SPECIALIST REPORT

FRESHWATER ECOSYSTEM ASSESSMENT FOR CLEARING OF INDIGENOUS VEGETATION FOR THE CULTIVATION OF NUT-TREES ON VARIOUS PORTIONS OF THE FARMS VERGELEGEN 709JT, CAMBALALA 765JT, WINKELHAAK 723JT, BATAVIA 151JT, NKOMAZI 772JT AND STERKSPRUIT 728JT BADPLAAS, ALBERT LUTHULI LOCAL MUNICIPALITY

Draft Report

Author
Danie van der Walt (*M.Sc.* Biol)

November 2020
Version 1

Afrika Enviro & Biology

Specialist Environmental & Biodiversity Assessments

CELL 072 623 1845
danie.aeb@gmail.com

P.O. BOX 2980
White River
1240

Specialist declaration

I, Danie van der Walt, declare that -

- I act as an independent specialist in this application;
- I have performed 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;
- I declare that there are no circumstances that may compromise my objectivity;
- I have expertise in conducting the specialist report relevant to this application, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the relevant environmental legislation, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in this project;
- I undertake to disclose to the applicant and the authorities all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this report are true and correct.

L.D. VAN DER WALT

Date: 2020-11-25

EXECUTIVE SUMMARY

The applicant plans to establish cultivated lands on the property, specifically for the production of Macadamia and Pecan nuts. The total project area is approximately 3600Ha in extent. As the clearing of indigenous vegetation is a regulated activity, environmental authorization is required before commencement of the activity. As part of the EIA process a wetland and biodiversity assessment was recommended by the environmental consultant and Afrika Enviro & biology was appointed to do this assessment.

The study area is located on the plains to the south of the foothills of the Makhonjwa Mountains in the north and Skurweberg (Escarpment), approximately 10km to the east of Badplaas / eManzana. Access is gained from the R541on the southern boundary. The Nkomazi Game Reserve is located directly to the east and several of the properties forming part of this project is fenced in with this Reserve. The main administrative buildings and staff quarters are located centrally. Due to the vastness of the project area (3600Ha) and the high number of potential wetland units present, the task of on foot delineation would be very difficult, if not impossible in a short to medium period of time. For this reason, the practitioner used the method of *remote sensing* by employing historic aerial photographs (era 1985), 150000 topographic maps, Google Earth satellite imagery and the latest available high resolution aerial photographs to aid in the delineation process. Each of the abovementioned played a significant role at different levels of the delineation process and the high resolution photographs whereupon the results are projected was very effective indeed. The historic maps and aerial photographs was employed to identify historic land uses and landscape features and the more recent high resolution material was used to identify wet soils and differences in vegetation cover. The results of this exercise are then verified by field sampling, analyzing soil samples and vegetation line transects. Several prominent valley bottom wetlands are present as well as associated seepage zones and artificial wetlands. The desktop study indicates that several of these wetlands are listed as NFEPA wetlands. The present ecological state, ecological sensitivity and importance are summarized in the following table:

Habitat unit	Present Ecological State (PES)	Ecological importance (EI)	Ecological sensitivity (ES)	Operational buffer zone
Komati River	Moderate	High	High	≥60m
Seekoeispruit	Moderate	High	High	≥60m
Lekkerloop	Moderate	High	High	≥60m
Valley bottom wetlands (HGM1; 4; 5)	Moderate	High	Moderate	≥40m
Valley bottom wetland (HGM3)	Largely modified	Moderate	Low	≥40m
Valley bottom wetland (HGM2)	Critical	Very low	Very low	≥40m
Small seepage wetlands and (HGM6)	Moderate	Low	Low	≥20m

The investigation indicates that the freshwater habitats are subject to various levels of negative impacts but are all regarded as sensitive ecosystems. In order to provide adequate protection of the sensitive habitats and to provide refuge for biota, buffer areas and corridors are provided. Considering the fact that these properties formed part of a Protected Area and the fact that the MTPA provides for ecological corridors in the site area, special consideration was given to provide land for corridors and to conserve important biodiversity and ecosystems. The proposed corridors and conservation areas have been designed to create corridors around sensitive habitats across the entire study area with the objective of including functional ecosystems and to connect terrestrial and freshwater habitats and minimize fragmentation and isolation of habitat.

The investigation and assessment concludes that the aquatic ecosystems and wetlands vary in ecological status and integrity and will not be significantly affected by the proposed activities if the appropriate buffer zones are adhered to. Generic mitigation measures will apply with regards to pollution, erosion and other environmental aspects.

1. Introduction

1.1 Background and objectives

The applicant plans to establish cultivated lands on the property, specifically for the production of Macadamia and Pecan nuts. The total project area is approximately 3600Ha in extent. As the clearing of indigenous vegetation is a regulated activity, environmental authorization is required before commencement of the activity. As part of the EIA process a wetland and biodiversity assessment was recommended by the environmental consultant and Afrika Enviro & biology was appointed to do this assessment. The terms are as follows:

- Wetland delineation and assessment;
- Determination of buffer zones where applicable;
- Selection of sites with least significant impact on biology and natural environment.

The site was investigated on 2020-10-21; 2020-11-04; 2021-01-14 and 2021-01-15.

1.2 Specialist report requirements

With reference to Appendix 6 of the EIA regulations (2014) the specialist declaration is included on page 2 of this report and details and the specialist's curriculum vitae are included with Appendix 1.

