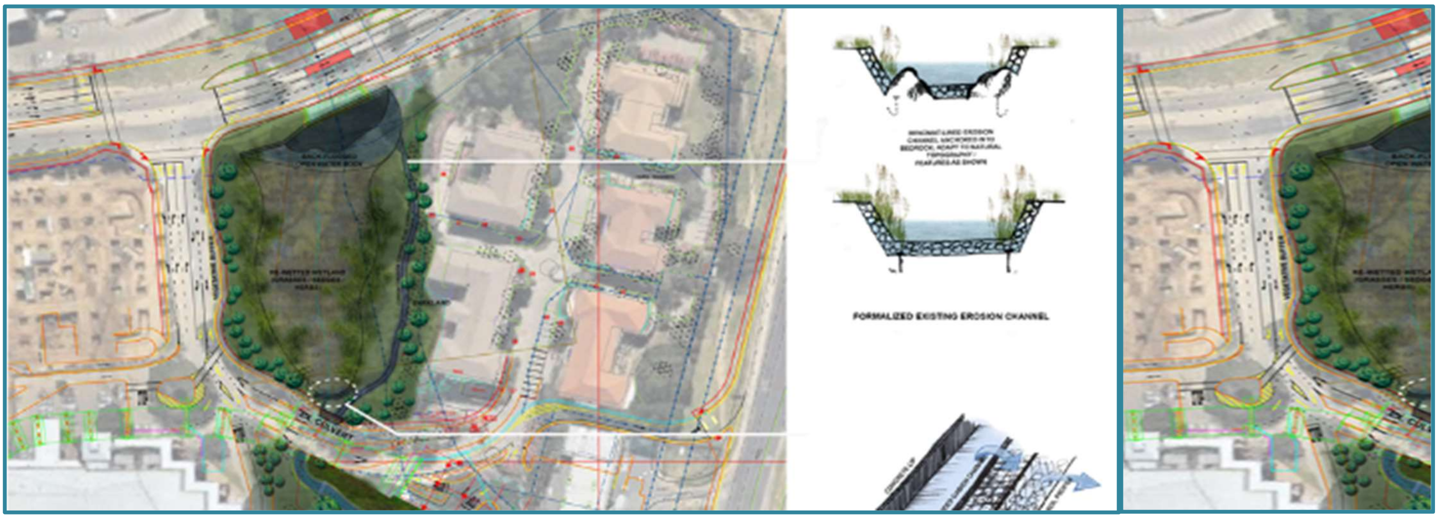
KHANYAZWE FLEXPOWER GAS POWER PLANT:
Wetland Site Sensitivity Verification Assessment

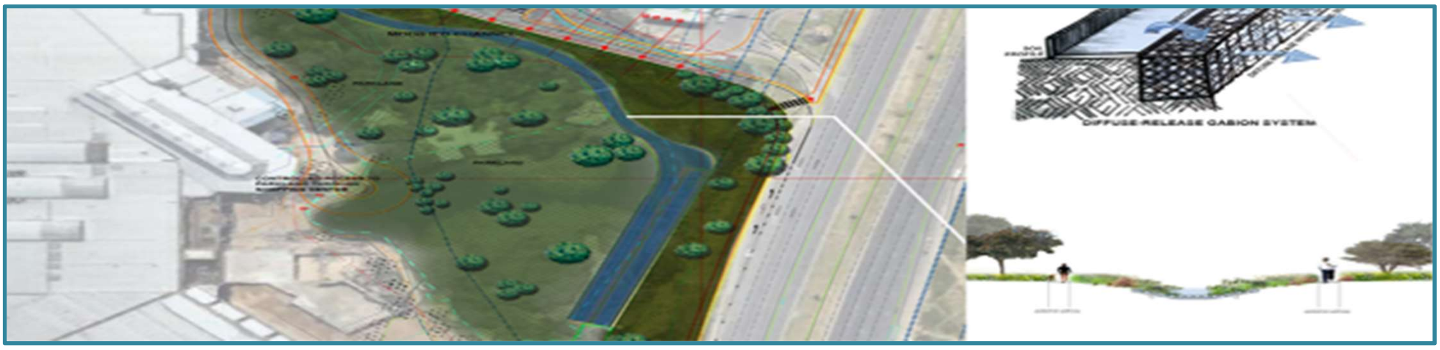
Prepared for:

NSOVO ENVIRONMENTAL CONSULTING

Prepared by:

Willem Lubbe
for
WaterMakers





March 2024

Declaration of Independence by Specialist

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

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

13/03/2024

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

Date

EXECUTIVE SUMMARY

Nsovo Environmental was appointed to undertake a Site Sensitivity verification for the proposed Khanyazwe Flexpower Gas Power Plant project. Four potential sites / alternatives were proposed for the development of the project. Subsequently, WaterMakers was appointed by Nsovo Environmental Consulting as independent specialists to conduct the relevant wetland-related studies This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the potential impact on watercourses associated with the proposed project.

