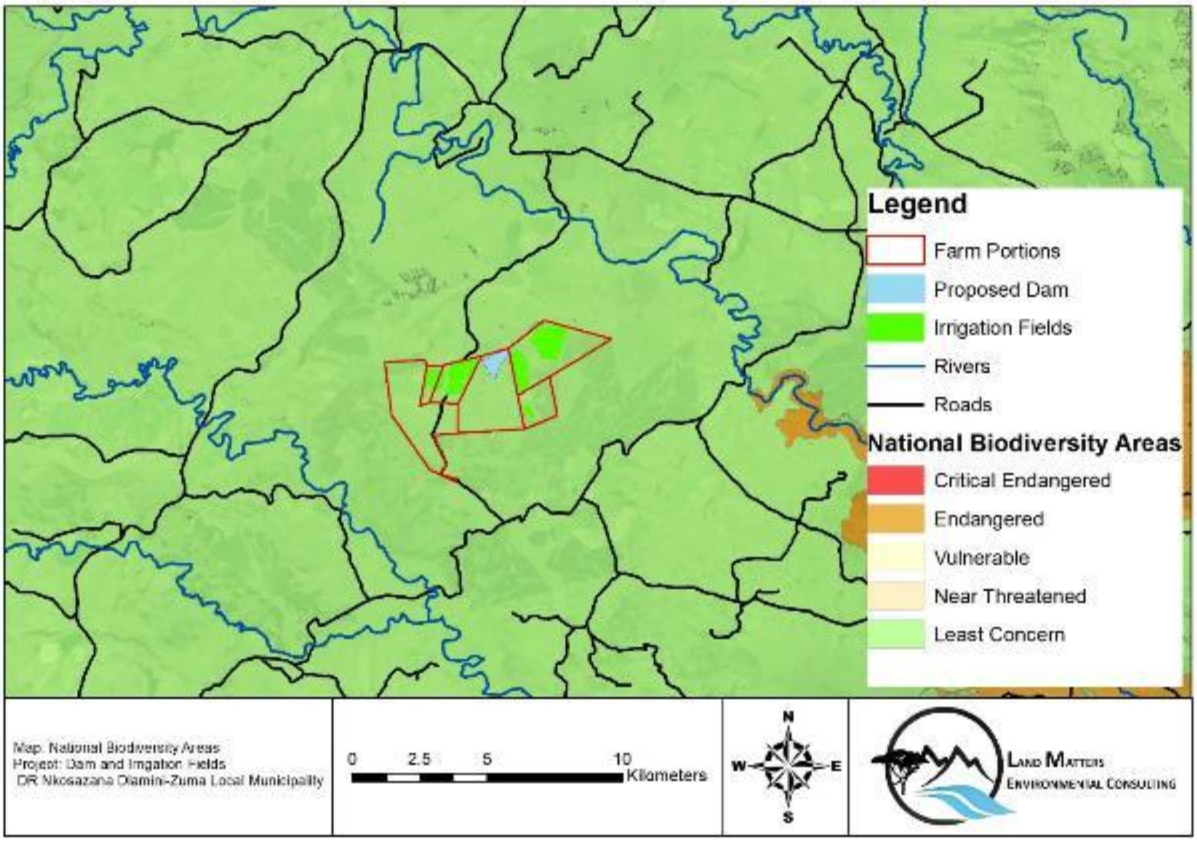

Figure 6-2: The study site in relation to the National Biodiversity Areas classification (NBA, 2018)

KwaZulu-Natal Biodiversity Sector Plan (2014)

The ecological sensitivity of the project area was assessed through the interrogation of provincial biodiversity databases. The KZN Biodiversity Sector Plan (BSP) is a conservation plan introduced and implemented by Ezemvelo KZN Wildlife. The primary aim of this conservation plan is to ensure that representative biodiversity samples are conserved to ensure that subsequent conservation targets are achieved. Areas are categorised based on a site's ecological sensitivity, biological functioning, and conservation significance.

Critical Biodiversity Areas (CBAs) are areas required to meet biodiversity targets for ecosystems, species and ecological processes, as identified in a systematic biodiversity plan, while Ecological Support Areas (ESAs) are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of CBAs and/or in delivering ecosystem services. The primary purpose of CBA and ESAs maps is to guide decision-making about where best to locate development and to encourage appropriate land uses that are compatible with the desired state of CBAs and ESAs.

Interrogation of the KZN BSP indicated that a portion of the farming area within the the study site is situated within an area classified as an irreplaceable CBA. However the proposed dam location as well as the irrigation fields and sludge dams are not located within areas classified as an irreplaceable or optimal CBA (Figure 6-3). As such the proposed project is not expected to impact on these conservation areas.

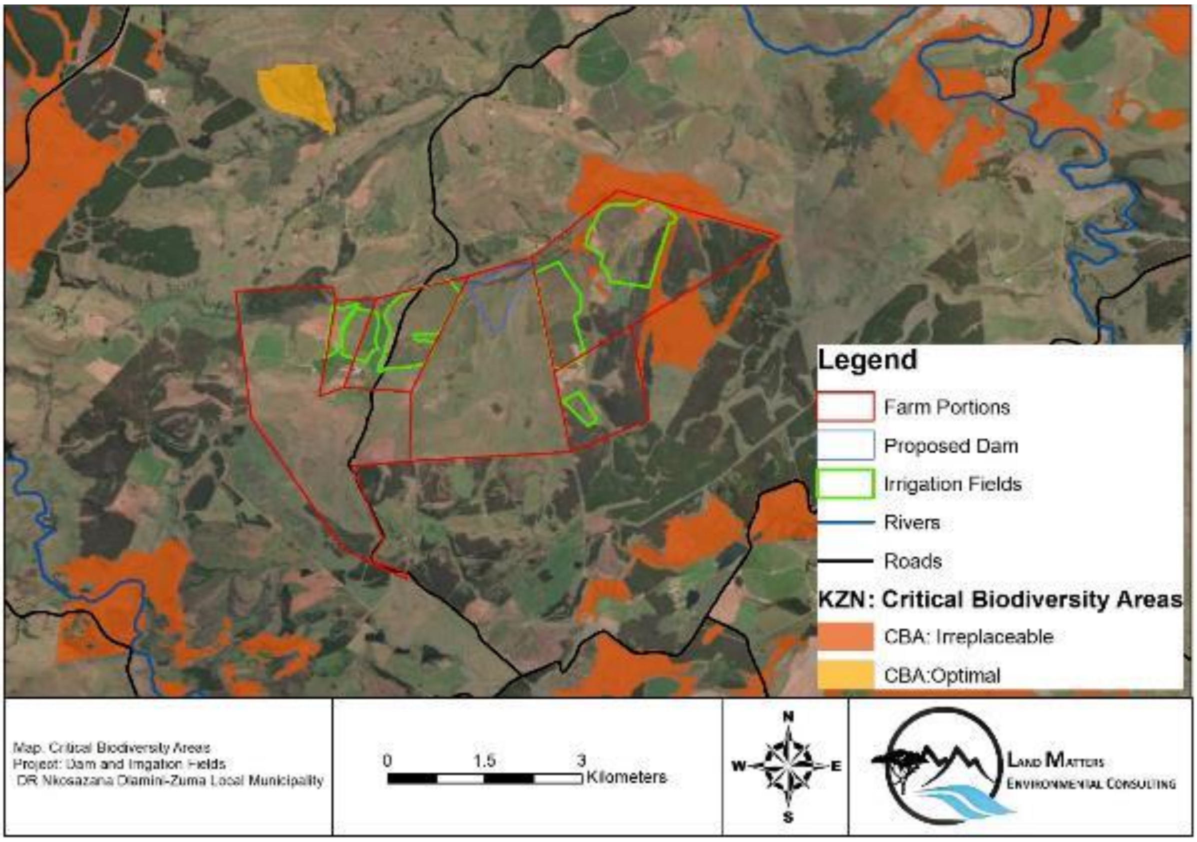

Figure 6-3: The study site in relation to the KZN Critical Biodviersity Areas database

6.4. Catchment characteristics and watercourses

The study site is located within the Pongola-Mtamvuna Water Management Area (WMA). Major rivers within this WMA include the Pongola, Mhlatuze, Mfolozi, Mkuze, Thukela, Mvoti, Umgeni, Umkomazi, Umzimkulu and Mtamvuna. These rivers experience significant levels of high-water demand related stress, particularly during drought seasons. Many of these surrounding communities rely on fresh water from these rivers throughout the year and supply adequate water for domestic, stock and irrigation.

More specifically, the project area is situated within the T51C quaternary catchment (Figure 6-4). The main river which flows within the quartenary catchment is the Mzimkhulu River which flows approximately 4.2km to the east of the study site. A number of smaller non-perennial watercourses flow within the study site (Figure 6-4).

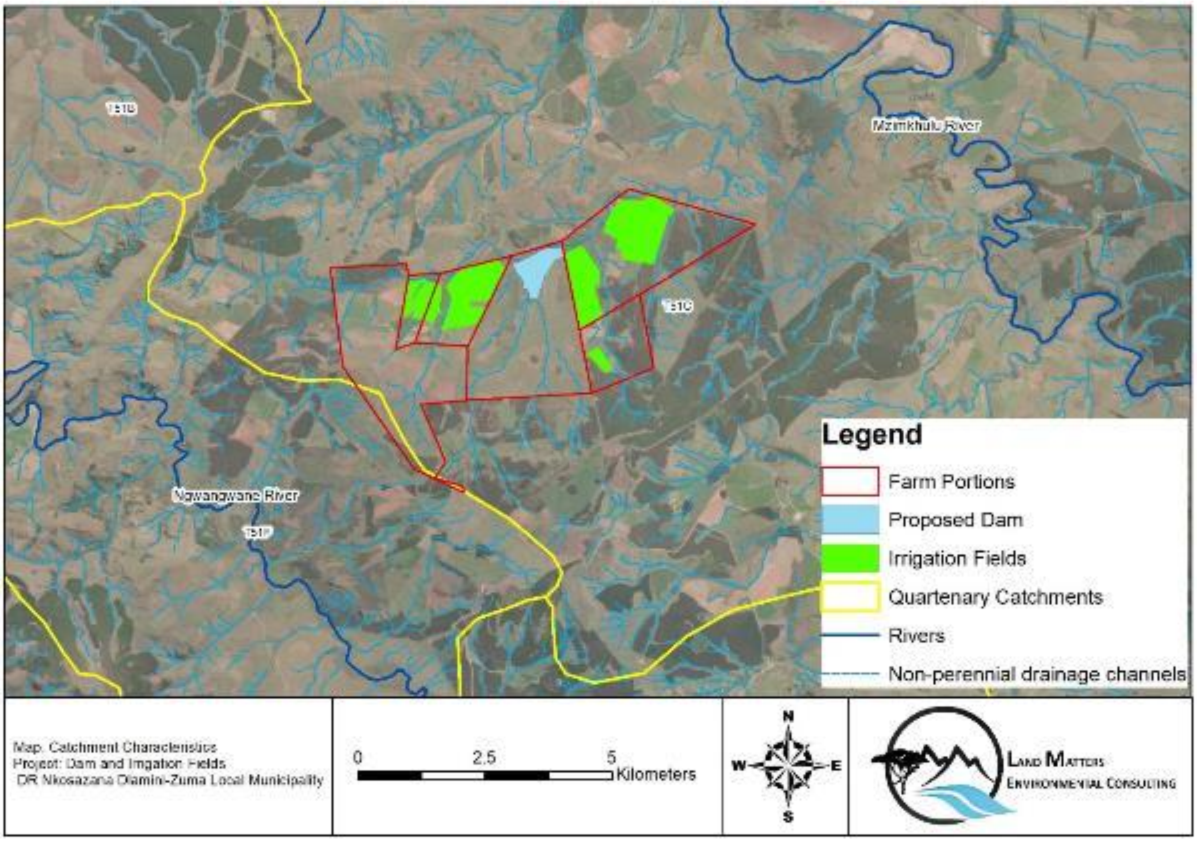

Figure 6-4: Catchment characterisitics of the study site

6.5. National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) project represents a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water Affairs (DWA; now Department of Water and Sanitation, or DWS), Department of

Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). More specifically, the NFEPA project aims to:

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

According to the outputs of the NFEPA project, the study site supports wetland ecosystem types that are classified as both FEPA wetlands as well as non-FEPA wetlands. Five wetland systems all classified as channelled valley bottom wetlands are located within the site. One of these is classified as a FEPA wetland as within a sub-quaternary catchment that is often utilised by Wattled Cranes (*Bugeranus carunculatus*), Grey Crowned Cranes (*Balearica regulorum*) and/or Blue Cranes (*Anthropoides paradiseus*). Further to this the remaining channelled valley bottom wetlands are associated with artificial dams or modified habitat (Figure 6-5).

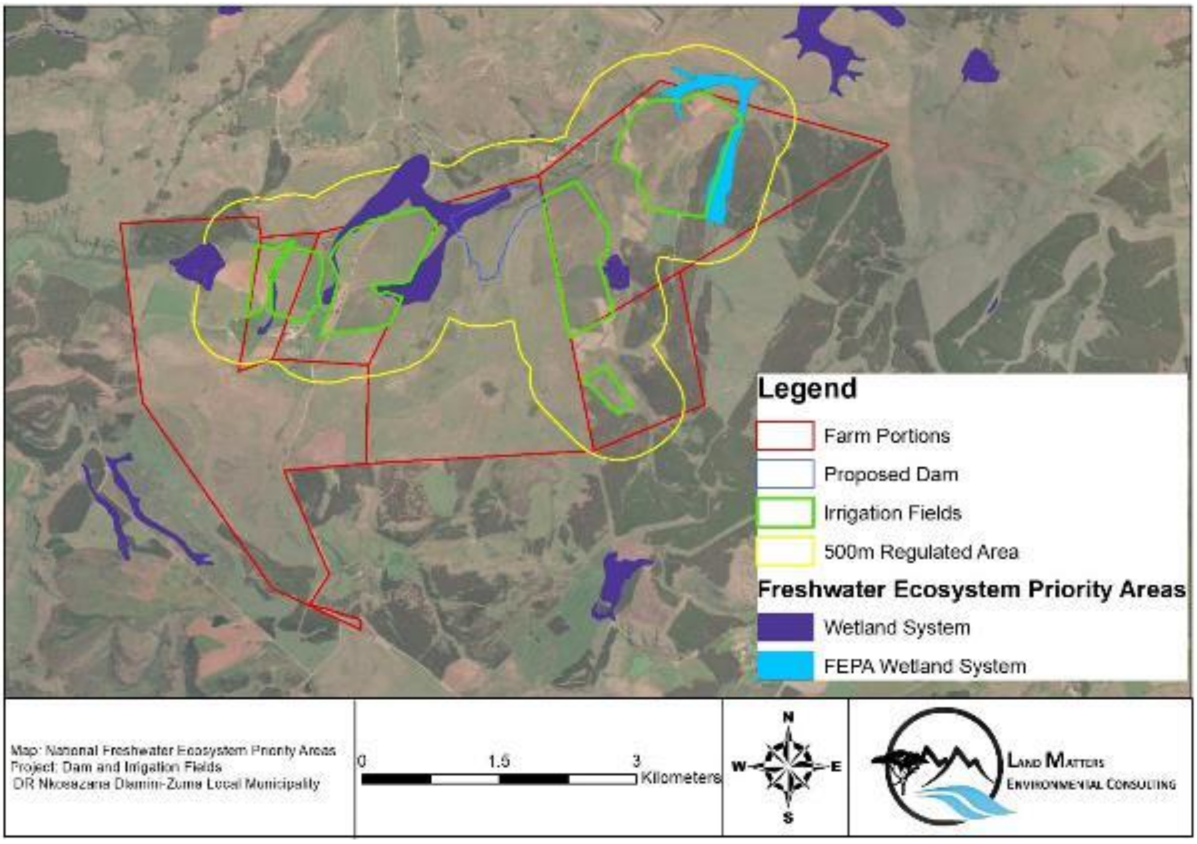

Figure 6-5: Wetlands within the study site as indicated by the NFEPA database (2011)

6.6. National Wetland Map 5

As an additional database to the NFEPA database, the more recent National Wetland Map 5 (van Deventer et al, 2018) database was utilised to assess the project area. The National Wetland Map 5 (NWM5) forms part of the National Biodiversity Assessment (2018) within the category of the Inland Aquatic (Freshwater) Realm. This project is a multi-partner project through the CSIR and SANBI. The NWM5 has significantly improved the representation of inland wetland ecosystem types. The representation of the extent of inland wetlands has improved by 123 %, whereas the incorrect representation of terrestrial ecosystems as wetlands has been reduced (Van Deventer et al, 2018).