2. Methods and Reporting

2.1 Assumptions, uncertainties and limitations

The results and recommendations of the report are based on the actual site status. Assumptions that are made and uncertainties that are encountered are indicated in the report (where applicable). As indicated under the relevant sections in the report consultation of authorities' data bases forms part of this report. The author is confident that the results obtained by the present study are of sufficient significance to make conclusions and recommendations regarding the subjects that were investigated.

2.2 Freshwater ecosystem assessment

2.2.1 Defining and delineation of watercourses

<u>Definitions</u>

For the purpose of this report, the definitions of these ecosystems as described by the National Water Act (1998) are used:

- A watercourse is defined as:
  (a) a river or spring;
  (b) a natural channel in which water flows regularly or intermittently;
  (c) a wetland, lake or dam into which, or from which, water flows; and
  (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse and a reference to a watercourse includes, where relevant, its bed and banks.
- A wetland is described 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."

- Riparian zones are described as *"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 areas"*
- Extent of a watercourse:
  (a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; and
  (b) Wetlands and pans: the delineated boundary (outer temporary zone) of any wetland or pan.

Riparian zones are not wetlands, however, depending on the ecosystem structure; wetlands can also be classified as riparian zones if they are located in this zone (e.g. valley bottom wetlands). Although these distinct ecosystems will be interactive where they occur in close proximity it is important not to confuse their hydrology and ecofunctions. For these reasons the results are reported in separate sections under specific headings. These delineations are performed according to *"A practical field procedure for identification and delineation of wetlands and riparian areas"* as amended and published by the Department of Water Affairs and Forestry (2008); (Henceforth referred to as DWAF Guidelines (2008). The manual for *Section 21(c) or (i) Water Use Authorization* (Roets, 2016) is another publication that is employed with riparian and aquatic investigations.

The following biophysical indicators are used for wetland identification and delineation: Terrain Unit Indicator; Soil Form Indicator; Soil Wetness Indicator; Vegetation Indicator. Wetlands must have one or more of the following attributes or indicators:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation. The soil forms (categories in the classification system) common to South African wetland soils are Champagne, Katspruit, Willowbrook and Rensburg. The Champagne form consists of a soil layer with greater than 10% organic carbon. The others are all characterised by the presence of a G horizon (i.e. a gleyed soil layer) immediately below the surface horizon. There are also other soil forms which are found mainly in non-wetland areas but which are also found in temporary wetlands. These include the Kroonstad, Westleigh, Longlands and Estcourt. The Dundee form is found near rivers but it is generally well drained and would not be considered a wetland soil.
- The presence, at least occasionally, of water loving plants (hydrophytes);
- A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil. Indicated by mottling and gleying.

In order for an area to be classified as a wetland by the DWAF guidelines, it must meet one or more of the abovementioned criteria. If an area is classified as wetland according to the abovementioned criteria further investigation may be necessary to determine the integrity of the wetland. For this purpose The WET-Health (Macfarlane et al. 2009) methodology is used to evaluate the integrity and the present ecological state of wetlands (PES).

Due to the vastness of the project area (3600Ha) and the high number of potential wetland units present, the task of on foot delineation would be very difficult, if not impossible in a short to medium period of time. For this reason, the practitioner used the method of *remote sensing* by employing historic aerial photographs (era 1985), 150000 topographic maps, Google Earth satellite imagery and the latest available high resolution aerial photographs to aid in the delineation process. Each of the abovementioned played a significant role at different levels of the delineation process and the high resolution photographs whereupon the results are projected was very effective indeed. The historic maps and aerial photographs was employed to identify historic land uses and landscape features and the more recent high resolution material was used to identify wet soils and differences in vegetation cover. The results of this exercise are then verified by field sampling, analyzing soil samples and vegetation line transects. Additionally, the soil classification report prepared by Agri Technovation (2020) for this project was used to aid in the evaluation of soil structure and classification.

The Global Mapper GIS program is used to accurately project the results of the delineation process onto a georeferenced high resolution aerial photograph. This product is used to create maps and project additional information such as calculated buffer lines and recommendations.

2.2.2 **Classification System for Aquatic Ecosystems**

The wetland system encountered within the study area was assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems, hereafter referred to as the “classification system” (Ollis et al., 2013). According to this manual a wetland is referred to as a hydro geomorphic unit (HGM) and these are subcategorized according to the following hierarchy:

Level 1: Inland systems

For the proposed Classification System, Inland Systems are defined as an aquatic ecosystem that have no existing connection to the ocean4 (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically. For Inland Systems, the regional spatial framework that has been included at Level 2 of the proposed Classification System is that of DWA’s Level 1 Ecoregions for aquatic ecosystems (Kleynhans et al., 2005). There are a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland (figure below). D

Level 2: NFWPA Wetland vegetation group / DWS Ecoregion

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) groups vegetation types across the country according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input.

Level 3: Landscape Setting

A distinction is made between four Landscape Units on the basis of the landscape setting (i.e. topographical position) within which a hydro geomorphic unit (HGM) is situated, as follows (Ollis et al., 2013):

- Slope: an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley.
- Valley floor: The base of a valley, situated between two distinct valley side-slopes.
- Plain: an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land.
- Bench (hilltop/saddle/shelf): an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes and up-slopes), and shelves / terraces / ledges.