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

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

A site visit to the area to be affected by the proposed activity was undertaken on the 13th of March 2024. A detailed description of the methodology used to address the above Terms of Reference is provided in Appendix A.

No wetlands (hydro-geomorphic units) were observed in any of the four study sites nor any wetland habitat within 500m from any of the study areas. One riparian channel that branched at higher elevation were observed and delineated within two of the study areas, namely Site 2 and Site 4.

Current impacts on the habitat integrity of the riparian habitat situated in Site 4 were considered to be low as a result of the limited vegetation removal and limited alien vegetation infestation. Further, water quantity and quality is expected to be close to the natural state as a result of the near natural state of the associated catchments which would contribute to the integrity and stability of the instream and riparian habitat. Further, the natural state would enhance the potential functions of the riparian vegetation, which according to Anon (2002) include:

- sediment trapping;

- nutrient trapping;
- bank stabilization and bank maintenance;
- contributes to water storage;
- aquifer recharge;
- flow energy dissipation;
- maintenance of biotic diversity; and
- primary production.

Considering the intactness of the structure and function as well as the high degree of landscape connectivity that the riparian habitat provide within Site 4, all of the riparian habitat present was considered to be of high sensitivity. Likely PES condition following a VEGRAI approach would fall in a Category B/C.

From Site 3 the riparian habitat entered Site 2 downstream where the riparian habitat was totally transformed, representing a VEGRAI score of PES F.

Site one and Site 3 was regarded as having a Very Low sensitivity from a watercourse perspective since there were no watercourses within these study sites nr within 500m from the sites (Table 1). The terrain is regarded as a recharge environment from a hydropedological perspective and is therefore regarded as having a low potential impact.

A watercourse, riparian habitat were identified that traverses through Site 2 and Site 4, the only difference is site 2 is transformed whereas site 4 is natural. Thus in order of preference for development it would be Site 1 and Site 3, followed by Site 2 which will include heavy mitigation and lastly Site 4 as a No-Go option (Table 1).

Table 1: Watercourse site sensitivity results

Site option:	**Site 1**	**Site 2**	**Site 3**	**Site 4**
Sensitivity based on proximity of watercourses within 500m:	**Very Low**	**High**	**Very Low**	**Very High**

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ACRONYMS

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

1. INTRODUCTION

1.1 Project Description

Nsovo Environmental was appointed to undertake a Site Sensitivity verification for the proposed Khanyazwe Flexpower Gas Power Plant project. Four potential sites / alternatives were proposed for the development of the project. Subsequently, WaterMakers was appointed by Nsovo Environmental Consulting as independent specialists to conduct the relevant wetland-related studies This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the potential impact on watercourses associated with the proposed project.

1.2 Scope of Work

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

- Desktop assessment
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A site visit to the area to be affected by the proposed activity was undertaken on the 13th of March 2024. A detailed description of the methodology used to address the above Terms of Reference is provided in Appendix A.

1.3 Assumptions and Limitations

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

- In order to obtain definitive data regarding the biodiversity, hydrology and functioning of particular wetlands, studies should ideally be conducted over a number of seasons and over a number of years. The current study relied on information gained during a single field survey conducted during a single season, desktop information for the area, as well as professional judgment and experience;
- Wetland and riparian areas within transformed landscapes, such as urban and/or agricultural settings, or mining areas with existing infrastructure, are often affected by disturbances that restrict the use of available wetland indicators, such as hydrophytic vegetation or soil indicators (e.g. as a

result of dense stands of alien vegetation, dumping, sedimentation, infrastructure encroachment and infilling). As such, wetland and riparian delineations as provided are based on indicators where available and the author’s interpretation of the current extent and nature of the wetlands and riparian areas associated with the proposed activity;