The National Wetland Map 5 database yielded similar results to the FEPA database however the wetlands are reclassified as seep systems (Figure 6-6). All wetland features associated with the project site are classified within the latest National Biodiversity Assessment as Critically Endangered, and not protected (Van Deveter et al., 2019).

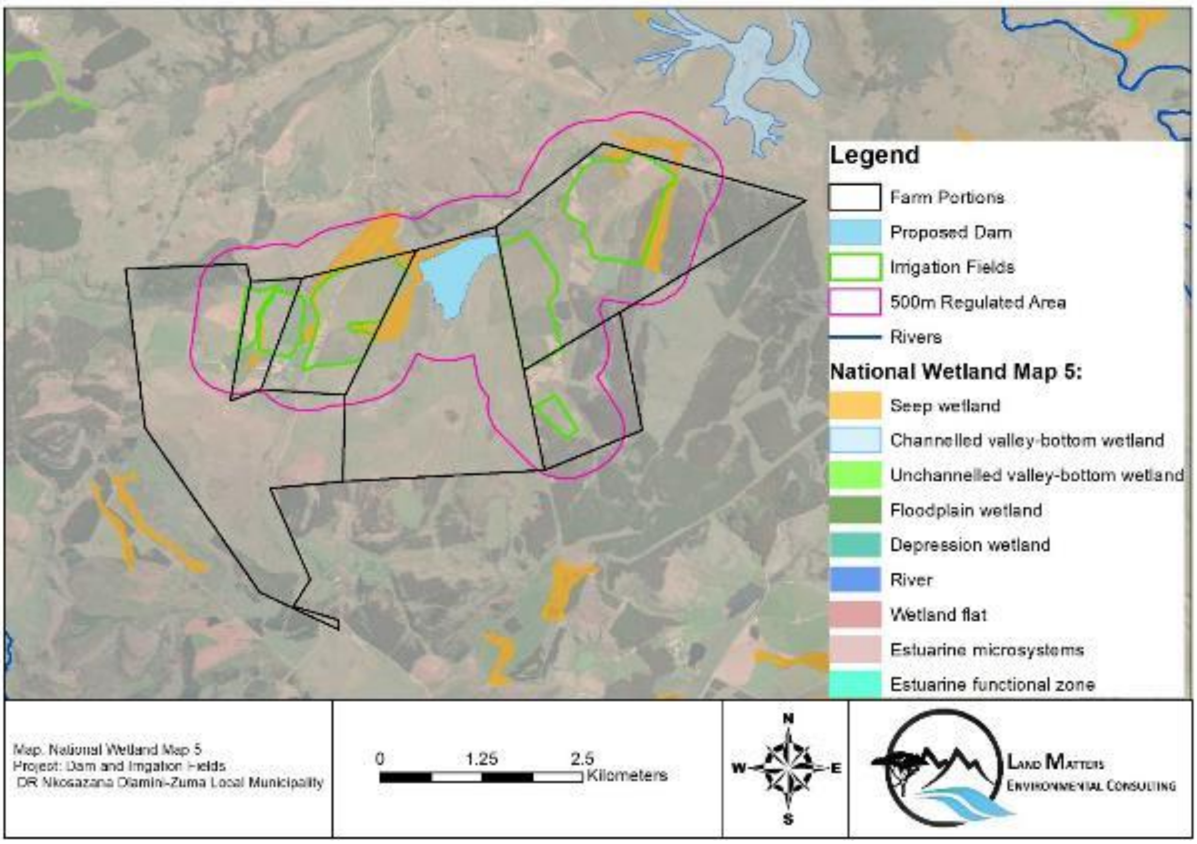

Figure 6-6: Wetlands within the study site as indicated by the NWM5 (2018)

7. RESULTS

7.1. Wetland Delineation

The South African classification system categorises wetland systems based on the characteristics of different Hydrogeomorphic (HGM) Units. An HGM unit is a recognisable physiographic wetland-unit based on the geomorphic setting, water source of the wetland and the water flow patterns (Macfarlane et al., 2009). There are five broad recognised wetland systems based on the abovementioned system and these are depicted in Figure 7-1. The classification of these wetlands is then further refined as per the 'Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (Ollis et al., 2013).

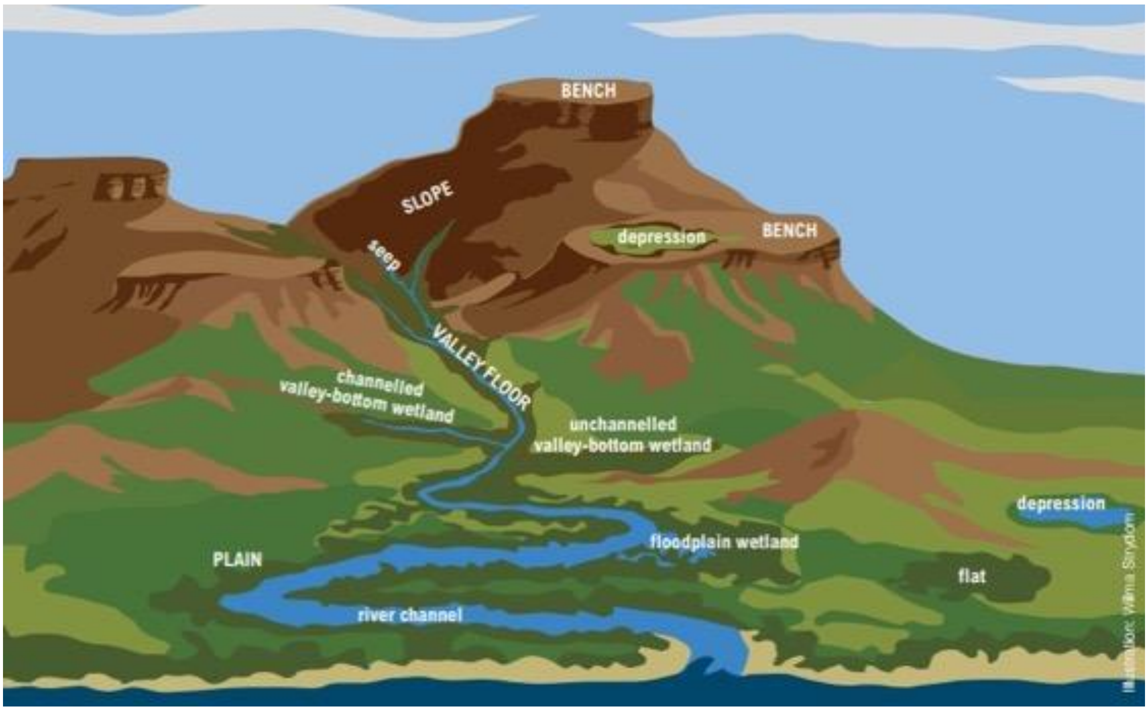

Figure 7-1: Diagrammatic representation of common wetland systems identified in South Africa

The delineation exercise concentrated both within the area to be inundated by the proposed dam construction, the irrigation fields as well as the 500 m regulated area around these sites. Based on the current identification of the four wetland indicators, fourteen HGM units were delineated within this project site. The HGM units were classified as thirteen seep systems and one floodplain wetland associated with the Ekamanzi River (Figure 7-4, Figure 7-5, Figure 7-6 and Figure 7-7).

Seepage wetlands (Figure 7-2) are characterised by their association with topographic positions that either cause groundwater to discharge to the land surface or rain-derived water to seep down-slope as subsurface interflow. Water movement through the seep is primarily attributed to interflow, with diffuse overland flow often being significant during and after rainfall events (Kotze et al., 2009; Ollis et al., 2013). 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.

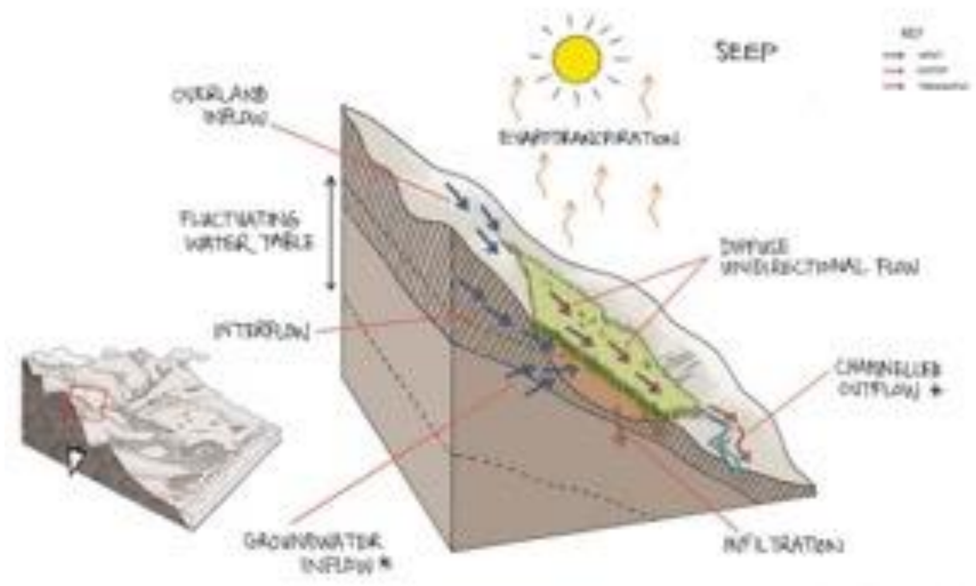

Figure 7-2: Diagrammatic representation of a seep system

Floodplain wetlands (Figure 7-3) are situated on mostly flat or gently-sloping land adjacent to and formed by an alluvial river channel under its present climate and sediment load, which is subject to periodic inundation by overtopping of the channel bank. They are typically characterised by a suite of geomorphological features associated with river-derived depositional processes, including point bars, scroll bars, oxbow lakes and levees. Water and sediment enter floodplain wetlands mainly as overspill from a major river channel during flooding. Water movement through the wetland is predominantly horizontal and bidirectional (i.e. in and out of the wetland), in the form of diffuse surface or subsurface flow, although significant temporary containment of water may occur in floodplain depressions. Water generally exits a floodplain wetland as diffuse surface and/or subsurface flow (often returning to the river channel), but infiltration and evapotranspiration of water from a floodplain wetland can also be significant, particularly if there are a number of depressional areas within the wetland.