Level 4: Hydro geomorphic Units

Eight primary HGM Types are recognised for Inland Systems at Level 4A of the classification system, on the basis of hydrology and geomorphology:

- River: a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.
- Channeled valley-bottom wetland: a valley-bottom wetland with a river channel running through it.
- Unchanneled valley-bottom wetland: a valley-bottom wetland without a river channel running through it.
- Floodplain wetland: the 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 over-topping of the channel bank.
- Depression: a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
- Wetland Flat: a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat.
- Seep: a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), uni-directional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

Level 5: Hydrological regime

Describes the behavior of water within the system and, for wetlands, in the underlying soil:

Perennial vs. non-perennial (Level 5A)

- Perennial—flows continuously throughout the year, in most years.
- Non-perennial—does not flow continuously throughout the year, although pools may persist.
- Unknown—for rivers where the flow type is not known.

Non-perennial sub-types (Level 5B)

- Seasonal—with water flowing for extended periods during the wet season/s (generally between 3 to 9 months duration) but not during the rest of the year.
- Intermittent—water flows for a relatively short time of less than one season's duration (i.e. less than approximately 3 months), at intervals varying from less than a year to several years.
- Unknown—for rivers where it is not known whether a non-perennial system is seasonal or intermittent.

Level 6: Characteristics

Natural or artificial (man-made); salinity; pH; substratum; vegetation cover type and geology.

2.2 **Watercourse / wetland assessments**

2.2.1 **River health assessment**

The DWS (2014) Desktop Assessment per Sub Quaternary Reach was used as information for this assessment.

2.2.2 **Wetland health assessment**

The WET-Health (Macfarlane et al. 2009) methodology is used to evaluate the integrity and the present ecological state of wetlands. This is a modular based approach for evaluating and monitoring the Present Ecological State (health) of a wetland and its trajectory of change and was specifically designed for the evaluation of all types of wetlands. It considers the key interacting processes that take place within a wetland and synthesize this information by evaluating three inter-related components of health (Hydrology, geomorphology and vegetation). The approach is as follows:

- The extent of impact is measured as the proportion of a wetland and/or its catchment that is affected by an activity. Extent is expressed as a percentage.
- The intensity of impact is estimated by evaluating the degree of alteration that results from a given activity.
- The magnitude of impact for individual activities is the product of extent and intensity.
- The magnitude of individual activities in each HGM unit is combined in a structured and transparent way to calculate the overall impact of all activities that affect hydrological, geomorphological or vegetation health. Present State health categories, on an impact score scale of 1-6 (or health category A-F), are as

follows: natural, largely natural, moderately modified, largely modified, extensively modified, and critically modified (Table 1.1).

- Using a combination of threat and/or vulnerability, an assessment is also made in each module on the likely *Trajectory of Change* within the wetland.

Table 1.1 Impact scores and categories of Present State used by WET-Health

Impact Category	**DESCRIPTION**	**Impact Score**	**PES** Category
None	Unmodified, natural.	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

2.2.3 **Ecological importance and sensitivity (EIS)**

The ecological importance of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales (DWAF, 1999). While the ecological sensitivity refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (DWAF, 1999). The ecological importance and sensitivity (EIS) can be calculated according to the relevant determinants. The sensitivity is determined on a descriptive scale from Very Low to Very High.

2.2.4 **Wetland functions**

The current (pre-development) and post-development value of the affected wetland units was determined using the WET-EcoServices tool developed by Kotze et al. (2009).

2.2.5 **Determining buffer zones**

The Water Research Commission report: *Bufffer zone guidelines for wetlands, rivers and estuaries* (Macfarlane & Bredin, 2017) were used to aid in watercourse classification and determining the need and extent of buffer zones. These publications use the following definitions:

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

According to this guideline, buffer widths should be tailored according to risk: This criterion recognizes the importance of using risk as a basis for establishing an appropriate buffer width. Where risk or uncertainty is high, ecologically conservative buffers should be established whereas less conservative buffers are appropriate for low-risk situations. A number of key risk factors have been identified for possible inclusion in the approach. These include: Land-uses or activities; The importance and sensitivity of the water resource; The conservation status of aquatic and semi-aquatic species; Characteristics of the buffer that affects the functionality of the buffer and mitigation measures that may be applied to reduce risks.
The extent of the buffer zone is calculated from:

(i) Edge of the active channel (Rivers and streams);
(ii) Edge of the temporary zone (Wetlands).

This method of calculating the extent of the buffer is designed for site-based assessments and includes a more detailed evaluation of risks and consideration of site-specific factors that can affect buffer requirements. Such an approach is designed to inform any detailed development planning and provide an appropriate level of information for authorization purposes.

3. Background Information

3.1 **Biophysical description of the study area**

Nkomazi Game Reserve is located in Mpumalanga approximately 20 km northeast of Badplaas between the latitudes of 30°30'00 to 31°00'00 and the longitudes of 25°45'00 to 26°00'00. Nkomazi is made up of 11 farms that were amalgamated to establish the reserve. The study site of Nkomazi can be divided into four general types of relief. The foothills of the Makhonya Mountains dominate the northern border of Sterkspruit. The southern portion of the farm Sterkspruit and the farms Winkelhaak and Vergelegen are characterised by flat and undulating plains with subtle slopes to the Komati and Seekoeispruit Rivers, with the exception of a few isolated koppies and rocky outcrops. The north-eastern regions of Nkomazi Wilderness is dominated by the Makhonya Mountains, the highest peak being 1900 m above sea level, which is a 955 m difference to the Komati River valley at 945 m above sea level. The difference in vegetation composition between these areas is substantial. The condition of the vegetation in the Nkomazi area is considerably variable, due to the history of land use. A large part was used as crop fields and this disturbance has affected the grasslands on their periphery. Some areas had cattle and other areas have been almost entirely unaffected by livestock. The topography of the study site also creates a miss-match of both sweet and sour grass species due to water availability. Consequently, the density and palatability of the grass sward in various areas differ substantially.