- Some precision agricultural techniques such as topographical manipulation and soil redistribution ploughing were evident within the study area which in some instances could obscure pedological signs of wetness and hydric soil forms;
- Wetland and riparian assessments are based on a selection of available techniques that have been developed through the Department of Water and Sanitation (DWS). These methods are, however, largely qualitative in nature with associated limitations due to the range of interdisciplinary aspects that have to be taken into consideration. Current and historic anthropogenic disturbance within and surrounding the study area has resulted in soil profile disturbances as well as successional changes in species composition in relation to its original /expected benchmark condition;
- Delineations of wetland areas were largely dependent on the extrapolation of field indicator data obtained during field surveys, 5m contour data for the study area, and from interpretation of geo-referenced orthophotos and satellite imagery as well as historic aerial imagery data sets received from the National Department of Rural Development and Land Reform. As such, inherent ortho-rectification errors associated with data capture and transfer to electronic format are likely to decrease the accuracy of wetland boundaries in many instances; and
- Wetlands outside of the study area boundary was extrapolated using aerial imagery, although some sampling was done outside of the study boundaries in order to confirm findings and better interpret hydropedological characterisation of the study area.
- Cumulative impacts should be considered from a regional level, thus DWS Mpumalanga.
- Further, invasion by *Dichrostachys cinera* also reduced field accessibility to accurately delineate riparian habitat along the total length of the watercourse.

2. GENERAL CHARACTERISTICS

2.1 Location

The study area is located south of the N4 (just south of the southern boundary of the Kruger National Park in the Mpumalanga Province. The study area lies within Quarter Degree Grid Cell (QDGC) 2528AD between 25°24’02.66” – 25°27’40.12” south and 28°15’02.38” – 28°14’25.33” east (Figure 1).

2.2 Biophysical Attributes

2.2.1 Climate

The study area experiences a strong seasonal summer rainfall with dry winters with the mean annual precipitation between 550mm and 600mm. Frost is experienced fairly frequently with maximum temperatures in January up to 36ºC while the minimum in July drops to -0.4ºC (Mucina and Rutherford, 2006.) The area under consideration is located within the North Eastern Highlands Level 1 ecoregion, and more specifically within Level 2 ecoregion 4.05. The North Eastern Highlands ecoregion is regarded as being transitional between the Lowveld and the Northern Escarpment, while Level 2 ecoregion 4,05 is characterised by closed hills and mountains with moderate to high relief and vegetation comprising North-Eastern Highveld

Grassland and Lowveld Bushveld types. Patches with Afromontane Forest are scattered throughout the region. Further, this ecoregion is characterised by a mean annual precipitation of 600mm to 1000mm, with rainfall seasonality being early to mid-summer. Mean annual temperatures range from 16°C to 22°C, with mean daily maximum temperatures in February ranging from 24°C to 30°C, and mean daily minimum temperatures in July ranging from 4°C to 7°C (Kleynhans *et al*., 2007).

2.2.2 Historic vegetation overview

The study area is situated within the Savanna Biome (Rutherford & Westfall, 1994). The Savanna Biome is the largest Biome in southern Africa, occupying over one-third of the surface area of South Africa (Mucina & Rutherford, 2006). It is characterised by a grassy ground layer and a distinct upper layer of woody plants. Where this upper layer is near the ground the vegetation may be referred to as Shrubveld, where it is dense, as Woodland, and the intermediate stages are locally known as Bushveld (Mucina & Rutherford, 2006).

The Savanna Biome is divided into smaller units known as vegetation types. According to Mucina & Rutherford (2006) two vegetation types, Kaalrug Mountain Bushveld and Baberton Montane Grassland occur within the study area.

Kaalrug Mountain Bushveld is limited to the Mpumalanga Province and extents slightly into Swaziland. It is located from Baberton in the west to the lower Crocodile River where is consists of dense, short mountain savanna with a dense grassy layer at higher altitudes. Important trees in this vegetation type include *Pavetta edentula, Tabernaemontana elegans, Galpinia transvaalica, Euphorbia triangularis* and *Combretum papoides*. This vegetation type is currently listed as Least Threatened with 15% conserved in Mountainlands Nature reserve and private reserves such as Boondocks (Mucina & Rutherford, 2006).

Barberton Montane Grassland also occurs in Mpumalanga and Swaziland from Barberton towards Nelshoogte and northwards along the high-lying grassland towards Kaapmuiden and Malelane. The terrain is steep and rugged with the dominant vegetation consisting of short rocky grassland which gradually becomes woodland along the lower slopes.