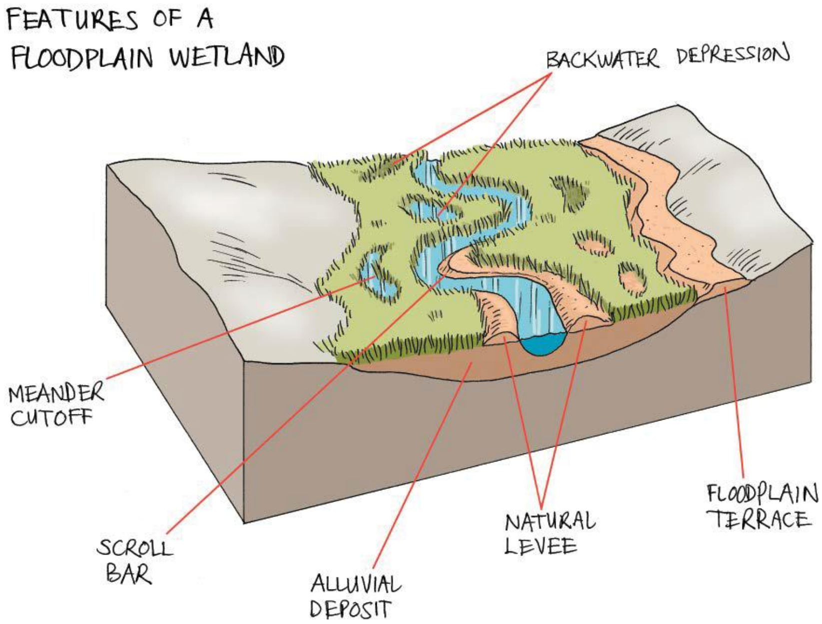

Figure 7-3: Diagrammatic representation of a floodplain system

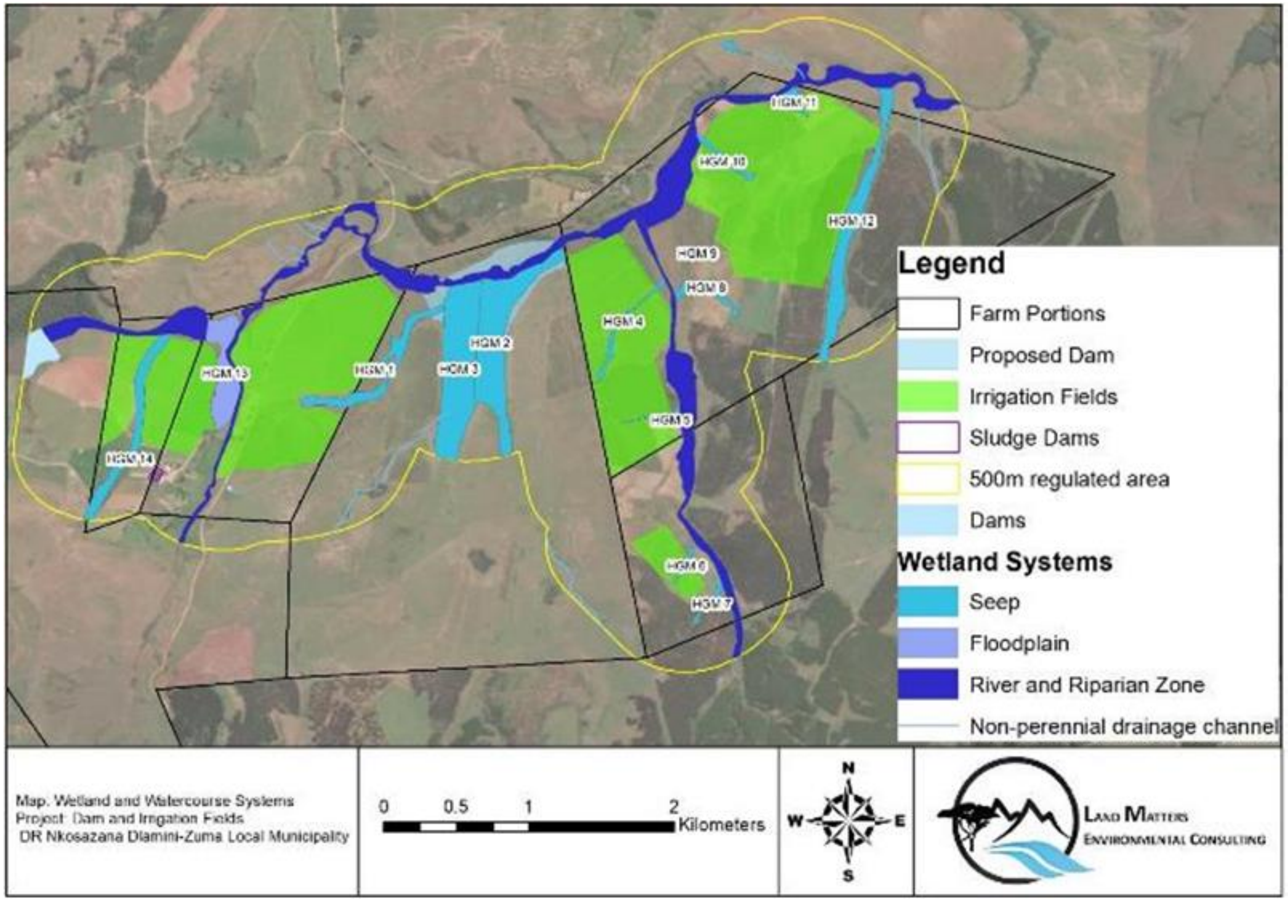

Figure 7-4: Wetland systems delineated within the study site

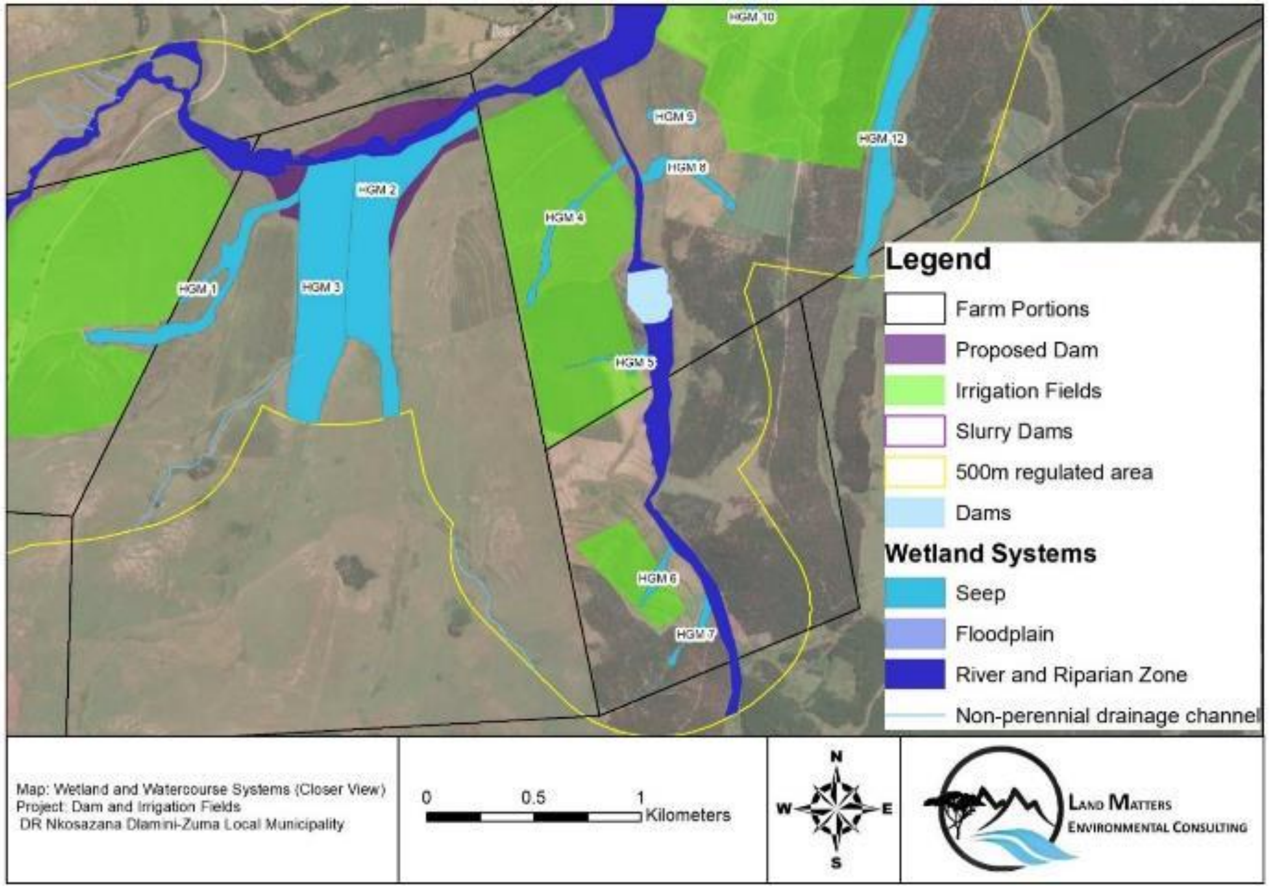

Figure 7-5: Closer view of the wetland systems delineated within the study site

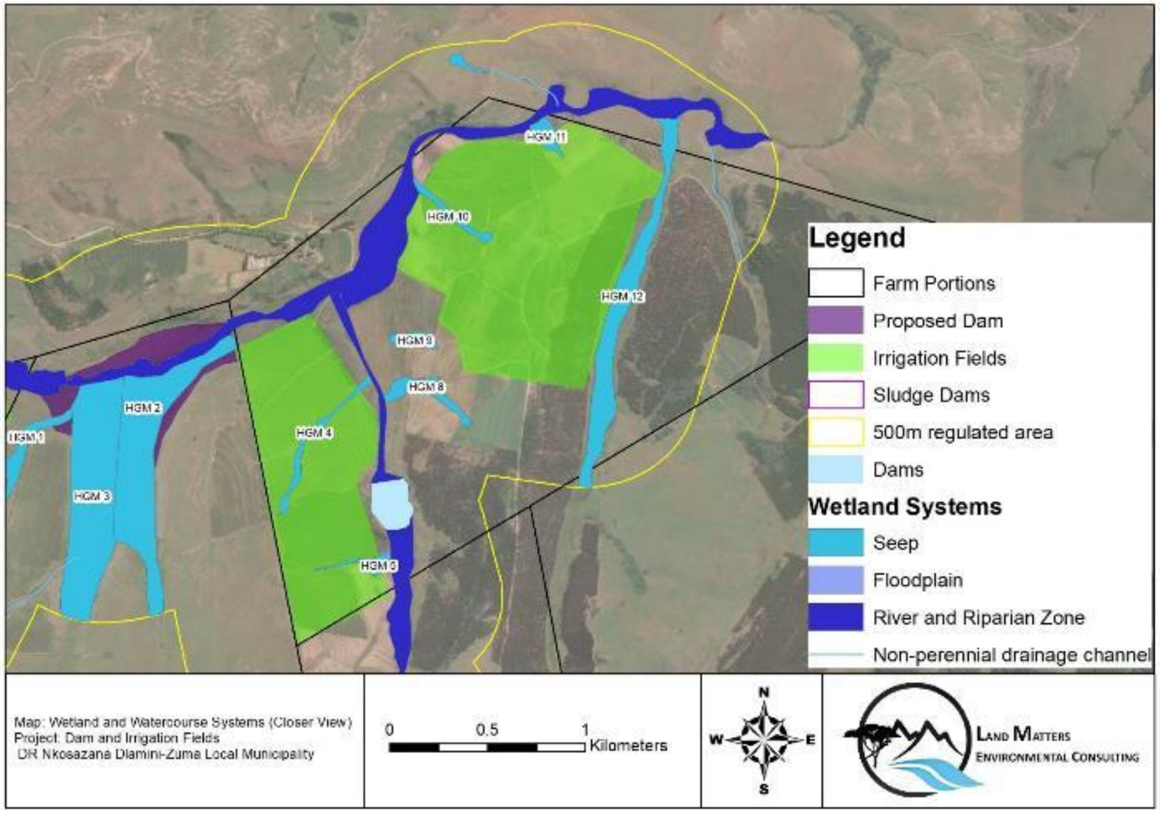

Figure 7-6: Closer view of the wetland systems delineated within the study site

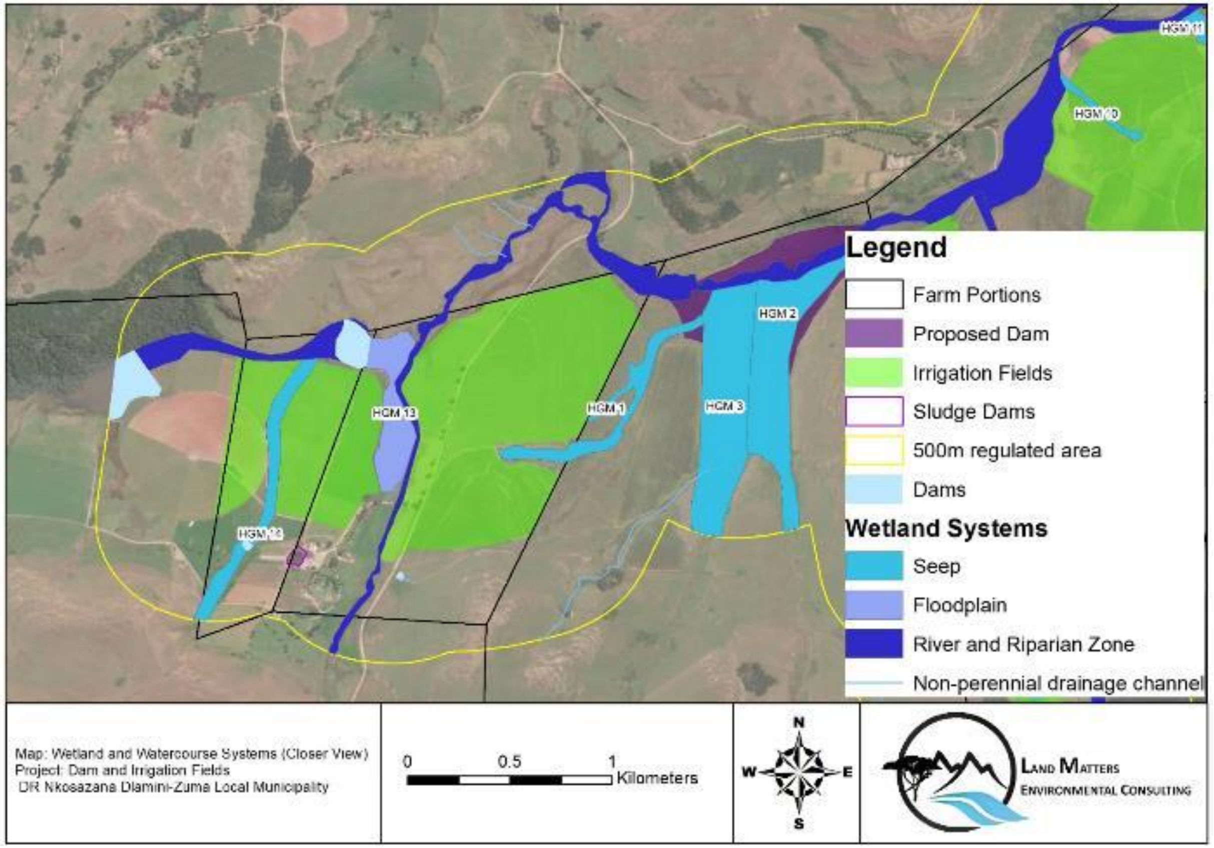

Figure 7-7: Closer view of the wetland systems delineated within the study site

Soil Wetness and Soil Form Indicator

Soil samples were taken throughout the project site using a hand-held soil auger during the field investigation. At each auger point, soils were examined for the presence of hydric (wetland) properties. Hydric soils are defined as those that typically show characteristics resulting from prolonged and repeated saturation. These characteristics are called redoximorphic features and include the presence of mottling (i.e., bright insoluble iron compounds); a gleyed matrix; and/or Manganese (Mn)/Iron (Fe) concretions (Figure 7-8).

The presence of redoximorphic features is the most important indicator of wetland occurrence, as these soil wetness indicators remain in wetland soils, even if they are degraded or desiccated (DWAF, 2005). It is important to note that the presence or absence of redoximorphic features within the upper 500 mm of the soil profile alone is sufficient to identify the soil as being hydric, or non-hydric and that a soil horizon does not have to be 100 % saturated for this reduction reaction to begin and to show within the profile as either mottling, a gleyed matrix or a concretion. A hydric soil will therefore not necessarily contain all the diagnostic horizons associated with redoximorphic features; however, all hydric soils will contain at least one of these features within the upper 500 mm of the soil profile (Collins, 2005).

Figure 7-8: Generic examples of hydric characteristics used as indicators for wetland conditions

Further to the identification of hydric properties, it is important to consider the soil form. The type of soil (or the soil form) has a significant influence on the formation and functioning of a wetland system and its location within a catchment. This includes the way in which water enters and flows through a wetland (Ollis et al., 2013). Soil forms are not randomly distributed in a landscape and therefore hydrological soil types typically occupy specific positions in the hillslope. This means that certain soils play more of a releasing or receiving role related to water movement within a hillslope or topographic position. This has important implications in landscape hydrology (van Tol, et al., 2013).

Soil sampling was undertaken within the assessment area, which includes the 500m regulated area. Soils within the site consisted of both hydric soils, (which included the Pinedene, Bloemdal and Katspruit soil forms) (Figure 7-9); and terrestrial soils (which included the Glenrosa, Hutton, Nkonkoni, and Clovelly soil forms) (Figure 7-10). Within the watercourse systems, alluvial soils were identified (Figure 7-11). The Katspruit soils were identified in the more permanently saturated areas while the Pinedene and Bloemdal soils were identified in the more seasonal and temporary zones of saturation.

Figure 7-9: Hydric soils identified in the wetland systems including the (A) Katspruit, (B) Pinedene and (C) Bloemdal soil forms

Figure 7-10: Terrestrial soils identified outside of the wetland systems including (A) Hutton, (B) Clovelly and (C) Glenrosa soil forms

Figure 7-11: Alluvial soils identified as part of the watercourse systems including the Ekamanzi River and riparian zones

Vegetation Indicator

According to DWAF (2005), vegetation is regarded as a key component to be used in the delineation procedure for wetlands as distinct changes in vegetation assemblages can be noted when moving through wetland systems, from the permanent zone to the temporary zone. Vegetation also forms a central part of the wetland definition in the National Water Act (Act 36 of 1998).

Hydrophytic vegetation are plant species that are adapted to growing in permanently or temporarily water-logged conditions (elevated water conditions in wetland soils). This is further subdivided into species that are obligate and facultative wetland species (Figure 7-1). The composition of a plant community is determined by the complex interactions between climate, soil type, position in the landscape and competition between plant species.