3.2 **Ecology & biodiversity**

Nationally, the site is situated within the Lowveld Sour Bushveld (A9) veld type according to Acocks (1988), or North-eastern Mountain Grassland (LR43) according to Low & Rebelo (1996) and Schmidt *et al* (2002). However, these classifications are very broad and may include several sub veld types of importance. The more detailed vegetation classification system of Mucina & Rutherford (2006) is used to classify the veld unit on a regional scale:

Unit 1) **Swaziland Sour Bushveld (SVl14) 2530DC**

Mainly found in Mpumalanga, Swaziland from Badplaas eastwards to Pigs Peak and Manzini. Altitude 400-1100m. Open to closed tree layer with well developed (closed) grass layer. Very hilly with moderate to steep slopes. Grey soils, derived from Randian granites and Swazian granites and gneiss. Soils are dark, very clayey: Sterkspruit, Valsrivier and Swartland soil forms. Summer rainfall with dry winters. MAP: 700-1350mm. Frost infrequent to occasional at higher altitudes. Approximately 21% transformed to cultivation and forestry. Conservation: Vulnerable.

3.3 **Conservation & Importance**

The Mpumalanga Biodiversity Sector Plan (MBSP); (MTPA, 2014) ratings for the terrestrial and freshwater ecology of the project area are projected in Appendix 2.

Table 1.2 MBCP categories relevant to the site

Freshwater ecosystems		
Category	**Subcategory**	**Content**
Critical Biodiversity Area	Wetlands	FEPA Wetlands
Ecological Support Area	Important sub catchments	Fish support areas
Ecological Support Area	Wetland clusters	Wetland clusters
Heavily or moderately modified	Heavily modified	Heavily modified
Terrestrial Ecology		
Category	**Subcategory**	**Content**
Protected Areas	National Parks & Nature Reserves	Nature Reserve
Critical Biodiversity Area	Irreplaceable	
Ecological Support Area	Local corridor	
Ecological Support Area	Protected Area buffer	
Heavily or moderately modified	Heavily modified	Heavily modified
Heavily or moderately modified	Moderately modified	Old lands

Application of the ***National Freshwater Ecosystem Priority Areas*** (NFEPA); (WRC, 2011) tool indicates whether priority wetland areas are present. The classification for these wetlands are determined using the NFEPA Technical Report and GIS metadata application (WRC, 2011) in combination with the *Classification system for wetlands and other aquatic ecosystems in South Africa* (SANBI, 2013). This application indicates that there are NFEPA listed wetlands on the site (Appendix 2).

3.4 **Protected Areas and Heritage Sites**

The study area falls within the Barberton Makhonjwa Mountains World Heritage Site and partially within the Nkomazi Private Game Reserve. Nkomazi Private Game Reserve was declared a Private Nature Reserve in 2001 via Section 85 (a) of The Mpumalanga Nature Conservation Act, Act 10 of 199. Furthermore, according to The Mpumalanga Biodiversity Conservation Plan (MBCP) Nkomazi falls in an area of conservation importance.

Nkomazi forms a corridor between the Barberton Mountain lands in the east and the Badplaas Mountain lands in the west. It is also the only natural lowland corridor linking Songimvelo Nature Reserve (MTPA) and the Badplaas/Kangwane Mountains.

4. Results

4.1 General site description and land uses

The study area is located on the plains to the south of the foothills of the Makhonjwa Mountains in the north and Skurweberg (Escarpment), approximately 10km to the east of Badplaas / eManzana. Access is gained from the R541on the southern boundary. The Nkomazi Game Reserve is located directly to the east and several of the properties forming part of this project is fenced in with this Reserve. The main administrative buildings and staff quarters are located centrally.

The Komati River flows from west to east through the central section and the Zeekoeispruit tribute to the Komati River on the property. These watercourses have well-defined channels with smaller tributaries present form north to south. Other hydrological features include wetlands and severely eroded drainage channels. Several prominent rocky outcrops are present and these are largely in a natural state.

The elevation ranges between 945m a.s.l. in the valley bottom to 1100m a.s.l. on the northern watershed. The local land use varies from natural areas to cultivated fruit and nut orchards as well as forestry in the higher lying areas. The study area is approximately 4000Ha in size and is being administered as part of the Game Reserve. In the historic past most arable land on the study area was cultivated, mainly with tobacco and fodder meadows but presently, no agricultural activities are present and all agriculture lands have been fallow for >10 years. The biophysical features and habitat delineation of the study sites are projected on an aerial image (Figure. 1). Illustrations of the environment and vegetation are included with the following sections.

The properties are located on the plains to the south of the Makhonya Mountains

4.2 **Habitat assessment and delineation**

i) **Riverine and riparian ecosystems / habitat**

The sites are located in sub quaternary catchments X11K (Komati River) and X12D (Seekoeispruit) approximately 10km downstream of the town Badplaas along the Seekoeispruit and 6km downstream of the Vygeboom Dam along the Komati River. Geographically, the upstream reach fall within the upper foothills zone, and the downstream reach within the lower foothills zone of the Northern Mountains Escarpment Aquatic Ecoregion (Ecoregion 10.3).