Small trees within this vegetation type include *Faurea galpinii, F.rochetiana, F.saligna, Rapanea melanophloes* and *Protea simplex* while the grass layer is dominated by species such as *Alloteropsis semialata, Andropogon schirensis, Ctenium concinnum, Eragrostis racemosa, Loudetia simplex* and various *Panicum* species. This vegetation type is classified as Vulnerable with 26% conserved within nature reserves and 40% transformed by plantations (Mucina & Rutherford, 2006).

Scarp Forest occurs in the Eastern Cape, KwaZulu-Natal, Mpumalanga and Swaziland where the tall vegetation is structurally diverse, multilayered forests with well developed canopies and understorey but with a poorly developed herb layer. The most conspicuous trees are *Buxus macowanii, B.natalensis, Drypetes gerrardii, Englerophytum natalense, Harpephyllum caffrum* and *Rinorea angustifolia.* This vegetation type is Least Threatened where it is well protected in reserves but exposed to over-exploitation elsewhere. More than 20% is statutorily conserved while numerous small scarp forests are not protected. Almost 5% has been transformed for cultivation or plantations and alien species such as *Chromolaena odorata, Solanum mauritianum, Melia azedarach* and *Lantana camara* are of concern.

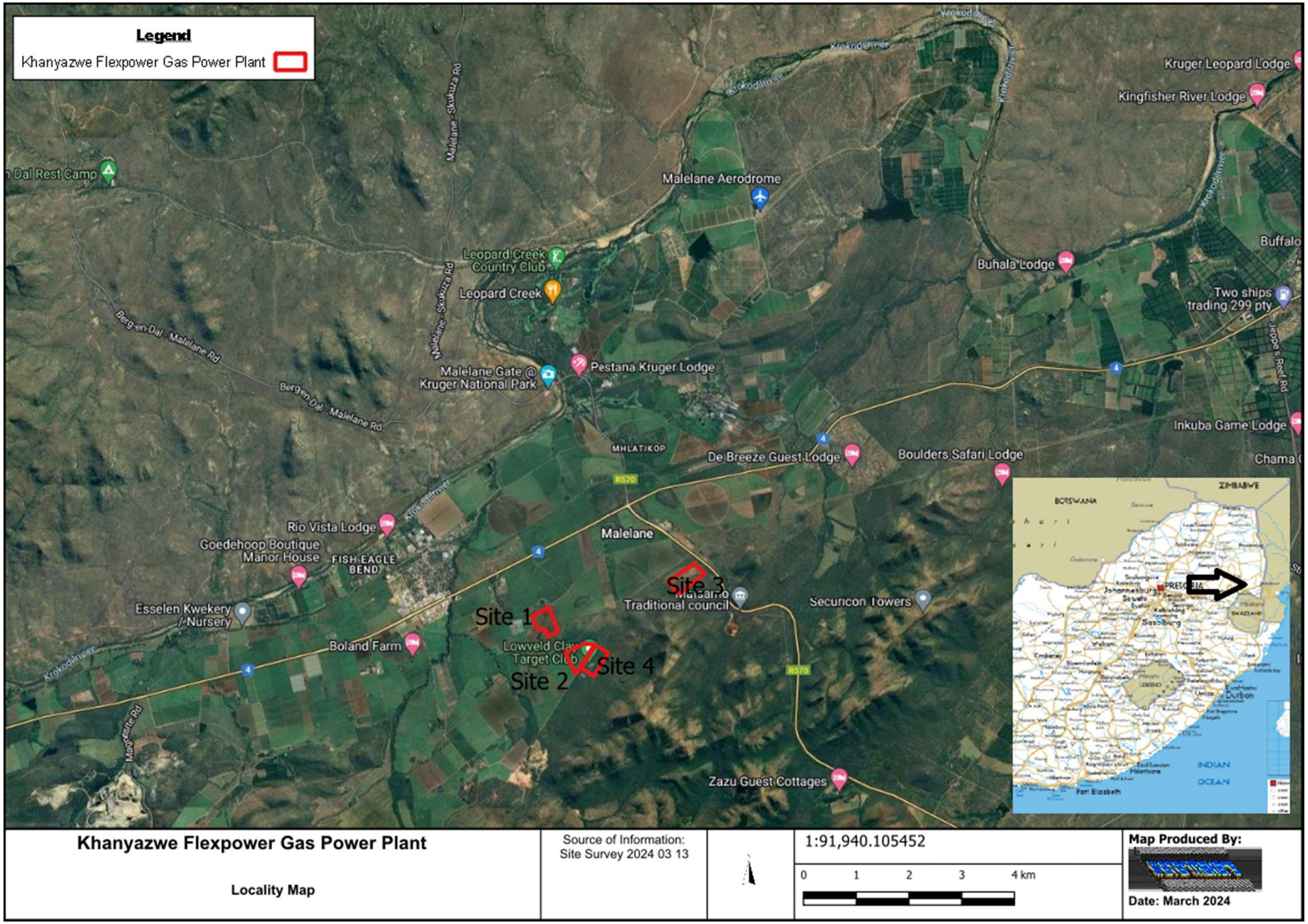

Figure 1: Locality map for the study area

2.2.3 Geology

The underlying geology represents elements of the Barberton Supergroup, namely the Fig Tree Group and the Moodies Group. Accordingly, the geology comprises arenite (including lutaceous arenite), volcanic rocks, conglomerate and shale.