Wetland plant species perform a variety of functions including:

- Maintaining water quality by filtering out nutrients and sediments.
- Providing food, shelter and breeding habitat for both aquatic and terrestrial fauna.
- Preventing erosion.

Table 7-1: The classification of plants according to occurrence in wetlands (DWAF, 2008)

VEGETATION COMPONENTS	DESCRIPTION
Obligate wetland species	Almost always grow in wetlands (> 99% of occurrences)
Facultative wetland species	Usually grow in wetlands (67-99% of occurrences) but occasionally are found in non-wetland areas
Facultative species	Are equally likely to grow in wetlands and non-wetland areas (34-66% of occurrences)
Facultative dry-land species	Usually grow in non-wetland areas but sometimes grow in wetlands (1- 34% of occurrences)

These wetland “indicator” species assist in the identification of wetland systems and associated boundaries. However, using vegetation as a primary wetland indicator requires undisturbed conditions (DWAF, 2005). The alteration of habitat and associated floral communities has a detrimental impact on the ability to confidently rely on vegetation as wetland indicators. In these instances, it makes scientific sense to utilise a combination of terrain and soil characteristics in determining wetland boundaries around transformed areas.

Vegetation within the project site consists of remnants of the Drakensberg Foothill Moist Grassland vegetation type as well as disturbed areas from agricultural activities including cultivation practices and livestock grazing (Figure 7-12). Hydrophytic species noted during the field investigation included *Juncus effuses*, Cyperus and Kyllinga species aincluding *Cyperus rupestris, Cyperus sphaerocephalus, Kyllinga pulchella Monopsis decipens,* some Helichrysum species as well as Typha capensis. Gramminoid species included Harpochloa falx, *Sporobolus* sp., and *Eragrostis* sp. (Figure 7-12).

Some alien invasive species were also noted, particularly in HGM 2, HGM 3 as well as HGM 4 to 7 which are surrounded by cultivation practices and/or tree plantations including *Rubus* sp., *Bidens pilosa*, *Ageratum* sp. and *Eucalyptus* and *Acacia mearnsii* species (Figure 7-12).

Figure 7-12: Vegetation indicators within the assessment area including (A) hydrophytic vegetation within the wetland systems, (B) more disturbed areas from agricultural practices and (C) some alien invasive species

Terrain Indicator

The topography of an area is generally a good practical indicator for identifying those parts in the landscape where wetlands/watercourses are likely to occur. Generally, these occur as valley bottom units however, wetlands can also occur on steep to mid slopes where groundwater or surface water discharge is taking place through seeps (DWAF, 2005). In order to classify a wetland system and/or a watercourse the localised landscape setting must be taken into consideration through ground-truthing of the study site after initial desktop investigations (Ollis et al., 2014).

The study site is situated within an area characterised by a gentle to moderate landscape which gives rise to wetland systems. The study site ranges in altitude from approximately 1750m above sea level in north-eastern areas to 1490m above sea level in the valley bottoms along the Ekamanzi River (Figure 7-13). Slopes range from gentle to steep, with average moderate slopes of 8-9%. This topography gives rise to seep systems which form between the slopes as well as floodplain systems along the slowly meandering river system.

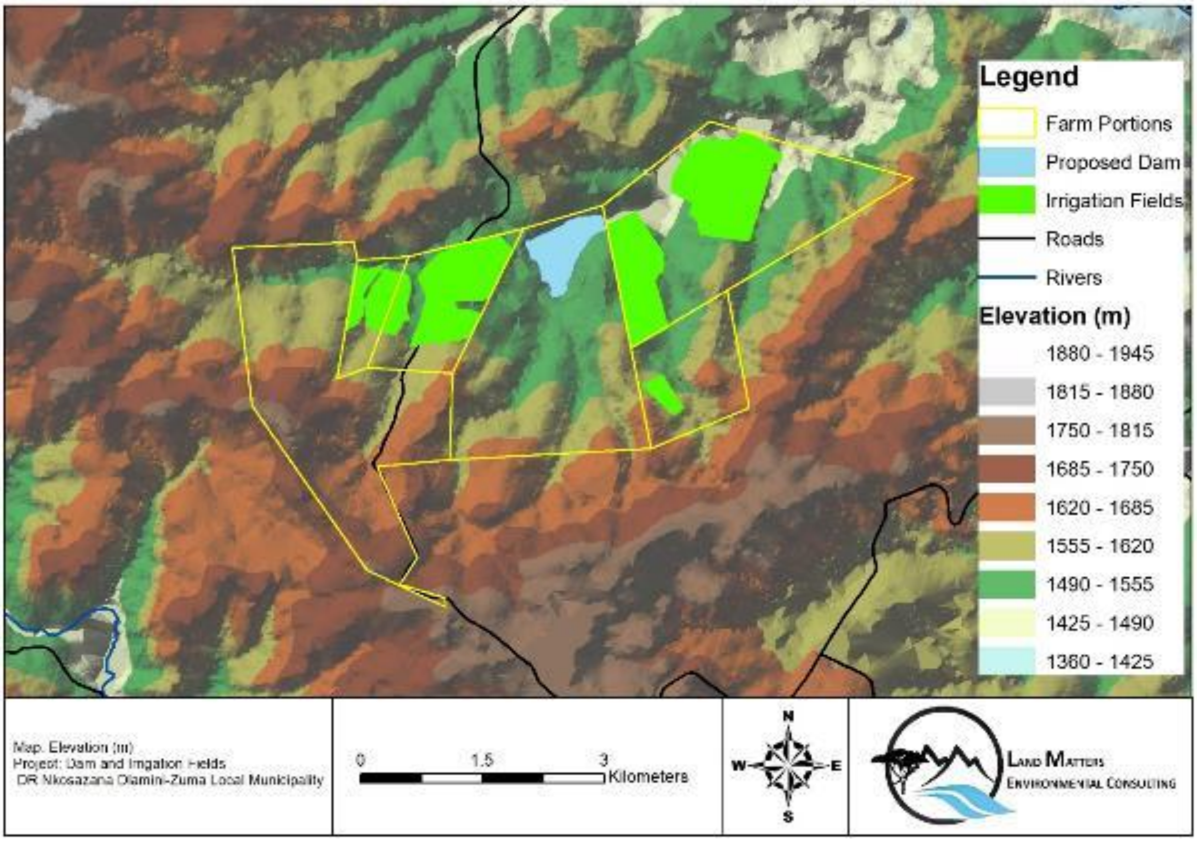

Figure 7-13: Topography (elevation) of the study site

7.2 Wetland Health and Functional Assessment

7.2.1. Present Ecological Score

The fourteen HGM units that were delineated were assessed with regards to their health according to the Wet-Health methodology (Level 2)[2]. HGM units were classified as Moderately Modified (PES Category C), and Largely Modified (PES Category D).

A number of impacts have occurred within the wetland systems as well as their respective catchments as a result of various historic and current agricultural activities within the area. These impacts include cultivation practices, the presence of dams, tree plantations and the construction of dirt roads to access cultivated fields.

Cultivation of wetland systems as well as within their catchments decreases their health and functional integrity as it causes the mixing of the soil profile, thus altering the bulk density, pH, and nutrient status, as well as changing the microtopography. This results in knock-on effects on the geomorphological setting and flow dynamics of the wetland. The negative effect on the soil health is often amplified by the input of fertilisers which increases the quantity of nitrates and phosphates within the wetland systems. Furthermore, the cultivation of the catchment areas associated with all wetland systems removes the historic vegetation, with shorter, less robust species becoming dominant. These species offer less resistance to stormwater flow and therefore an increase in velocity of overland flow during storm events. This leads to the formation of erosion gullies. Cultivation was recorded in a portion of HGM 2 and HGM 3, where the proposed dam is to be located, and this has led to the decline in health of these wetland systems.

Dams were not noted in any of the HGM units but were recorded higher up in the catchments as well as in the river system. Dams have long term negative impacts on the hydrology, geomorphology, and vegetation dynamics of river systems. They cause a decrease in the quantity of water reaching downstream areas as well as an increase in flooding of the upstream systems, leading to changes in the hydrological flow through the channels as surface flow and through the soil profile as subsurface flow. Further to this, dams act as sediment sinks, reducing the sediment load of water released downstream. This results in water that is regarded as ‘sediment hungry’, having an increased capacity for erosion.

Within the catchment areas of the majority of the wetland systems, tree plantations were recorded. Plantations adjacent to and within wetland systems have a significant impact on the water storage function of wetlands as these trees use more water than indigenous counterparts and their roots penetrate deeper into the water table.

[2] The current size of the delineated wetlands was recorded. It must be noted that this is not the entire size of the wetland but rather the portion of the system delineated within the assessment area.

A summary of the PES scores obtained for the field-based delineated systems following application of the Wet-Health approach is provided in Figure 7-2.

Table 7-2: Summary of PES scores

HGM Unit	Extent Delineated (Ha)	Hydrology	Geomorphology	Water Quality	Vegetation	PES Score (Category)
HGM 1	7.08	3.9	2.7	5.1	2.6	C (3.6)
HGM 2	21.27	4.1	3.0	4.8	5.1	D (4.2)
HGM 3	23.28	4.7	3.7	5.2	5.4	D (4.7)
HGM 4	2.01	6.3	4.8	5.6	6.5	D (6.0)
HGM 5	1.04	4.3	2.4	5.1	4.0	C (4.0)
HGM 6	0.88	7.0	2.4	4.8	4.0	D (5.4)
HGM 7	0.81	5.3	2.4	4.7	4.0	D (4.3)
HGM 8	2.19	4.0	2.2	4.8	4.0	C (3.8)
HGM 9	1.14	4.9	3.8	5.5	5.1	D (4.8)
HGM 10	1.47	4.1	3.1	5.2	4.6	D (4.3)

HGM Unit	Extent Delineated (Ha)	Hydrology	Geomorphology	Water Quality	Vegetation	PES Score (Category)
HGM 11	1.21	2.3	1.6	4.8	1.5	C (2.5)
HGM 12	13.19	4.1	1.8	4.5	3.1	C (3.5)
HGM 13	8.99	3.7	0.2	4.2	0.7	C (2.4)
HGM 14	7.80	5.6	3.2	5.1	3.8	D (4.6)

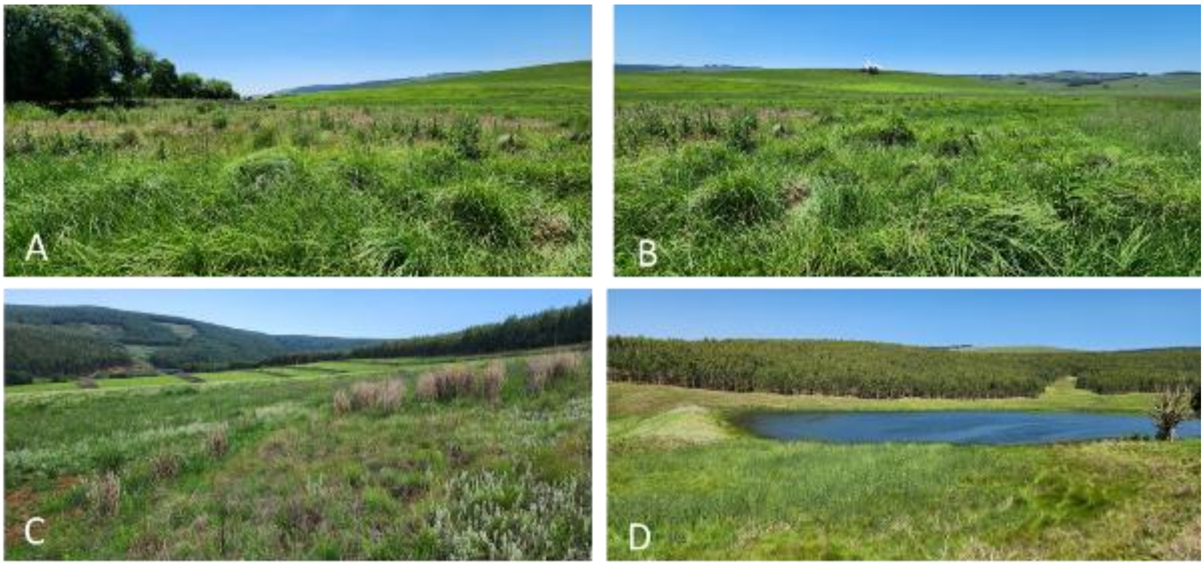

Figure 7-14: Some of the impacts noted within the wetland systems, including (A) cultivation in HGM 1 and (B and C) a dam in HGM 3

7.2.2. Functional Assessment (Ecosystem Goods and Services)

Ecosystem goods and services were calculated for all HGM units (Figure 7-15, Figure 7-16 and Figure 7-17). Scores depicted generally moderately functioning systems depending on the level of impact to the wetland. Highest scores received relate to flood attenuation, streamflow regulation, sediment trapping, filtration, and erosion control. All wetland systems provide ecosystem services for the maintenance of biodiversity within the agricultural landscape. The wetlands provide habitat for faunal, avifaunal and semi-aquatic species for feeding, breeding and foraging.