The riparian habitat is found in the valley bottoms alongside the Komati River, Seekoeispruit and Lekkerloopspruit. All three are perennial watercourses and as such the availability of water and fertile alluvial soils presents excellent conditions to maintain riparian vegetation.

The Komati River meanders along the southern boundary of the Sterkspruit farms and flow velocity varies according to gradient and topography. The riparian zone of the Komati River is well developed with large obligate riparian trees present. Where the topography allows the riparian zone forms a continuous strip of closed woodland of approximately 20-30m wide alongside the river. Due to historic clearing of vegetation there is no transitional zone and the change in vegetation structure from pioneer grassland (old lands) to riparian zone is abrupt. The vegetation assemblage is not very diverse and totally dominated by *Combretum erythrophyllum*. Other indigenous species are *Vachellia natalita, Diospyros lycioides* and *Salix mucronata*. In the slower flowing areas on the flat gradients the river widens and may include wide tree lined floodplains below the historic channel margins. *Phragmites australis* forms reed beds alongside the floodplains and also in-stream, resulting in faster flowing channels in the main stream.

The riparian one of the Komati River is intact and is dominated by large examples of *Combretum erythrophyllum* with *Phragmites australis* in the marginal and the in stream zones.

The extent of the riparian zone of the Komati River is well illustrated in this image

Phragmites dominated floodplains are present alongside the lower reach of the river within the study area

This aquatic habitat is characteristic of a lower foothill stream with a steep gradient and fast flowing river. The velocity depth classes fast shallow (very abundant) and fast deep (abundant) dominated this habitat, with only sparse slow shallow habitat types. The fish cover present rated moderately for overhanging vegetation and sparse for undercut banks and root wads. This reach can be regarded as an optimum habitat for flow dependent aquatic fish and invertebrate species with abundant habitat availability during high flow periods. Available data obtained from the DWS (2014) Desktop Assessment per Sub Quaternary Reach is summarized in Table 2.1.

Table 2.1 Desktop analysis for the sub quaternary catchment

Sub quaternary catchment: X11K-1227 Komati River			
PES Impact category	**Ecological importance (EI)**	**Ecological sensitivity (ES)**	**Ecological category (EC)**
Moderately modified	High	High	C
The following impacts were identified in this catchment:			
The following impacts/activities were identified: CRITICAL: None. SERIOUS/ABUNDANT: Abstraction. LARGE: Algal growth, Bed and Channel disturbance, Large dams, Small (farm) dams, Forestry, Inundation, Irrigation, Grazing (land-use), Vegetation removal. MODERATE: Agricultural fields, Low water crossings, Erosion, Alien vegetation, Overgrazing/trampling, Runoff/effluent: Irrigation, Sedimentation, and Urbanization. SMALL: Runoff/effluent: Industries.			

The Seekoeispruit flows from west to east and tribute to the Komati River on the southern section of the Sterkspruit farms. Geographically, the reach falls within the lower foothills zone. The riparian zone of the Seekoeispruit is well developed with large obligate riparian trees dominated by *Combretum erythrophyllum.* Other species present are similar as to those described in the abovementioned paragraph. A significant loss of riparian vegetation has occurred on site as result of agriculture. Due to the steep gradient and mountainous environment, the riparian vegetation of the Seekoeispruit is mostly limited to the marginal zone but widens where the topography allows. Alien invasive vegetation is problematic and well represented by *Melia azedarach, Populus alba, Morus alba, Lantana camara* and *Solanum mauritianum.* Aquatic habitat includes deep water pools with infrequent rapids, riffles and runs.

The riparian vegetation of the Seekoeispruit is mostly limited to the marginal zone

Table 2.2 Desktop analysis for the sub quaternary catchment

Sub quaternary catchment: X11K: Seekoeispruit			
PES Impact category	**Ecological importance (EI)**	**Ecological sensitivity (ES)**	**Ecological category (EC)**
Moderate	High	Very High	C
The following impacts were identified in this catchment:			
The following impacts/activities were identified: CRITICAL: None SERIOUS: None, LARGE: None MODERATE: Abstraction, Grazing (land-use) SMALL: Algal growth, Low water crossings, Small (farm) dams, Alien vegetation, Overgrazing/trampling, Vegetation removal			

The Lekkerloop is a small perennial stream and is in a largely natural state with good quality water

The Lekkerloop is a relatively small tributary to the Seekoeispruit flowing from south to north across the farm Vergelegen. Its geomorphology is typified by a relatively deep ravine with steep rocky, grass covered slopes. The substrate is rocky varying from loose rocks and stones to bedrock. The size of the stream and the topography limits size and species assemblage of the riparian vegetation to the marginal zone. These include *Cyperus spp, Phragmites australis* and *Schoenoplectus corymbosus*. Trees and shrubs are small to medium sized and include *Combretum erythrophyllum*, *Vachellia natalita*, *Diospyros lycioides*, *Searsia rehmanniana* and *Euclea crispa.* Available data obtained from the DWS (2014) Desktop Assessment per Sub Quaternary Reach is summarized in Table 2.2.