2.2.4 Associated Aquatic Ecosystems and Drainage

The study area is located within the Inkomati Water Management Area (WMA), and within the Crocodile sub-management area. The Inkomati WMA is situated in the eastern part of South Africa and borders both Swaziland and Mozambique. Economic activity within the water management area is mainly centred on irrigation and afforestation, with related industries and commerce, and a strong eco-tourism industry. A key feature within this management area is the Kruger Park, with the Sabie River, which flows through the park, considered to be one of the most ecologically-important rivers in South Africa. An additional important feature of the management area is the joint management by South Africa and Swaziland of part of the water resources of the Komati River by the Komati River Water Authority (DWAF, 2004). The present study area is specifically located within Quaternary Catchment X24D.

2.2.5 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.

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

Based on current outputs of the NFEPA project (Nel *et al.*, 2011), no FEPA wetlands were identified in the study area. Further no wetland FEPA's or wetland clusters were identified within tens of kilometres from the study area. (Figure 2).

2.2.6 Wetland Vegetation Group

According to Nel et al. (2011), Site 1, Site 2 Site 3 and Site 4 falls within the Lowveld Group 3 wetland vegetation group. According to Macfarlane et al. (2014), the Lowveld Group 3 wetland vegetation group is regarded as being Critically Endangered (Macfarlane et al., 2014).