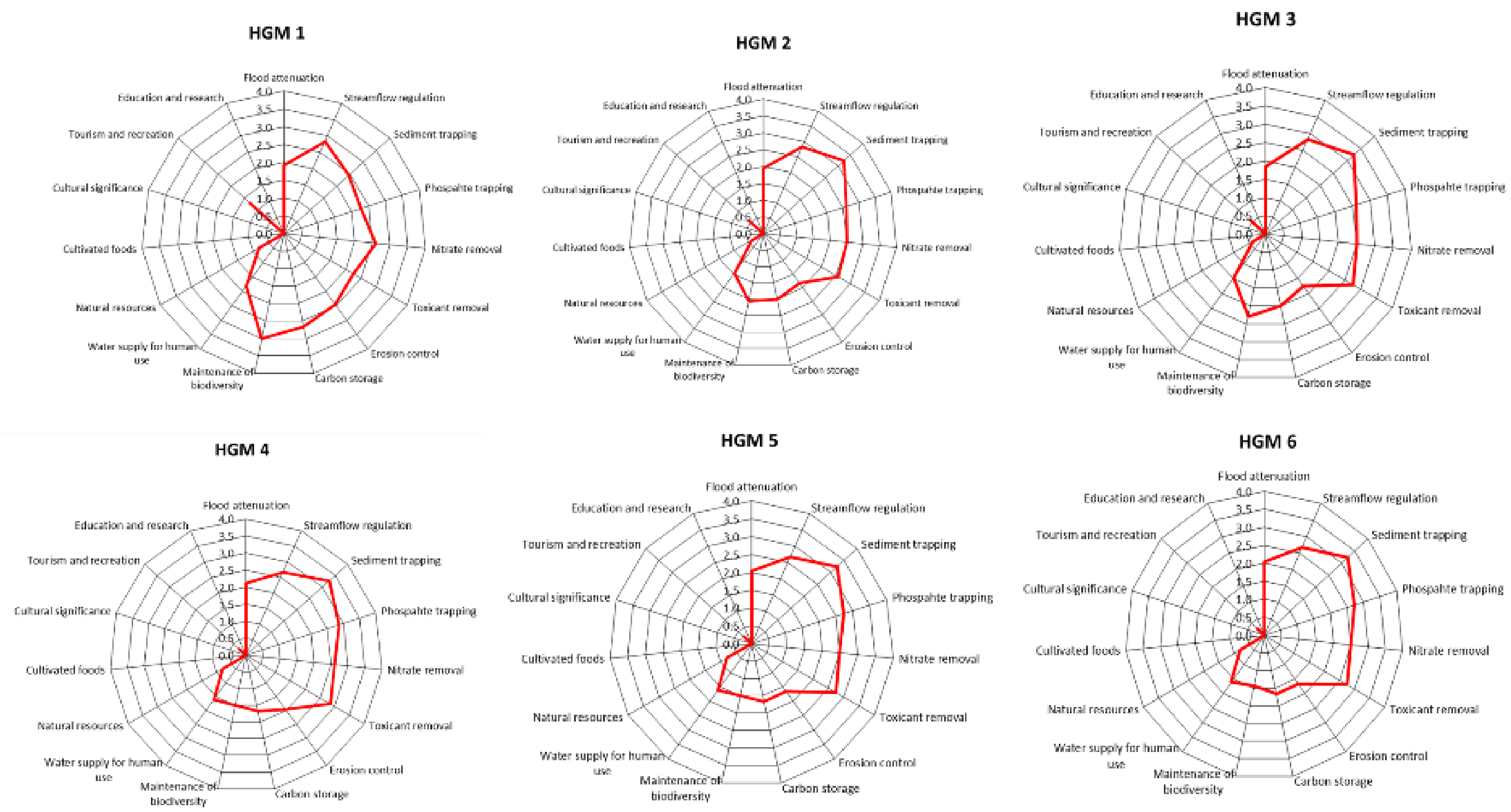

Figure 7-15: General WET-EcoServices results for HGM units 1-6

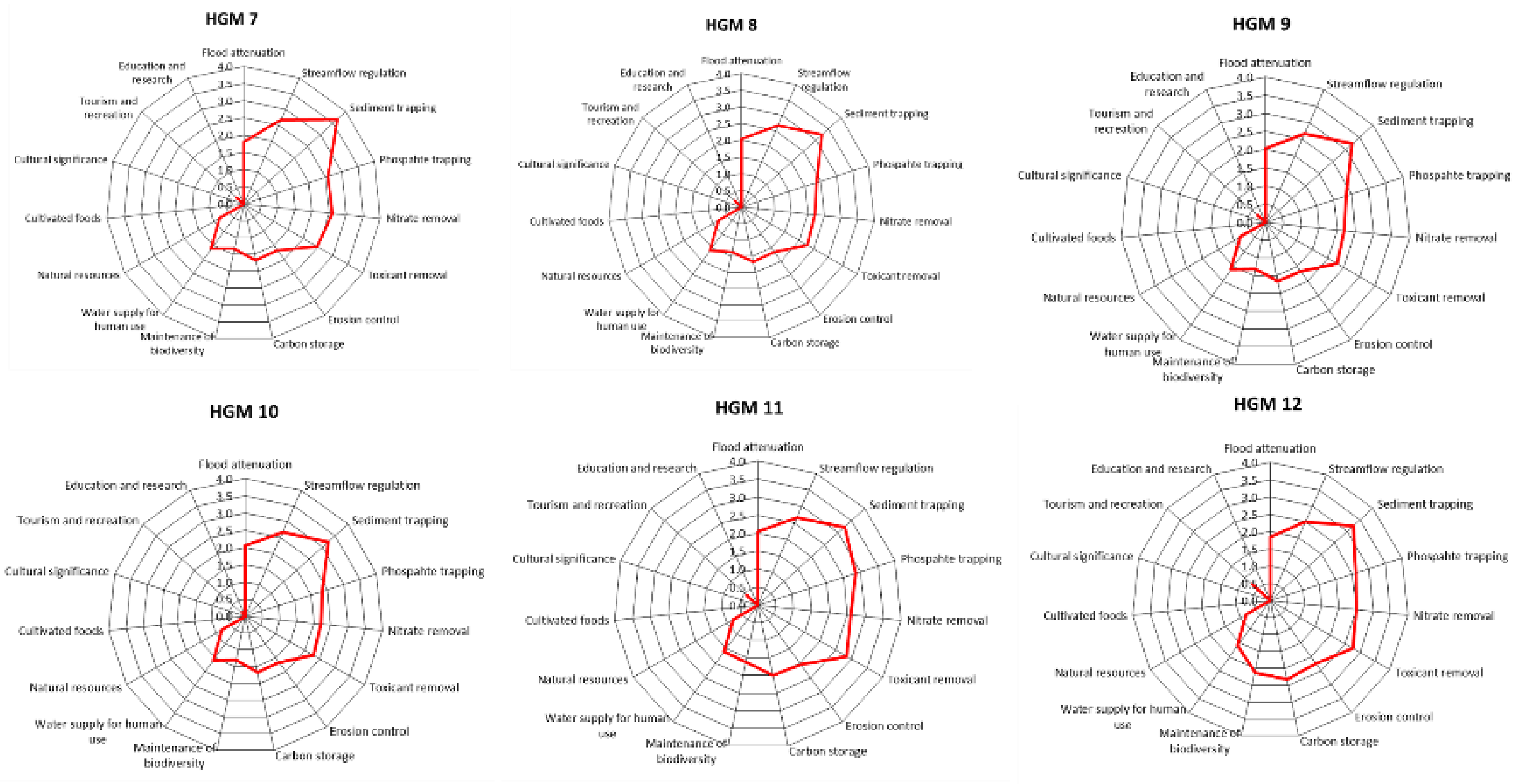

Figure 7-16: General WET-EcoServices results for HGM units 7-12

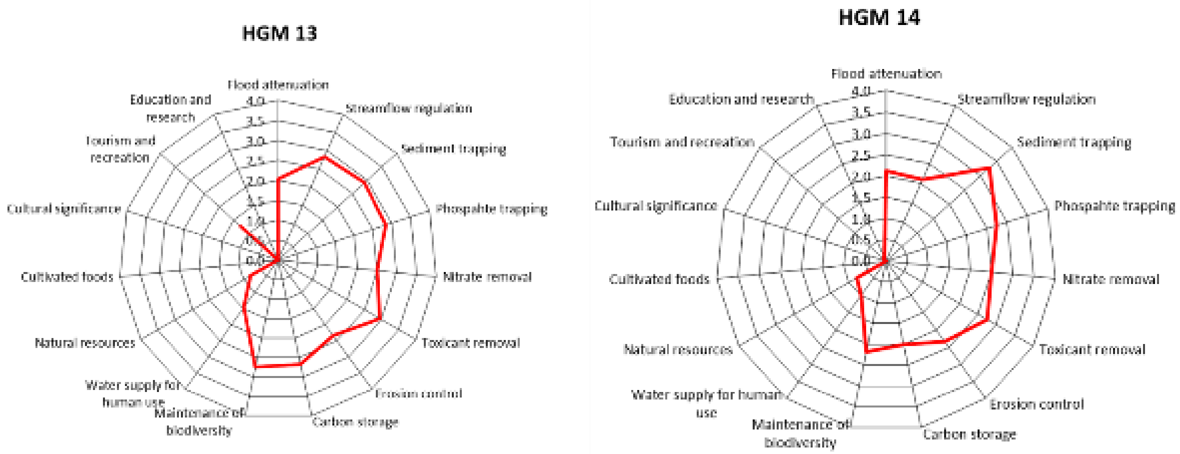

Figure 7-17: General WET-EcoServices results for HGM units 13 and 14

7.2.3. Ecological Importance and Sensitivity (EIS)

The EIS scores received for all HGM units ranges from low to moderate (Table 8-3), depending on the level of impact to the wetland as well as the level of saturation within each individual wetland system. These wetlands, particularly during the summer wetter months, will provide habitat for faunal and floral species. The Hydrological Functional Scores are moderate for all wetland systems, and this is related to the moderate functional integrity of these systems as provided by the scores obtained following the Wet-Ecoservices assessment. Socio-cultural benefits for the wetlands are associated with the use of the wetlands for crop cultivation as grazing of livestock as well as tree plantations adjacent to some of the systems.

Table 7-3: Summary of the Ecological Importance and Sensitivity

HGM Unit	EIS	Score (0-4)	Confidence (0-5)	Category
HGM 1	Ecological Importance and Sensitivity	2.36	4.00	**Moderate**
	Hydrological Functional Importance	2.43	4.50	**Moderate**
	Direct Human Benefits	1.00	4.00	**Low**
HGM 2	Ecological Importance and Sensitivity	1.81	4.00	**Low**
	Hydrological Functional Importance	2.44	4.50	**Moderate**
	Direct Human Benefits	1.00	4.00	**Low**
HGM 3	Ecological Importance and Sensitivity	1.78	4.00	**Low**
	Hydrological Functional Importance	2.43	4.50	**Moderate**
	Direct Human Benefits	1.00	4.00	**Low**
HGM 4	Ecological Importance and Sensitivity	1.50	4.00	**Low**
	Hydrological Functional Importance	2.49	4.50	**Moderate**
	Direct Human Benefits	1.17	4.00	**Low**
HGM 5	Ecological Importance and Sensitivity	1.39	4.00	**Low**
	Hydrological Functional Importance	2.40	4.50	**Moderate**
	Direct Human Benefits	1.17	4.00	**Low**
HGM 6	Ecological Importance and Sensitivity	1.18	4.00	**Low**

HGM UNIT	EIS	SCORE (0-4)	CONFIDENCE (0-5)	CATEGORY
	Hydrological Functional Importance	2.40	4.50	**Moderate**
	Direct Human Benefits	1.00	4.00	**Low**
HGM 7	Ecological Importance and Sensitivity	1.24	4.00	**Low**
	Hydrological Functional Importance	2.38	4.50	**Moderate**
	Direct Human Benefits	1.00	4.00	**Low**
HGM 8	Ecological Importance and Sensitivity	1.60	4.00	**Low**
	Hydrological Functional Importance	2.26	4.50	**Moderate**
	Direct Human Benefits	1.17	4.00	**Low**
HGM 9	Ecological Importance and Sensitivity	1.40	4.00	**Low**
	Hydrological Functional Importance	2.26	4.50	**Moderate**
	Direct Human Benefits	0.83	4.00	**Low**
HGM 10	Ecological Importance and Sensitivity	1.31	4.00	**Low**
	Hydrological Functional Importance	2.26	4.50	**Moderate**
	Direct Human Benefits	1.00	4.00	**Low**
HGM 11	Ecological Importance and Sensitivity	1.88	4.00	**Low**
	Hydrological Functional Importance	2.53	4.50	**Moderate**

HGM UNIT	EIS	SCORE (0-4)	CONFIDENCE (0-5)	CATEGORY
	Direct Human Benefits	1.17	4.00	**Low**
HGM 12	Ecological Importance and Sensitivity	2.32	4.00	**Moderate**
	Hydrological Functional Importance	2.50	4.50	**Moderate**
	Direct Human Benefits	1.33	4.00	**Low**
HGM 13	Ecological Importance and Sensitivity	2.58	4.00	**Moderate**
	Hydrological Functional Importance	2.63	4.50	**Moderate**
	Direct Human Benefits	1.33	4.00	**Low**
HGM 14	Ecological Importance and Sensitivity	2.07	4.00	**Moderate**
	Hydrological Functional Importance	2.47	4.50	**Moderate**
	Direct Human Benefits	1.17	4.00	**Low**

8. Identification of Impacts

Any activities associated with a natural system, whether historic, current, or proposed, will impact on the surrounding environment, usually in a negative way. In order to minimise these impacts development planning should be based on ecological principles that promote sustainable development. The purpose of this phase of the study was to identify and assess the significance of the potential impacts caused by the proposed construction of the dam, the use of the dam water for irrigation activities, as well as the use of the sludge dams for irrigation on the identified wetland systems. Furthermore, this section aims to provide a description of the mitigation required to limit the perceived impacts on the natural environment.

This project includes the construction of a storage dam with a capacity of 1 500 000m^3 (Figure 8-1) to be used for the irrigation of existing cultivation fields including perennial grass pastures and vegetables (Figure 8-2). Furthermore, the applicant currently utilises two sludge dams for irrigation purposes and these form part of the WUL application (Figure 8-3). The proposed dam will have a direct impact on a portion of HGM 1, HGM 2 and HGM 3. This will lead to the loss of 26.94ha of wetland area. The proposed irrigation will only occur within existing fields, and these occur outside of wetland systems. Furthermore, the sludge dams are located outside of all wetland systems, with the sludge used for irrigation.