The riparian zones provide an important refuge and corridor for fauna and flora and have a ***High*** ecological importance and sensitivity rating. Buffer zones are recommended in order to protect the riparian zones.

ii) **Wetland habitat**

Several prominent valley bottom wetlands are present as well as associated seepage zones and artificial wetlands. The desktop study indicates that several of these wetlands are listed as NFEPA wetlands (Figure 1.1 and Figure 1.2). The wetlands were delineated by a combination of site assessments where the edges were plotted by GPS and refining by remote sensing on the aerial images. In order to simplify the map work, the wetland delineations projected in Figure 1.1, Figure 1.2 and Figure 1.3 projects the buffer zones around the wetlands. Determination of buffers zones are calculated in section 6.4. These are mostly at least >40m, however, the buffer varies and may be more than 100m and more where deemed necessary to create a wide ecological corridor (and to include maximum grassland habitat and to consider erosion prone areas). The wetland types are listed in Table 2.3 and the main wetland units are discussed in the following text.

Table 2.3 Wetland types and attributes

Reference	**Classification and attributes**					
	Level 1 (Ecoregion)	Level 2 (Wetland vegetation group)	Level 3 (Landscape unit)	Level 4 (Hydrogeo-morphic unit)	Level 5 (Hydrological regime)	Level 6 (Characteristics)
Type 1	Lowveld	Lowveld *Group 9*	Valley floor	Channelled valley bottom	Non-perennial	Natural
Type 2	Lowveld	Lowveld *Group 9*	Bench	Flat	Non-perennial	Natural
Type 3	Lowveld	Lowveld *Group 9*	Slope	Valley head seep	Non-perennial	Natural
Type 4	Lowveld	Lowveld *Group 9*	Bench	Flat	Non-perennial	Artificial

It should be understood that the larger wetland units comprises one or more different wetland type as listed (Table 2.3). The wetland units are described below:

Wetland unit 1 Moderately modified; 327Ha Buffer 40m

The northernmost wetland is located on Nkomazi 772JT to the north of the Komati River. It is listed as a NFEPA wetland and classified as a valley bottom wetland with small bench and head-seepage zones. It consist of three valley bottoms that converge near to the Komati River where it tribute to this river. Its headwaters is located in the foothills to the north and flow is in a southerly direction where it tribute to the Komati River. The sub-units have well defined channels. Headwater and lateral seepage zones are present. Wetland vegetation indicators are the hygrophilous grass *Imperata cylindrica* on the seepage zones and edges leading to the permanent zone where *Phragmites australis* or Typha capensis totally dominate the permanent and in-stream zone where permanent water is available. Soils are grey and very clayey leading to temper wet areas leading to the permanent zone where the soil is very dark, clayey and wet.

This is a typical valley bottom wetland and consist of three main legs that converge near to the Komati river

Beds of *Typha* and *Phragmites* is an indication of the nitrate removal function of this wetland system

The catchment of this wetland has been transformed to agriculture and this activity has encroached severely into the temporary wet areas. These activities included the clearance of natural vegetation, construction of three in-stream dams, draining of lateral seepage zones and tilling / disturbance to wetland soils. The negative consequences are a large loss of natural vegetation and sensitive biota (fauna & flora), loss of biodiversity, loss of wetland surface area, lateral soil erosion, lowering of the water table and erosion of the valley bottom channel.

Land cover of the catchment consist entirely of pioneer grassland (old agriculture lands)

The consequences of past agriculture activities include erosion of the lateral banks

The agriculture activities have ceased in the past 10 to 20 years and the vegetation of the catchment has recovered to pioneer grassland and the other negative consequences have largely stabilized. The Wet-Health module calculates a *moderate impact category* for this wetland unit.

Wetland unit: HGM 1			
PES	**Ecological importance (EI)**	**Ecological sensitivity (ES)**	**Ecological category (EC)**
Moderately modified	High	Low	C
The following impacts were identified:			
The following impacts/activities were identified: Historical encroachment of agriculture into wetland and associated vegetation removal. Low vegetation diversity			

Wetland unit 2 Critically modified; 30Ha; Buffer 40m

This wetland unit is located to the east of wetland unit 1on the farms Nkomazi 772JT and Sterkspruit 709JT. It is not listed as a NFEPA wetland. This wetland is classified as a valley bottom wetland but has been seriously degraded as result of severe erosion. Calculations indicate that more than 100Ha of wetland surface area has been lost as result of erosion.

Almost the total extent of this wetland is severely eroded

Wetland surface area, vegetation and soils are completely lost

The catchment of this wetland has been transformed to agriculture and this activity has encroached into the temporary zone. These activities included the clearance of natural vegetation, construction of two in-stream dams, draining of lateral seepage zones and tilling / disturbance to wetland soils. The negative consequences are a large loss of natural vegetation and sensitive biota (fauna & flora), loss of biodiversity, loss of wetland surface area, lateral soil erosion, lowering of the water table and erosion of the valley bottom channel.

Syzygium cordatum lines the drainage lines within the eroded basin

The agriculture activities have ceased in the past 10 to 20 years and the vegetation of the catchment has recovered to pioneer grassland. However, the negative consequence remains high as the water table has dropped significantly and the seepage zones have become dry. Hygrophilous vegetation consists of the grass *Eragrostis plana* and sedges along the upper channel as well as clumps of *Syzygium cordatum* and *Vachellia natalita* that have established within the eroded area. *Phragmites* and *Typha* is well established on the margins of two dams in the lowest section. This wetland is severely eroded and the largest extent can technically not be classified as a wetland in its present state. Flow is presently largely dependent on precipitation and seepage is present only in the lower reach. Flow is in a southerly direction where it tribute to the Komati River. The Wet-Health module calculates a *critical impact category* for this wetland unit.