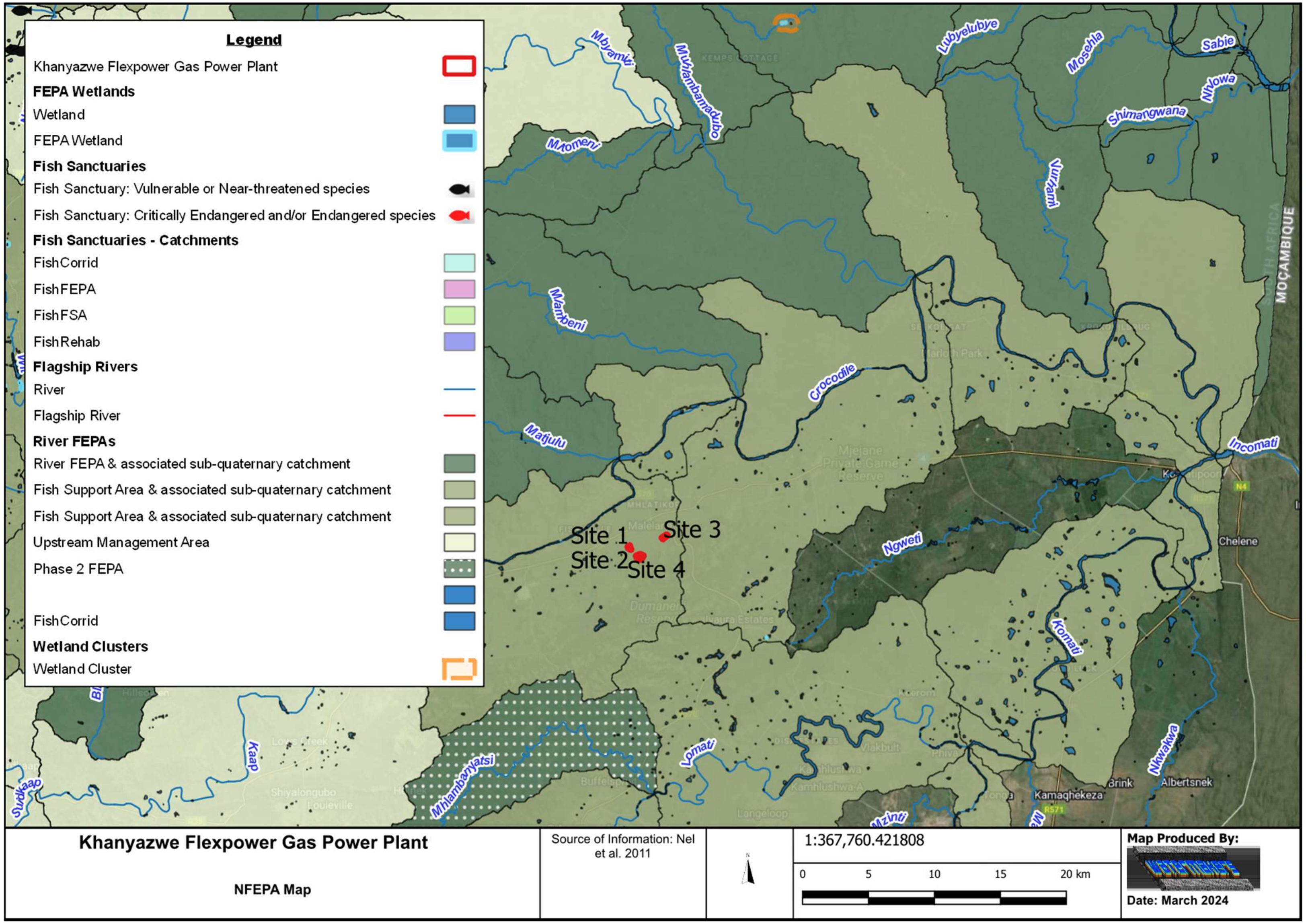

Figure 2: NFEPA map indicating closest FEPA features in relation to the study area

3. ASSOCIATED WETLANDS AND RIPARIAN HABITAT

3.1 Wetland soils

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

The traversed catenas within the study area were dominated by terrestrial soil forms that is well drained and contain colluvial material.

Figure 3: Operational borrowpit active in Site 3. Topsoil historically seems to be consisting of mostly Glenrosa and Mispah soils

No hydric soil forms were identified within any of the four study areas or within serval hundred meters thereof. Terrestrial soil forms within the study areas included the Nkokoni, Vaalbos, Tubatsi, Glenrosa and Mispah soil forms.

Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of iron and manganese oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic. No redoximorphic features were observed in any of the study areas

The new Soil Classification working Group (2018) classification system has incorporated several changes to the previous soil classification Soil Classification Working Group (1991). The new open classification system allows for the classification of whole-soil profiles which potentially enhances studies of water flows in river basins where soil morphology is recognised as an important hydrological indicator of water flow paths and storage mechanisms in hillslopes. The new Soil Classification working Group (2018) soil classification system's open classification structure also allows "natural soils" and "anthropogenic materials" to be separated at the highest category with their respective criteria and structures. This was relevant in the study area itself where historic borrowpit activities are responsible for the complete removal of horisons while more recently applied precision farming techniques are likely responsible for soil disturbances and topographical manipulation to increase maize production. Physically disturbed anthrosols identified within the study area included Grabouw 1000 and Grabouw 2000 cf, whereas hydric technosols included Stilfontein 3100. Most of the historic soil disturbances and topographical manipulation took place through agricultural sugarcane practices.

3.2 Wetland and Riparian Vegetation

According to the Department of Water Affairs and Forestry (2005), vegetation is regarded as a key component to be used in the delineation procedure for wetlands. Vegetation also forms a central part of the wetland definition in the National Water Act (Act 36 of 1998). Using vegetation as a primary wetland indicator however, requires undisturbed conditions (Department of Water Affairs and Forestry, 2005). A cautionary approach must therefore be taken as vegetation alone cannot be used to delineate a wetland, as several species, while common in wetlands, can occur extensively outside of wetlands. When examining plants within a wetland, a distinction between hydrophilic (vegetation adapted to life in saturated conditions) and upland species must be kept in mind.

There is typically a well-defined 'wetness' gradient that occurs from the centre of a wetland to its edge that is characterized by a change in species composition between hydrophilic plants that dominate within the wetland to upland species that dominate on the edges of, and outside the wetland (Department of Water Affairs and Forestry, 2005). It is important to identify the vegetative indicators which determine the three wetness zones (temporary, seasonal and permanent) which characterize wetlands. Each zone is characterized by different plant species which are uniquely suited to the soil wetness within that zone.