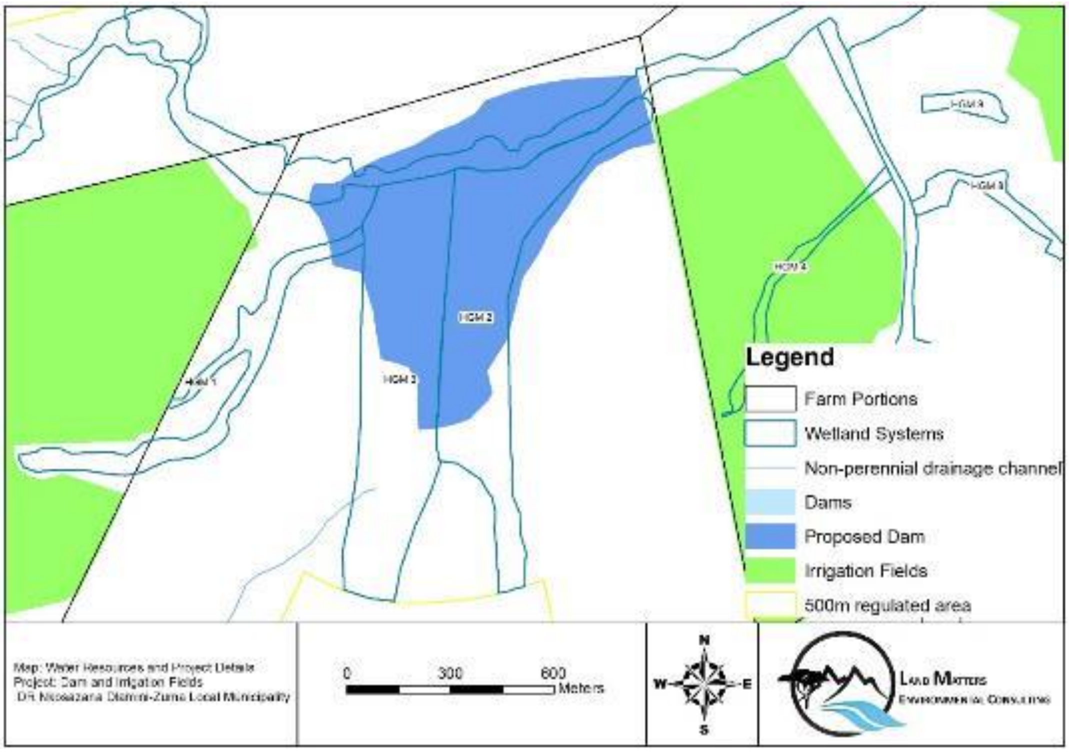

Figure 8-1: Wetland systems that will be affected by the proposed dam

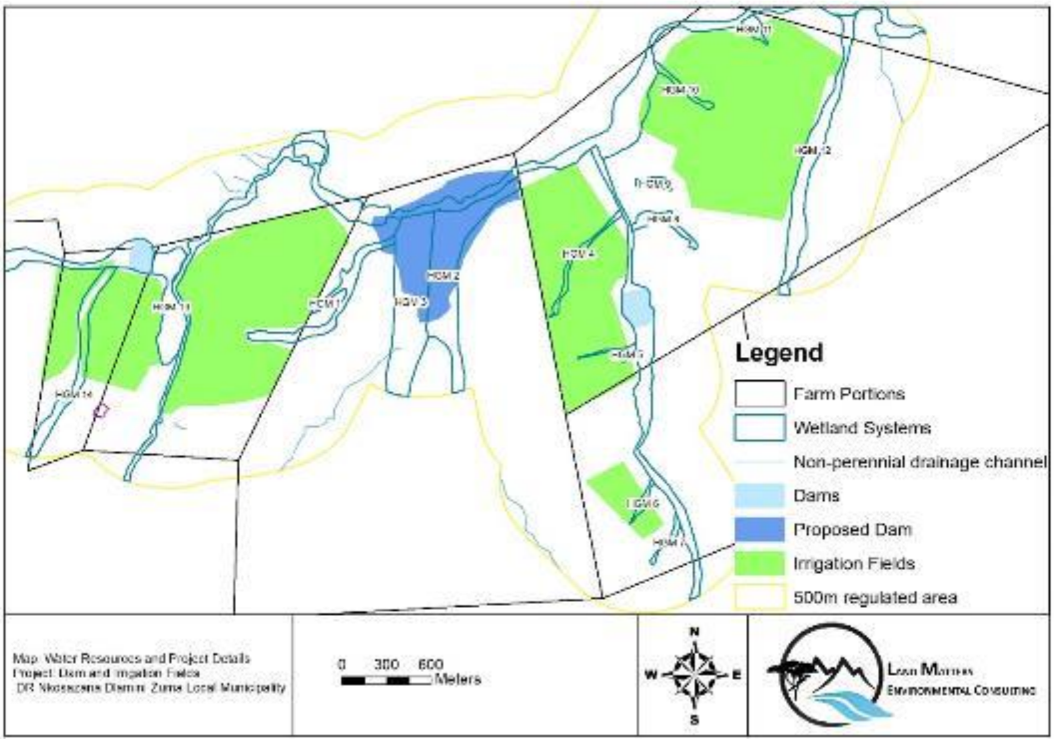

Figure 8-2:Wetland systems in relation to irrigation fields that will make use of the dam

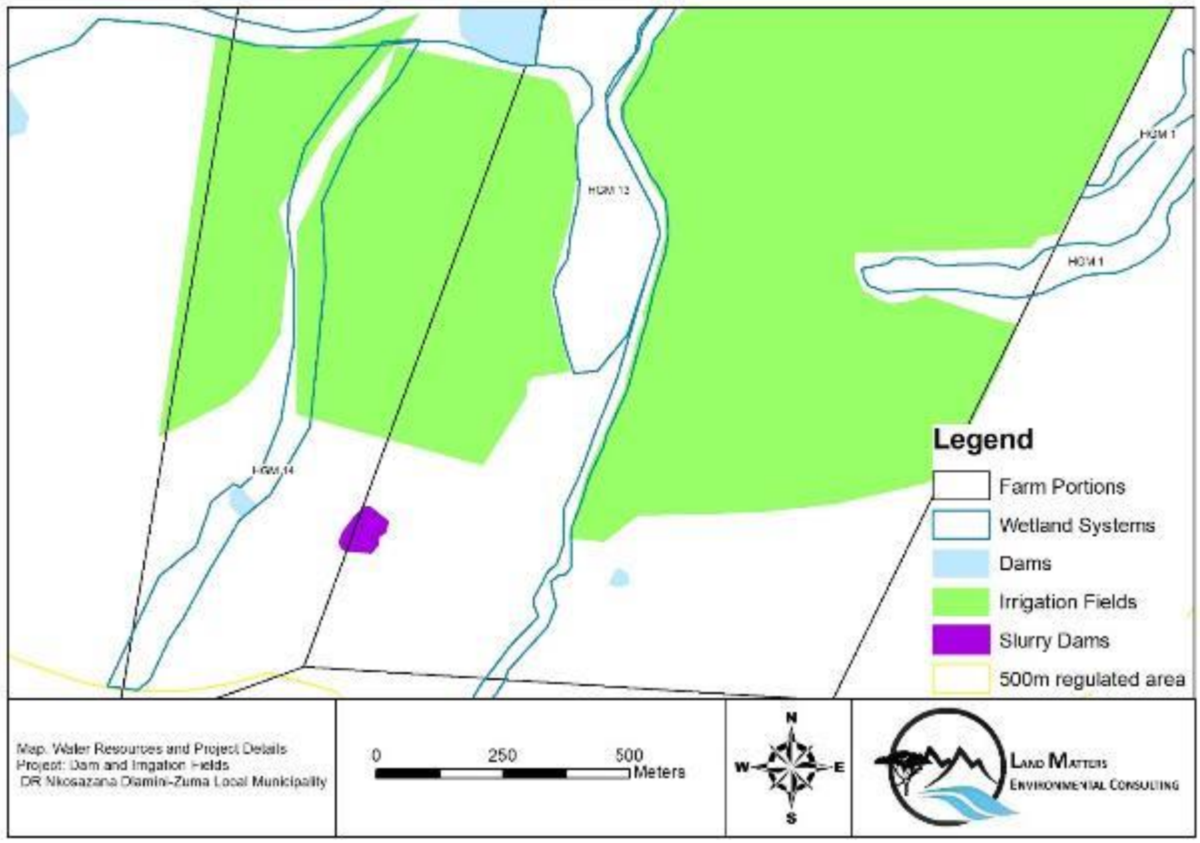

Figure 8-3: Wetlands in relation to the sludge dams

A number of potential impacts on the wetland systems have been identified. These relate to the direct loss of portions of wetland systems, the potential for soil erosion and sedimentation as a result of an increase in water flow from the irrigated fields to adjacent and downstream wetland systems, and thus the quantity of water entering into and flowing through the wetland systems; and the potential for pollution of the wetlands is increased if fertilisers and/or herbicides/pesticides are utilised on the cultivation fields. Mitigation measures must therefore be aimed at the protection of the current services provided by the wetland systems. Several general and specific measures are proposed to mitigate impacts.

8.1. Impact Assessment Criteria

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

The **Nature** of an impact refers to a description of the activity, inherent features, characteristics and/or qualities of the impact. Thus, each impact will be comprehensively detailed and contextualised prior to being assessed.

The **Extent** refers to the impact footprint. What that means is that if a species were to be lost then the extent would be global because that species would be lost to the world. If human health is threatened, then the impact is likely to be no more than local and possibly (in the case of a nuclear power station) regional.

Table 8-1: Descriptors and scoring for the Extent of an impact

Descriptors	Definitions	Score
Site only	The impact remains within the footprint or cadastral boundary of the site.	1
Local	The impact extends beyond the footprint or cadastral boundary of the site, to include the immediately adjacent and surrounding areas.	2
Regional	The impact includes the greater surrounding area within which the site is located.	3
National	The scale/extent of the impact is applicable to the Republic of South Africa.	4
Global	The scale /extent of the impact is global (i.e. world-wide).	5

The **Duration** is the period of time for which the impact would be manifest. Importantly, the concept of reversibility is taken into consideration in the scoring. In other words, the longer the impact endures, the less likely is the reversibility of the impact.

Table 8-2: Descriptors and scoring for the Duration of an impact

Descriptors	Definitions	Score
Temporary	The impact endures for only a short period of time (0-1 years).	1
Short term	The impact continues to manifest for a period of between 1-5 years.	2
Medium term	The impact continues to manifest for a period of 5-15 years.	3
Long term	The impact will cease after the operational life of the activity.	4
Permanent	The impact will continue indefinitely.	5

The **Magnitude** is the measure of the potential severity of the impact on the associated environment. As with duration, the concept of reversibility should be taken into account when considering the magnitude of the potential impact.

Table 8-3: Descriptors and scoring for the Magnitude of an impact

Descriptors	Definitions	Score
Negligible	The ecosystem pattern, process and functioning are not affected, although there is a small negative impact on quality of the ecosystem.	1
Minor	Minor impact - a minor impact on the environment and processes will occur.	2
Low	Low impact - slight impact on ecosystem pattern, process and functioning.	4
Moderate	Valued, important, sensitive or vulnerable systems or communities are negatively affected, but ecosystem pattern, process and functions can continue albeit in a slightly modified way.	6
High	The environment is affected to the extent that the ecosystem pattern, process and functions are altered and may even temporarily cease. Valued, important, sensitive or vulnerable systems or communities are substantially affected.	8

Very High	The environment is affected to the extent that the ecosystem pattern, process and functions are completely destroyed and may permanently cease.	10

The **Probability** is the likelihood of the impact manifesting. Although likelihood and probability may be considered interchangeable, the term likelihood is preferred as probability has a very specific mathematical and/ or statistical connotation. As such the expectation created by the term probability is that there will be an accurate empirically or mathematically defined expression of risk, which is not necessarily required.

Table 8-4: Descriptors and scoring for the Probability of an impact

Descriptors	Definitions	Score
Very improbable / Rare	Where it is highly unlikely that the impact will occur, either because of design or because of historic experience	1
Unlikely	Improbable – where the impact is unlikely to occur (some possibility), either because of design or historic experience.	2
Probable	there is a distinct probability that the impact will occur (< 50% chance of occurring)	3
Highly Probable	Most likely that the impact will occur (50 – 90% chance of occurring)	4
Definite	The impact will occur regardless of any prevention or mitigating measures (>90% chance of occurring).	5

The **Significance** of impacts will be derived through a synthesis of ratings of all criteria in the following calculation:

(Extent + Duration + Magnitude) x Probability = Significance

Table 8-5: Descriptors for the significance score of an impact

Descriptors	Definitions	Score
Low	The perceived impact will not have a noticeable negative influence on the environment and is unlikely to require management intervention that would incur significant cost.	**0 – 19**
Low to Moderate	The perceived impact is considered acceptable, and application of recommended mitigation measures recommended.	**20 – 39**
Moderate	The perceived impact is likely to have a negative effect on the receiving ecosystem and is likely to influence the decision to approve the activity. Implementation of mitigation measures is required, as is routine monitoring to ensure effectiveness of recommended mitigation measures.	**40 – 59**
Moderate to High	The perceived impact will have a significant impact on the receiving ecosystem and will likely have an influence on the decision-making process. Strict implementation of mitigation measures as provided is required, and strict monitoring and high levels of compliance and enforcement in respect of the impact in question are required.	**60 – 79**
High	The impact on the receiving ecosystem is considered of high significant and likely to be irreversible, and therefore highly likely to result in a fatal flaw for the project. Alternatives to the proposed activity are to be investigated as impact will have an influence on the decision-making process.	**80 - 100**

8.2. Loss of wetland systems from the proposed construction of the dam

IMPACTS ASSOCIATED WITH THE LOSS OF THE WETLAND SYSTEMS										
Potential impact	Extent		Duration		Magnitude		Probability		Significance scoring without mitigation	Significance scoring with mitigation
	Without	With	Without	With	Without	With	Without	With		
CONSTRUCTION PHASE – LOSS OF WETLAND SYSTEMS										
Loss of wetland systems	2	2	5	5	4	4	5	5	55 (Moderate)	55 (Moderate)
OPERATIONAL PHASE – LOSS OF WETLAND SYSTEMS										
Loss of wetland systems	2	2	5	5	6	6	5	5	65 (Moderate to High)	65 (Moderate to High)

<u>Description of impact</u>

The proposed dam will lead to the direct loss of a 26.94ha of a portion of HGM 1, HGM 2 and HGM 3 as per the following:

- 0.39ha of HGM 1 will be lost,
- 11.37ha of HGM 2 will be lost and
- 15.18ha of HGM 3 will be lost.

The construction of the dam wall will occur in the Ekamanzi River and well as a portion of HGM 2. Therefore the loss of the entire 26.94ha of wetland area will only occur if the dam reaches full capacity. Loss will include both the construction of the dam wall in HGM 2 as well as the flooding of the portions of HGM 1, HGM 2 and HGM 3. Loss of the portions of the HGM units through flooding will change these areas of the systems to permanently saturated, leading to a loss in the existing vegetation as well as changing the geomorphological characteristics of these systems.

<u>Mitigation Options</u>

The loss of a portion of the wetland systems can not be mitigated should the project be authorised. As a result of this, an offset application must be conducted as per the Wetland Offsets Best Practice Guidelines for South Africa (Macfarlane et al, 2016) to compensate for the loss of wetland habitat. The offset application must take into account the location of the wetland systems, their present ecological state (health) and functional integrity.

8.3. Soil erosion, sedimentation, and degradation of the wetlands

IMPACTS ASSOCIATED WITH SOIL EROSION, SEDIMENTATION AND DEGRADATION OF THE WETLANDS										
Potential impact	Extent		Duration		Magnitude		Probability		Significance scoring without mitigation	Significance scoring with mitigation
	With out	With	With out	With	With out	With	Wit hout	With		
CONSTRUCTION PHASE										
Soil erosion, sedimentation, and degradation of the wetlands from the construction of the dam	2	1	1	1	6	4	4	3	36 (Low to Moderate)	18 (Low)
Soil erosion, sedimentation, and degradation of the wetlands from the irrigation of fields	2	1	2	2	6	4	4	3	36 (Low to Moderate)	18 (Low)
Soil erosion, sedimentation, and degradation of the wetlands from the use of the sludge dams	1	1	5	5	4	2	3	2	24 (Low to Moderate)	16 (Low)
OPERATIONAL PHASE										

Ongoing soil erosion, sedimentation, and degradation of the wetlands from the construction of the dam	2	1	5	5	6	4	4	3	52 (Moderate)	30 (Low to Moderate)
Ongoing soil erosion, sedimentation, and degradation of the wetlands from the irrigation of fields	2	1	5	5	6	4	4	3	52 (Moderate)	30 (Low to Moderate)
Ongoing soil erosion, sedimentation, and degradation of the wetlands from the use of the sludge dams	1	1	5	5	6	4	4	3	48 (Moderate)	30 (Low to Moderate)

<u>Description of impact</u>

The construction of the dam wall will result in the alteration of the soil profile and expose soils to environmental factors including rainfall and wind. The exposure to these factors will result in the removal of sediment and the deposition of this sediment into HGM 2. Sedimentation of the deposited soil poses a risk to the geomorphological/functional integrity of both HGM 2 and the Ekamanzi River as it increases the turbidity of water within these water resources. This sedimentation is destructive to many faunal species affecting their habitat, breeding, and feeding cycles as well as causing smothering of vegetation. Compaction of soil within the work area will furthermore occur which will experience heavy vehicle traffic during construction. This will increase the soil bulk density, reduce the porosity and the hydraulic conductivity, impeding hydrological flow and leading to wetland degradation.

In the long term, the formation of a dam commonly impacts the frequency of downstream flooding and sediment cycling. This includes the timing; water quantity; and chemical composition of the water associated with the flow of water into and through the river system as well as HGM 1, HGM 2 and HGM 3. An increase in the flooded area of the dam will hold back a greater quantity of water and sediments that would naturally replenish the downstream ecosystems, particularly the Ekamanzi River. When a river channel is deprived of its sediment load, it seeks to recapture it by eroding the downstream channel bed and banks. Channel beds downstream of dams are therefore typically eroded and this damage can extend for kilometres outside of the dam area. Further to this, channel bed deepening (or incising) will also lower the groundwater table along the channel and within the associated wetland systems. As the connectivity of the river channel to its downstream component is reduced as a result of the dam, the surrounding plant life becomes disjointed and disturbed having a negative impact on the vegetation community (NSW, 2002).