Wetland unit: HGM 2			
PES	**Ecological importance (EI)**	**Ecological sensitivity (ES)**	**Ecological category (EC)**
Critically modified	Low	Low	E/F
The following impacts were identified:			
The following impacts/activities were identified: Severe Erosion Low biodiversity			

Wetland unit 3 Largely modified; 253Ha total and an additional 300Ha; Buffer 40m

This wetland is located on the farms Cambalala 765JT and the remainder of Vergelegen 728JT to the south of the Komati River. It is listed as a NFEPA wetland. This wetland is classified as a valley bottom wetland. Flow is in a northerly direction where it tribute to the Komati River.

The catchment of this wetland has been transformed to agriculture and this activity has encroached into the wetland zone. These activities included the clearance of natural vegetation, construction of two small in-stream dams, draining of lateral seepage zones and tilling / disturbance to wetland soils. The negative consequences are a large loss of natural vegetation and sensitive biota (fauna & flora), loss of biodiversity, loss of wetland surface area, lateral soil erosion, lowering of the water table and erosion of the valley bottom channel.

The head of this wetland is severely eroded

Reed beds has colonized the permanently inundated areas where weirs have been constructed to mitigate erosion

The channel becomes narrow and wetland features are absent as the substrate becomes rocky near to its confluence with the Komati River

The head and central sections are severely eroded and barren. The agriculture activities have ceased in the past 10 to 20 years and the vegetation of the catchment has recovered to pioneer grassland. The construction of weirs / walls in the channel of the northern section has addressed erosion and improved the status of the northern section as aquatic vegetation has colonized the inundated areas. Wetland vegetation indicators present are the hygrophilous grass *Imperata cylindrica* on the temporary zones and banks and *Phragmites australis, Typha capensis* and *Cyperus spp* in the permanent and in-stream zone. The head and southern section is still

seriously degraded as result of erosion. The Wet-Health module calculates a *large impact category* for this wetland unit.

Wetland unit: HGM 3			
PES	**Ecological importance (EI)**	**Ecological sensitivity (ES)**	**Ecological category (EC)**
Largely modified	Moderate	Low	D
The following impacts were identified:			
The following impacts/activities were identified: Severe Erosion, Low biodiversity			

Wetland unit 4 (X12G) 89Ha; Buffer 40

This wetland is located on the farm Cambalala 765JT directly to the east of wetland unit 3. It is listed as a NFEPA wetland. This wetland is classified as a perennial valley bottom wetland. Flow is in a northerly direction where it tribute to the Komati River.

Permanent water bodies is present in a diffuse channel

This wetland is well-vegetated and has recovered well since agriculture activities have ceased

The catchment of this wetland has been transformed to agriculture and this activity has encroached into the wetland zone. Natural vegetation remains on the southern section and eastern bank of this wetland. The agriculture activities were more or less limited to the northern section and western bank and included the clearance of natural vegetation, draining of lateral seepage zones and tilling / disturbance of wetland soils. The negative consequences are a loss of natural vegetation and sensitive biota (fauna & flora), loss of biodiversity and loss of wetland surface area. The agriculture activities have ceased in the past 10 to 20 years and the vegetation of the catchment has recovered to pioneer grassland and the other negative consequences have largely stabilized. Little sign of erosion is present and the wetland vegetation is in a good state and covers the total extent of the wetland. *Phragmites australis, Typha capensis, Cyperus spp* and *Schoenoplectus corymbosus* are present in the permanent and temporary zones. *Imperata cylindrica* and *Eragrostis inamoena* are indicators of the seasonally wet areas along the margins. The Wet-Health module calculates a *moderate impact category* for this wetland unit.

Wetland unit: HGM 4			
PES	**Ecological importance (EI)**	**Ecological sensitivity (ES)**	**Ecological category (EC)**
Largely natural	Moderate	Moderate	B
The following impacts were identified:			
The following impacts/activities were identified: Historic encroachment of agriculture			

Wetland unit 5: Moderately modified; 39Ha; Buffer 40m

This wetland is located on the remainder of the farm Vergelegen 728JT. It is not listed as a NFEPA wetland. This wetland is classified as a seasonal valley bottom wetland. Flow is in a northwesterly direction where it tribute to the Seekoeispruit.

The catchment of this wetland has been transformed to agriculture and this activity has encroached into the wetland zone. Fragments of natural vegetation remain alongside the banks of this wetland. The agriculture activities included the clearance of natural vegetation, draining of lateral seepage zones and tilling / disturbance of wetland soils. This wetland has been fragmented by the construction of roads and infrastructure (sheds and workshops). The negative consequences are a loss of natural vegetation and sensitive biota (fauna & flora), loss of biodiversity and loss of wetland surface area. The agriculture activities have ceased in the past 10 to 20 years and the vegetation of the catchment has recovered to pioneer grassland and the other negative consequences have largely stabilized. Little erosion is present and the wetland vegetation is in a good state and covers the total extent of the wetland. The Wet-Health module calculates a *moderate impact category* for this wetland unit.