No natural wetland vegetation were observed on site (except for a few species associated with concrete dams and canals that form part of the local Crocodile River fed artificial canal system).

Riparian vegetation that could potentially be present within the study area included elements of both Kaalrug Mountain Bushveld as well as a small section of Maputuland Scarp Forest in the south-western portion of the study area. Species noted to be present included *Anthocleista grandiflora, Broanadia salicina, Combretum erythrophyllum, Diospyros mespiliformis, Englerophytum natalense, Harpephyllum caffrum, Kigelia Africana,* *Kraussia floribunda, Monanthotaxis caffra, Ptaeroxylon obliquum, Rapanea melanophloeos, Rauvolfia caffra, Rawsonia lucida, Tabernaemontana ventricosa, Trichillia dregeana* and *Trichillia emetic.*

3.3 Delineated Wetland and Riparian Areas

According to the National Water Act (Act no 36 of 1998) a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*." Wetlands typically occur on the interface between aquatic and terrestrial habitats and therefore display a gradient of wetness – from permanent, to seasonal, to temporary zones of wetness - which is often represented in their plant species composition, as well as their soil characteristics. It is important to take cognisance of the fact that not all wetlands have visible surface water. An area which has a high water table just below the surface of the soil is as much a wetland as a pan that only contains water for a few weeks during the year. No natural wetlands were observed within any of the study areas or within 500m from any of the study areas.

The National Water Act (Act 36 of 1998), defines a riparian habitat as follows: "Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse, which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas." Due to water availability (often a result of bedrock interflow and or geological features supporting hydrological concentrated flow) and or rich alluvial soils, riparian areas are usually more productive than the surrounding landscape.

For the current study, alluvial soils, species composition and vigorous growth form were utilised to indicate riparian boundaries. It should be noted however that alluvial soils were difficult to observe in most sections as a result of the dominance of deep red soils throughout the whole study area, making individual soils layers that were transported and deposited very cryptic to observe in most localities. The riparian area delineated in the study site is shown in Figure 3.