With regards to the use of the dam for irrigation purposes, potential impacts can occur if there is oversaturation of the fields. Excess water will runoff of the area as overland flow once the soil profile is saturated. This can lead to the washing away of the topsoil associated with the disturbed cultivated fields and its deposition within the downstream wetland and river systems. Sedimentation of wetlands and watercourses causes changes to the geomorphic setting and hydrological flow dynamics having knock on effects on the vegetation communities associated with these systems through the smothering of species. This leads to a general decline in the health and functional integrity of the system.

<u>Mitigation Options</u>

- The use of sediment traps must be enforced downstream of the dam wall area to minimise the flow of sediment into the wetland and river areas outside of the dam.
- Whilst constructing the required structures for the dam, frequent monitoring of the shape of the dam wall must be enforced to ensure there is no failure of the wall. Once at the correct height the wall must be convex in shape with more soil laid in the centre of the wall, where more settlement will take place, and the crest must have a slight slope towards the less erodible upstream side to permit surface water drainage which will be full of sediment to not be washed downstream.
- Further to this, the last soil layers to be laid on the wall must be good quality topsoil so as to encourage rapid vegetation growth to minimise the movement of soil in the long term.
- If it is not possible to establish vegetation on the wall, other erosion protection measures must be taken. These include stone pitching the wall or placing rip-rap on areas of high risk such as the ends of the wall that are likely to be affected by erosion and then to place loose stone and rock on the rest of the wall.
- Frequent monitoring of the dam must be carried out as per an environmental management programme to ensure that any minor problems with erosion can be timeously fixed.

- The duration of the irrigation cycles should be monitored to establish a baseline timing according to soil type in order to avoid excessive saturation and surface runoff, which would increase the erosion hazard and sedimentation of downstream wetlands.
- Do not allow surface water from over-irrigation to be concentrated, or to flow down slopes created within any pivot areas without erosion protection measures being in place.
- Erosion control measures must be implemented throughout areas susceptible to erosion. These measures include but are not limited to - sand bags, hessian sheets, silt fences, retention or replacement of vegetation and geotextiles such as soil cells which must be used in the protection of slopes.
- Any irrigation pipelines installed must be buried at a sufficient depth so that they do not interfere with surface water movement leading to erosion.
- When soil is excavated for the pipeline trench, the topsoil and subsoil must be separated and placed back in the trench in the correct order.
- Schedule soil preparation and planting activities, such that there are no unprecedented delays, to ensure that the soil exposure duration is reduced to an absolute minimum.
- Any vegetation clearance, soil preparation and planting must be scheduled to coincide with the low rainfall season such that surface runoff and erosion are minimal.
- Soil compaction (where encountered) can be alleviated by lightly ripping the soils to at least 45 cm below ground surface to physically loosen the soil prior to re-vegetating the soil.

8.4. Pollution of water resources and soil

IMPACTS ASSOCIATED WITH POLLUTION OF THE WETLANDS AND SOIL										
Potential impact	Extent		Duration		Magnitude		Probability		Significance scoring without mitigation	Significance scoring with mitigation
	With out	With	With out	With	With out	With	With out	With		
CONSTRUCTION PHASE										
Pollution of wetlands and soil from the construction of the dam	2	1	1	1	6	4	4	2	36 (Low to Moderate)	12 (Low)
Pollution of wetlands and soil from the irrigation of fields	2	1	1	1	8	4	4	3	44 (Moderate)	18 (Low)
Pollution of wetlands and soil from the use of the sludge dams	2	1	1	1	6	4	3	2	27 (Low to Moderate)	12 (Low)
OPERATIONAL PHASE										
Pollution of wetlands and soil from the construction of the dam	2	1	5	5	6	4	4	3	52 (Moderate)	30 (Low to Moderate)
Pollution of wetlands and soil from the irrigation of fields	2	1	5	5	8	4	4	3	60 (Moderate to High)	30 (Low to Moderate)
Pollution of wetlands and soil from the use of the sludge dams	2	1	5	5	6	4	3	2	39 (Low to Moderate)	20 (Low to Moderate)

Description of the impact

Sediment release into the downstream aquatic environment is one of the most common forms of waterborne pollution. Sediment will be released into the wetland and river system during the construction of the dam wall. Furthermore, mismanagement of waste and pollutants including hydrocarbons, construction waste, and other hazardous chemicals from any heavy machinery used to construct the dam wall result in these substances entering and polluting HGM 2 and the Ekamanzi River either directly through surface runoff during rainfall events, or subsurface water movement. The linked nature of these systems to downstream water resources will result in pollutants being carried downstream from the construction site having consequences on further downstream users. An increase in pollutants will lead to changes in the water quality of the water resources affecting their ability to maintain biodiversity and act as ecological corridors in the larger landscape.

Furthermore, agricultural practices including irrigation and cultivation can lead to increased levels of nutrients and pollutant loads. This is generally in the form of pesticides/herbicides and fertilisers. This increased load will result in changes to the nutrient and pollutant levels of the soils and waters of the wetland and river systems (www.fao.org). Given the linked nature of the wetlands to downstream water resources, these pollutants have the means to affect the downstream receiving environment if not managed. This will lead to a decline in the water quality of the affected water resources.

Mitigation Options

- No release of any substance i.e. cement, oil, fertilisers or pesticides that could be toxic to fauna or faunal habitats. Furthermore, the washing of any containers, wheelbarrows, spades, picks or any other equipment that may be used and that has been contaminated with cement or chemicals within any of the wetland and river systems or dams must be strictly prohibited.
- 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 (not to be disposed of within the natural environment). Any contaminated soil must be removed, and the affected area rehabilitated immediately – consult with a wetland/aquatic specialist if spills occur.
- The duration of the irrigation cycles should be monitored to establish a baseline timing according to soil type in order to avoid excessive saturation and surface runoff, which would increase the erosion hazard and sedimentation of downstream wetlands as well as release of excess nutrients/pollutants.
- Should any waste be generated during day-to-day agricultural activities, these must be disposed of and not dumped in open land.

8.5. Invasive alien species encroachment

IMPACTS ASSOCIATED WITH ALIEN INVASIVE SPECIES										
Potential impact	Extent		Duration		Magnitude		Probability		Significance scoring without mitigation	Significance scoring with mitigation
	With out	With	With out	With	With out	With	With out	With		
CONSTRUCTION PHASE										
Spread of invasive alien vegetation	2	1	1	1	4	2	3	2	21 (Moderate to Low)	8 (Low)
OPERATIONAL PHASE										
Spread of invasive alien vegetation	2	1	5	5	6	4	4	2	52 (Moderate)	20 (Low to Moderate)

Description of the impact

Any disturbance to a vegetation community throughout the project area, increases the likelihood of the colonisation and encroachment of alien invasive species into the area. Alien species were noted on site, particulary *Rubus* sp (American bramble) and these species will colonise newly disturbed sites. Alien species generally out-compete indigenous species for water, light, space, and nutrients as they are adaptable to changing conditions and are able to easily invade a wide range of ecological niches (Bromilow, 2010). Alien invader plant species pose an ecological threat as they alter habitat structure, lower biodiversity (both number and "quality" of species), change nutrient cycling and productivity, and modify food webs (Zedler, 2004).

Mitigation Options

- An invasive alien management programme must be incorporated into the management of the farm.
- Ongoing alien plant control must be undertaken. Areas which have been disturbed will be quickly colonised by invasive alien species. An ongoing management plan must be implemented for the clearing/eradication of alien species.

- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. This requirement is in fulfilment of the terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004).

9. Risk Matrix

The Risk Assessment for the proposed construction of the dam, the irrigation, and the use of the sludge dams was undertaken in accordance with the General Authorisation in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21 (c) and (i) (Notice 509 of 2016). The risk assessment involves the analysis of the risk matrix provided in appendix 1 of this notice and involves the evaluation of the severity of impacts to the flow regime, water quality, habitat, and biota of the water resource. Based on the outcome of the Risk Assessment Matrix, low risk activities will be generally authorised with conditions, while moderate to high-risk activities will be required to go through a Water Use Licence Application Process. Water use activities that are authorised in terms of the General authorisations will still need to be registered with the Department of Water and Sanitation.

It must be borne in mind that when assessing the impact significance following the DWS Risk Assessment Matrix, determination of the significance of the impact assumes that mitigation measures as listed within this report as well as within an Environmental Management Programme for the construction and operational phase of the development are feasible and will be implemented, and as such does not take into consideration significance before implementation of mitigation measures.

The risk assessment is provided in Appendix B. Impacts associated with the construction and operation of the dam and the associated loss of wetland area received a Moderate Risk Score. Impacts associated with the use of the dam for irrigation received Moderate Risk Scores and the continuation of the use of the sludge dams received a Low Risk Score.

10. Conclusions and Recommendations

Based on the current identification of the four wetland indicators, fourteen HGM units were delineated within this project site. The HGM units were classified as thirteen seep systems and one floodplain wetland associated with the Ekamanzi River.

The fourteen HGM units were assessed with regards to their health according to the Wet-Health methodology (Level 2). HGM units were classified as Moderately Modified (PES Category C), and Largely Modified (PES Category D).

This project includes the construction of a storage dam with a capacity of 1 500 000m^3 to be used for the irrigation of existing cultivation fields including perennial grass pastures and vegetables. Furthermore, the applicant currently utilises two sludge dams for irrigation purposes and these form part of the WUL application. The proposed dam will have a direct impact on a portion of HGM 1, HGM 2 and HGM 3. This will lead to the loss of 26.94ha of wetland area when the dam is at full capacity. The proposed irrigation will only occur within existing fields, and these occur outside of wetland systems. Furthermore, the sludge dams are located outside of all wetland systems, with the sludge used for irrigation.

A number of potential impacts on the wetland systems have been identified. These relate to the direct loss of portions of wetland systems, the potential for soil erosion and sedimentation as a result of an increase in water flow from the irrigated fields to adjacent and downstream wetland systems, and the potential for pollution of the wetlands if fertilisers and/or herbicides/pesticides are utilised on the cultivation/irrigation fields.

The Risk Assessment for the proposed construction of the dam, the irrigation, and the use of the sludge dams was undertaken in accordance with the General Authorisation in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21 (c) and (i) (Notice 509 of 2016). The risk assessment is provided in Appendix B. Impacts associated with the construction and operation of the dam and the associated loss of wetland area received a Moderate Risk Score. Impacts associated with the use of the dam for irrigation received Moderate Risk Scores and the continuation of the use of the sludge dams received a Low Risk Score.

Mitigation measures must therefore be aimed at the protection of the current services provided by the wetland systems. Several general and specific measures are proposed to mitigate impacts and it is recommended that these are adhered to. Furthermore, the loss of wetland area from portions of HGM 1, HGM 2 and HGM 3 (26.94ha) need to be offset through the use of a Wetland Offset Plan. An offset application must be conducted as per the Wetland Offsets Best Practice Guidelines for South Africa (Macfarlane et al, 2016) to compensate for the loss of wetland habitat. Provided this occurs and is approved, it is the author's opinion that the project be approved.

11. Detailes of Specialist

This Specialist Report has been compiled by the following specialists:

Table 11-1: Details of the Specialist(s) who prepared this Report

Responsibility	Report Writing
Full Name of Specialist	Rowena Harrison
Highest Qualification	PhD
Professional Accreditation	Pr. Sci. Nat. Reg. No. 400715/15
Years of experience in specialist field	>10

11.1. Declaration of the Specialist

I, **Rowena Harrison**, as the appointed specialists hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

- in terms of the general requirement to be independent:
- other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
- am not independent, but another specialist that meets the general requirements set out in Regulation 13 have been appointed to review my work (Note: a declaration by the review specialist must be submitted);
- in terms of the remainder of the general requirements for a specialist, am fully aware of and meet all of the requirements and that failure to comply with any the requirements may result in disqualification;
- have disclosed/will disclose, to the applicant, the Department and interested and affected parties, all material information that have or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application;
- have ensured/will ensure that information containing all relevant facts in respect of the application was/will be distributed or was/will be made available to interested and affected parties and the public and that participation by interested and affected parties

was/will be facilitated in such a manner that all interested and affected parties were/will be provided with a reasonable opportunity to participate and to provide comments;

- have ensured/will ensure that the comments of all interested and affected parties were/will be considered, recorded and submitted to the Department in respect of the application;
- have ensured/will ensure the inclusion of inputs and recommendations from the specialist reports in respect of the application, where relevant;
- have kept/will keep a register of all interested and affected parties that participate/d in the public participation process; and
- I am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.

Rowena Harrison Pr. Sci. Nat. No. 400715/15

Signature of the specialist

Rowena Harrison

Full Name and Surname of the specialist

Land Matters on behalf of Hunts Green Consulting

Name of company

January 2024

Date

12. References

Bromilow, C. (2010). Problem plants and alien weeds of South Africa. Briza Publications.

Collins, N.B. (2005). Wetlands: The basics and some more. Free State Department of Tourism, Environment and Economic Affairs.

Driver, A., Nel, J., Snaddon, K., Murray, K., Roux, D., Hill, L. & Swartz, E. (2011). Implementation Manual for Freshwater Ecosystem Priority Areas. WRC Report No. 1801/1/11. Pretoria: Water Research Commission.

Department of Water Affairs and Forestry (2005) A Practical Field Procudure for Identification and Delineation of Wetlands and Riparian Areas - Edition 1.

Department of Water Affairs and Forestry (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. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa.

Department of Water and Sanitation (2014). A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. https://www.dwa.gov.za/iwqs/rhp/eco/peseismodel.aspx.

Kotze, D., Macfarlane, D., and Edwards, R. (2021) Wet-EcoServices (Version 2). A technique for rapidly assessing ecosystem services supplied by wetlands and riparian areas. Report to the Water Research Commission. WRC Report No. 2737/1/21.

Macfarlane, D.M, Ollis, D.J., and Kotze, D.C. (2020). Wet-Health (Version 2.0). A Refined Suite of Tools for Assessing the Present Ecological State of Wetland Ecosystems. Technical Guide. Report to the Water Research Commission. WRC Report No. TT 820/20

Mitsch, W. J. & Gosselink, J. G. (1993) Wetlands (2nd edn) Van Nostrand Reinhold, New York.

Mucina, L., Rutherford, M.C. & Powrie, L.W. (eds). (2006). Vegetation Map of South Africa, Lesotho and Swaziland, edn 2, 1:1 000 000 scale sheet maps. South African National Biodiversity Institute, Pretoria. ISBN 978-1-919976-42-6.

Nel, J.L., Maree, G., Roux, D., Moolman, J., Kleynhans, C.J., Sieberbauer, M. & Driver, A. (2004). South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 2: River Component. CSIR Report Number ENV-S-I-2004-063. Council for Scientific and Industrial Research, Stellenbosch.

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, L.B. (2011). Atlas of Freshwater

ECOSYSTEM Priority Areas in South Africa: Maps to support sustainable development of water resources. Water Research Commission.

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

Van Deventer, H., Smith-Adao, L., Collins, N.B., Grenfell, M., Grundling, A., Grundling, P.-L., Impson, D., Job, N., Lötter, M., Ollis, D., Petersen, C., Scherman, P., Sieben, E., Snaddon, K., Tererai, F. & Van der Colff, D. (2019). South African National Biodiversity Assessment 2018: Technical Report. Volume 2b: Inland Aquatic (Freshwater) Realm. CSIR report number CSIR/NRE/ECOS/IR/2019/0004/A. South African National Biodiversity Institute, Pretoria, South Africa.

van Tol, J. J. Le Roux, P.A.L., Lorentz, S. A. and Hensley, M. (2013). Hydropedological Classification of South African Hillslopes. Journal of Vadose Zone.

Water Resource Commission (2011). Easy Identification of some South African Wetland Plants. WRC Report No TT 479/10.

Zedler, J.B. & Kercher, S. (2004). Causes and Consequences of Invasive Plants in Wetlands: Opportunities, Opportunists, and Outcomes. Critical Reviews in Plant Sciences, 23(5):431–452.

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13. Appendix A: Methodology

Wetland Definition & Delineation Technique

For the purpose of this assessment, wetlands are considered as those ecosystems defined by the National Water Act 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."*

The study site was assessed with regards to the determination of the presence of wetland areas according to the procedure described in 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas – Edition 1' (DWAF, 2005). This methodology requires the delineator to give consideration to the following four indicators in order to identify wetland areas; to find the outer edge of the wetland zone; and identify the different zones of saturation within the wetland systems identified:

i. Terrain Unit Indicator: helps to identify those parts of the landscape where wetlands are more likely to occur.

ii. Soil Form Indicator: identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.

iii. Soil Wetness Indicator: identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation. Signs of wetness are characterised by a variety of aspects including marked variations in the colour of various soil components, known as mottling; a gleyed soil matrix; or the presence of Fe/Mn concretions. It should be noted that the presence of signs of wetness within a soil profile is sufficient to classify an area as a wetland area despite the lack of other indicators.

iv. Vegetation Indicator: identifies hydrophilic vegetation associated with frequently saturated soils.

In assessing whether an area is a wetland, the boundary of a wetland should be considered as the point where the above indicators are no longer present. An understanding of the hydrological processes active within the area is also considered important when undertaking a wetland assessment. Indicators should be 'combined' to determine whether an area is a wetland, to delineate the boundary of that wetland and to assess its level of functionality and health.

Assessment of the Wetland's Present Ecological State (PES)

The Present Ecological State (PES) for wetlands which is defined as 'a measure of the extent to which human impacts have caused the wetland to differ from the natural reference condition' is also an indication of each wetland's ability to contribute to ecosystem services within the study area. This was assessed according to the methods contained in the WET-Health: (Version 2.0) A refined suite of tools for assessing the present ecological state of wetland ecosystems (Macfarlane et al., 2020). A Level 2 assessment was conducted for the wetlands identified on site.

This document assesses the health status of a wetland through evaluation of four main factors:

- **Hydrology:** defined as the distribution and movement of water through a wetland and its soils.
- **Geomorphology:** defined as the distribution and retention patterns of sediment within the wetland.
- **Vegetation***: defined as the vegetation structural and compositional state.*
- **Water Quality:** defined as the physico-chemical attributes of the water in a wetland

The WET-Health (Version 2.0) tool evaluates the extent to which anthropogenic changes have impacted upon the functional integrity or health of a wetland through assessment of the above-mentioned factors. The deviation from the natural condition is given a rating based on a score of 0-10 with 0 indicating no impact and 10 indicating modifications have reached a critical level. Since hydrology, geomorphology, water quality and vegetation are interlinked their scores are then aggregated to obtain an overall PES health score These scores are then used to place the wetland into one of six health classes (A – F; with A representing completely unmodified/natural and F representing severe/complete deviation from natural as depicted in Table 13-1.

Table 13-1: Health categories used by WET-Health for describing the integrity of wetlands

Description	Impact Score	Health Category
Unmodified, natural.	0 - 1.0	A
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 - 2.0	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2.1 - 4.0	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4.1 - 6.0	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable	6.1 - 8.0	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota	8.1 - 10.0	F

Due to differences in the pattern of water flow through various hydro-geomorphic (HGM) types, the tool requires that the wetland is divided into distinct HGM units at the outset. Ecosystem services for each HGM unit are then assessed separately.

<u>Assessment of the Wetland's Functional Integrity</u>

Wetlands within the study area serve to improve habitat within and potentially downstream of the study area through the provision of various ecosystem services. These ecosystem services relate to:

- Flood attenuation
- Sediment trapping
- Erosion control
- Streamflow regulation
- Water quality regulation
- Carbon storage
- Water provision

- Grazing
- Plants for crafts & construction
- Medicinal plants
- Indigenous/wild foods
- Cultivated foods
- Tourism and recreation

Wetlands therefore affect the quantity and quality of water within a catchment (Mitsch & Gosselink, 1993). The importance of wetland conservation and sustainable management is directly related to the value of the functions provided by a wetland. An indication of the functions and ecosystem services provided by wetlands is assessed through the WET-EcoServices (Version 2) manual (Kotze et al., 2021) and is based on a number of characteristics that are relevant to the particular benefit provided by the wetland. The tool uses biophysical characteristics of the wetland and the level of disturbance within the wetland and its catchment to estimate the level of supply of ecosystem goods and services. A Level 2 WET-EcoServices assessment was undertaken for the wetlands identified.

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Assessment of Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) assessment was determined by utilising a rapid scoring system. The system has been developed to assess the 'Ecological Importance and Sensitivity' of the wetland within the larger landscape; the 'Hydrological Functional Importance' of the wetland; and the 'Direct Human Benefits' obtained from the wetland through either subsistence or cultural practices. The scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999), and the work conducted by Kotze et al. (2008) on the assessment of wetland ecological goods and services from the WET-EcoServices tool. The scores obtained were placed into a category of very low; low; medium; high; and very high as shown:

- Very low: 0 – 1.0
- Low: 1.1 – 2.0
- Medium: 2.1 – 3.0
- High: 3.1 – 4.0
- Very High 4.1 – 5.0

14. Appendix B: Risk Matrix

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

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Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity				Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating	PES AND EIS OF WATERCOURSE
No.	**Phases**	**Activity**	**Aspect**	**Impact**	**Flow Regime**	**Physico & Chemical (Water**	**Habitat (Geomor ph + Vegetatio**	**Biota**															
1	Construction Phase	Loss of wetland area from dam	The proposed dam will lead to the direct loss of a 26.94ha of a portion of HGM 1, HGM 2 and HGM 3.	The construction of the dam wall will occur in the Ekamanzi River and well as a portion of HGM 2. Therefore, the loss of the entire 26.94ha of wetland area will only occur if the dam reaches full capacity. Loss will include both the construction of the dam wall in HGM 2 as well as the flooding of the portions of HGM 1,	3	2	2	3	2.5	1	1	4.5	3	3	5	2	13	58.5	M	80	As per section 9 of the report		Three Seep Wetlands (HGM 1 – PES C, EIS Moderate; HGM 2 – PES D, EIS Low; HGM 3 – PES D, EIS Low)

				HGM 2 and HGM 3.																										
2	Construction phase	Soil erosion, sedimentation, and degradation of the wetlands from the construction of the dam	Exposure of soil from the construction of the dam leading to sedimentation within wetland systems	Changes to hydrological flow of the seep systems (particularly HGM 2). Soil compaction, disturbance to vegetation community, soil erosion, sediment deposition.	2		2		1		1		1.5	1	1		3.5		4	3	5	1		13	45.5	L	80	As per section 9 of the report		Three Seep Wetlands (HGM 1 – PES C, EIS Moderate; HGM 2 – PES D, EIS Low; HGM 3 – PES D, EIS Low)
2	Construction phase	Soil erosion, sedimentation, and degradation of the wetlands from the irrigation of fields	Exposure of soil from irrigation systems, leading to it being washed into downstream and adjacent wetland systems.	Changes to hydrological flow of the wetland systems. Soil compaction, disturbance to vegetation community, soil erosion, sediment deposition.	2		2		2		2		2	1	1		4		4	3	5	1		13	52	L	70	As per section 9 of the report		14 Wetland systems as per Section 8.2 of the report
3	Construction phase	Soil erosion, sedimentation, and degradation of the wetlands from the use of the sludge dams	Over-irrigation of soils from the sludge dams leads to the formation of erosion gullies and subsequent sedimentation	Changes to hydrological flow of the wetland systems. Soil compaction, disturbance to vegetation community,	1		2		1		1		1.25	1	1		3.25		3	2	5	1		11	35.75	L	**70**	As per section 9 of the report		HGM 13 (PES – C, EIS – Moderate); and HGM 14 (PES – D, EIS - Moderate)

			of adjacent and downstream water resources.	soil erosion, sediment deposition.																										
4	Construction phase	Pollution of wetlands and soil from the construction of the dam	Pollution potential from hydrocarbons, cement and any other chemicals used to construct dam wall. Pollution potential from any vehicles used to access site.	Contaminants reduce water quality, having a negative impact on hydrophytic vegetation, aquatic and semi-aquatic fauna.	1		2		1		1		1.25	1	2		4.25		5	1	5	1		12	51	L	70	As per Section 9 of the report		Three Seep Wetlands (HGM 1 – PES C, EIS Moderate; HGM 2 – PES D, EIS Low; HGM 3 – PES D, EIS Low)
5	Construction phase	Pollution of wetlands and soil from the irrigation of fields	Sediment deposition in downstream wetlands, release of hydrocarbons and/or fertilisers during installation of irrigation systems	Pollution of wetland systems through sedimentation and fertilisers. Deterioration in water quality of the wetland systems	1		2		2		2		1.75	1	1		3.75		4	3	5	2		14	52.5	L	**70**	As per Section 9 of the report		14 Wetland systems (PES and EIS as per Section 8.2 of the report)

6	Construction phase	Pollution of wetlands and soil from the use of the sludge dams	Sediment deposition in downstream wetlands, release of hydrocarbons and other pollutants during construction	Pollution of wetland systems through sedimentation and fertilisers. Deterioration in water quality of the wetland systems	**1**		**2**		**1**		**2**		**1.5**	**1**	**1**		**3.5**		**3**	**2**	**5**	**2**		**12**	**42**	L	**70**	As per Section 9 of the report		HGM 13 (PES – C, EIS – Moderate) ; and HGM 14 (PES – D, EIS - Moderate)
3	Construction phase	Spread of invasive alien vegetation	Any disturbance to vegetation leads to the encroachment of alien invasive species	Encroachment of alien invasive species into the catchment and wetland systems from disturbed sites	**2**		**1**		**1**		**2**		**1.5**	**1**	**1**		**3.5**		**2**	**2**	**5**	**2**		**11**	**38.5**	L	70	As per Section 9 of the report		14 Wetland systems (PES and EIS as per Section 8.2 of the report)
	Operational Phase	Loss of wetland area from dam	The dam when at full capacity will lead to the loss of 26.94ha of a portion of HGM 1, HGM 2 and HGM 3	Changes to the flow dynamics of the wetland systems, the geomorphic setting, flooding of vegetation. Permanently saturated areas.	**4**		**2**		**3**		**3**		**3**	**1**	**4**		**8**		**3**	**5**	**5**	**2**		**15**	**120**	M	**80**	As per section 9 of the report		Three Seep Wetlands (HGM 1 – PES C, EIS Moderate; HGM 2 – PES D, EIS Low; HGM 3 – PES D, EIS Low)

4	Operational phase	Ongoing soil erosion, sedimentation, and degradation of the wetlands from the construction of the dam	Long-term sediment movement as a result of inadequately designed spillways	Formation of erosion gullies from spillway sites. Downstream sediment deposition.	**3**		**2**		**3**		**2**		**2.5**	**1**	**4**		**7.5**		**2**	**2**	**5**	**2**		**11**	**82.5**	M	60	As per Section 9 of the report		Three Seep Wetlands (HGM 1 – PES C, EIS Moderate; HGM 2 – PES D, EIS Low; HGM 3 – PES D, EIS Low)
5	Operational phase	Ongoing soil erosion, sedimentation, and degradation of the wetlands from the irrigation of fields	Long-term sediment movement as a result of over-saturation of soils leading to the formation of erosion gullies	Excessive erosion in sensitive environments. Knock on effects on downstream systems	**2**		**2**		**1**		**1**		**1.5**	**1**	**4**		**6.5**		**3**	**3**	**5**	**1**		**12**	**78**	M	**60**	As per Section 9 of the report		14 Wetland systems (PES and EIS as per Section 8.2 of the report)
6	Operational phase	Ongoing soil erosion, sedimentation, and degradation of the wetlands from the use of the sludge dams	Over-irrigation of the soils where the sludge is utilised as irrigation can lead to the formation of erosion gullies and subsequent sedimentation of wetland systems.	Excessive erosion in sensitive environments. Knock on effects on downstream systems	**1**		**1**		**1**		**1**		**1**	**1**	**3**		**5**		**1**	**3**	**5**	**2**		**11**	**55**	L	70	As per Section 9 of the report		HGM 13 (PES – C, EIS – Moderate); and HGM 14 (PES – D, EIS - Moderate)

5	Operational phase	Pollution of wetlands and soil from the construction of the dam	Pollution potential from maintenance of dam wall and/or spillways	Long term deterioration in water quality of wetlands and watercourse systems.	**1**		**2**		**2**		**2**		**1.75**	**1**	**4**		**6.75**		**2**	**2**	**5**	**2**		**11**	**74.25**	M	60	As per Section 9 of the report		Three Seep Wetlands (HGM 1 – PES C, EIS Moderate; HGM 2 – PES D, EIS Low; HGM 3 – PES D, EIS Low)
5	Operational phase	Pollution of wetlands and soil from the irrigation of fields	Pollution from over-fertilisation of crops within the irrigation areas being washed into the wetland systems.	Pollution of wetland systems from sediment deposition as well as contaminated stormwater runoff from any over fertilisation or over irrigation. Long-term deterioration in water quality of wetland systems	**1**		**2**		**2**		**2**		**1.75**	**1**	**4**		**6.75**		**3**	**3**	**5**	**2**		**13**	**87.75**	M	60	As per Section 9 of the report		14 Wetland systems (PES and EIS as per Section 8.2 of the report)
5	Operational phase	Pollution of wetlands and soil from the use of the sludge dams	Pollution from over-fertilisation of crops within areas that are irrigated with sludge. This can be washed into the wetland systems.	Pollution of wetland systems from sediment deposition as well as contaminated stormwater runoff from any over-irrigation utilising sludge water. Long-term deterioration in water quality of wetland systems if this occurs.	1		1		1		1		1	1	4		6		2	2	5	2		11	66	M	60	As per Section 9 of the report		HGM 13 (PES – C, EIS – Moderate) ; and HGM 14 (PES – D, EIS - Moderate)

6	Operational phase	Spread of invasive alien vegetation	Any continued disturbance to vegetation leads to the encroachment of alien invasive species	Encroachment of alien invasive species into the catchment and wetland systems from disturbed sites	2		1		1		2		1.5	1	1		3.5		2	2	5	2		11	38.5	L	70	As per Section 9 of the report		14 Wetland systems (PES and EIS as per Section 8.2 of the report)