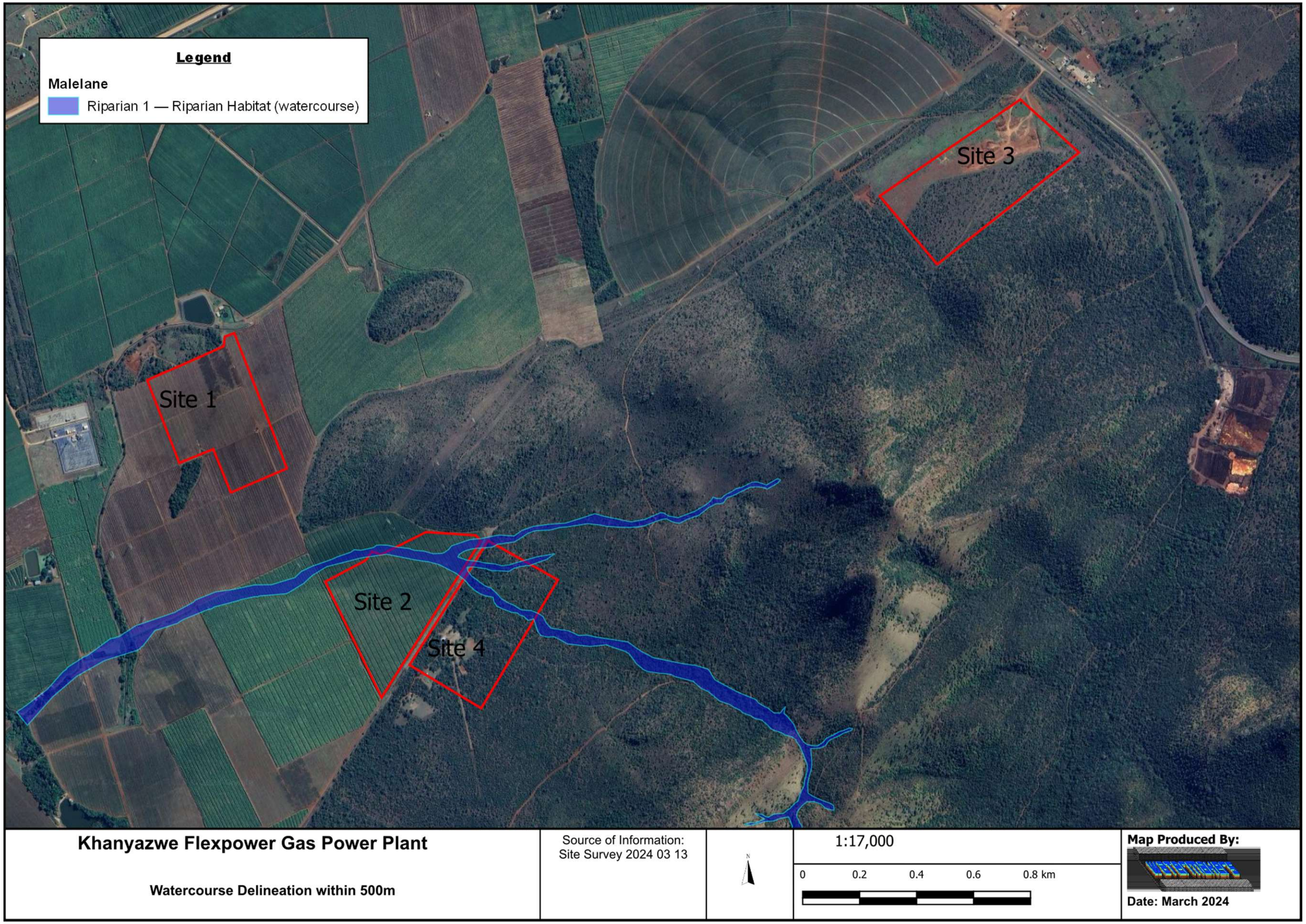

Figure 4: Delineated watercourses within the study area and within 500m

3.4 Riparian Habitat Sensitivity, PES, EIS

Current impacts on the habitat integrity of the riparian habitat situated in Site 4 were considered to be low as a result of the limited vegetation removal and limited alien vegetation infestation. Further, water quantity and quality is expected to be close to the natural state as a result of the near natural state of the associated catchments which would contribute to the integrity and stability of the instream and riparian habitat. Further, the natural state would enhance the potential functions of the riparian vegetation, which according to Anon (2002) include:

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A watercourse, riparian habitat were identified that traverses through Site 2 and Site 4, the only difference is site 2 is transformed whereas site 4 is natural. Thus in order of preference for development it would be Site 1 and Site 3, followed by Site 2 which will include heavy mitigation and lastly Site 4 as a No-Go option (Table 1).

Table 2: Watercourse site sensitivity results

Site option:	**Site 1**	**Site 2**	**Site 3**	**Site 4**
Sensitivity based on proximity of watercourses within 500m:	**Very Low**	**High**	**Very Low**	**Very High**

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APPENDIX A – Methodology

Wetland Delineation

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

- Google Earth images;
- 1:50 000 cadastral maps;
- ortho-rectified aerial photographs; and
- 5m contour data.

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

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

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

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

Wetland Functionality

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

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

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

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

For the assessments, an impact and indicator system were used. The wetland is first categorized into the different hydrogeomorphic (HGM) units and their associated catchments, and these are then assessed individually in terms of their hydrological, geomorphologic and vegetation health by examining the extent, intensity and magnitude of impacts, of activities such as grazing or draining. The extent of the impact is measured by estimating the proportion the wetland that is affected. The intensity of the impact is determined by looking at the amount of alteration that occurs in the wetland due to various activities. The magnitude is then calculated as the combination of the intensity and the extent of the impact and is translated into an impact score. This is rated on a scale of 1 to 10, which can be translated into six health classes (A to F – compatible with the EcoStatus categories used by DWAF, Table 19). Threats to the wetland and its overall vulnerability can also be assessed and expressed as a likely Trajectory of Change.

Determination of Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity was determined by utilising a rapid scoring system. As wetlands outside of the study area were only partially visited, there could easily be oversight as detailed studies are required to increase the confidence of the assessment which relied heavily on the experience of the author. The system has been developed to provide a scoring approach for assessing the Ecological, Hydrological Functions; and Direct Human Benefits of importance and sensitivity of wetlands. These scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments, and the work conducted by Kotze et al. (2008) on the assessment of wetland ecological goods and services from the WET-EcoServices tool (Rountree et al., 2013). An example of the scoring sheet is attached as Table 20. The scores are then placed into a category of very low, low, moderate, high and very high as shown in Table 21.

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

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

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

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

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

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

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