Wetland vegetation indicators are present all along the valley bottom. The hygrophilous grass *Imperata cylindrica* on the seepage zones and banks and *Phragmites* and *Typha capensis* in the permanent and in-stream zone.


This wetland is located on a relatively flat area and is rather wide in some areas. Permanent zone is indicated by *Phragmites australis* and *Typha capensis*


A wide temporary zone forms the headwaters where the gradient is quite flat

Wetland unit: HGM 5			
PES	**Ecological importance (EI)**	**Ecological sensitivity (ES)**	**Ecological category (EC)**
Moderately modified	Moderate	Low	C
The following impacts were identified:			
The following impacts/activities were identified: Historic encroachment of agriculture			

<u>Smaller wetland units (HGM 6)</u>
Buffer 20-40m

Many small to medium sized seasonal seepage zones and temporary wet zones are present on the combined properties. These zones tribute to the larger units

described above or directly to one of the larger perennial watercourses (rivers). These zones are indicated on the site maps (Figure 1.1 and Figure 1.2). In order to simplify the assessment process, these are described collectively under this heading.

The slopes on the study area (excluding those of the outcrops) are gentle and seep zones are well vegetated with the hygrophilous grass, *Imperata cylindrica*, which is totally dominant. These seepage zones have been subject to agriculture activities (tilling of wetland soils and drainage furrows has been excavated to dry additional land for agriculture). As agriculture is no longer practiced these disturbances has stabilized and the wet zones have recovered and are best left as is in order to prevent further degradation. The Wet-Health module calculates a *moderate impact category* for these wetland units.

Permanent seepage zone

Seasonal seep line

Imperata cylindrica is an indicator of wet conditions at all wetland zones

Seasonal seep zones on these properties are mostly associated with shallow sandstone outcrops that forces subsurface water (after sufficient rains) to the surface

4.3 **Wetland health and functions**

The calculated wetland functions are captured in Table 2.5. It is notable that the functions of those wetlands that have been subject to negative impacts are noticeably lower. For example the erosion control function of the seriously eroded wetland units 2 and 3 is very low. The highest scores are for nitrate removal and erosion control.

Table 2.5 Wetland functions

Wetland Unit	**HGM 1**	**HGM 2**	**HGM 3**	**HGM4**	**HGM 5**	**HGM 6**
Hydro-geomorphic setting	**VC**	**VC**	**VC**	**VC**	**V**	**HW**
	Score	**Score**	**Score**	**Score**	**Score**	**Score**
Flood attenuation	2,3	2,0	2,2	2,1	2,1	2,2
Stream flow regulation	2,8	2,5	2,5	2,8	2,0	2,0
Sediment trapping	1,8	1,6	2,1	1,8	2,0	1,4
Phosphate trapping	2,7	2,1	2,3	2,5	2,7	2,3
Nitrate removal	3,1	1,8	2,5	3,0	3,0	2,6
Toxicant removal	2,6	2,0	2,0	2,4	2,4	1,7
Erosion control	3,0	0,8	1,2	2,9	2,9	2,7
Carbon storage	2,7	1,3	0,7	2,7	2,3	1,7
Maintenance of biodiversity	2,0	0,9	1,0	2,1	1,6	1,5
Water supply for human use	1,3	1,1	0,8	1,1	0,8	0,5
Natural resources	0,0	0,0	0,0	0,0	0,0	0,0
Cultivated foods	0,0	0,0	0,0	0,0	0,0	0,0
Cultural significance	1,0	1,0	1,0	1,0	2,0	1,0
Tourism and recreation	1,7	0,7	0,9	1,6	1,1	0,6
Education and research	1,8	1,0	1,0	1,8	1,5	1,5
Threats	2,0	0,0	0,0	2,0	2,0	0,0
Opportunities	2,0	4,0	4,0	1,0	1,0	1,0

5. Sensitivity and buffer zones

5.1 **Present ecological state, sensitivity and importance**

The present ecological state, ecological sensitivity and importance are summarized in Table 4.1:

Table 4.1 Habitat sensitivity and minimum buffer zones

Habitat unit	Present Ecological State (PES)	Ecological importance (EI)	Ecological sensitivity (ES)	Operational buffer zone
Komati River	Moderate	High	High	≥60m
Seekoeispruit	Moderate	High	High	≥60m
Lekkerloop	Moderate	High	High	≥60m
Valley bottom wetlands (HGM1; 4; 5)	Moderate	High	Moderate	≥40m
Valley bottom wetland (HGM3)	Largely modified	Moderate	Low	≥40m
Valley bottom wetland (HGM2)	Critical	Very low	Very low	≥40m
Small seepage wetlands and (HGM6)	Moderate	Low	Low	≥20m

The investigation indicates that the freshwater habitats are subject to various levels of negative impacts but are all regarded as sensitive ecosystems. In order to provide adequate protection of the sensitive habitats and to provide refuge for biota, buffer areas and corridors must be provided.

5.2 **Potential impacts and buffer zone**

The MTPA minimum requirement is a 100m buffer zone around NFEPA wetlands and rivers. This requirement may be applicable in cases to protect pristine ecosystems but in this instance it will sterilize a large surface area of land available for cultivation in an already disturbed ecosystem. The MTPA handbook suggests that the DWS tool for buffer zones can be used to calculate an effective buffer instead of applying the generic 100m buffer zone.

The DWS tool (The Water Research Commission report: *Buffer zone guidelines for wetlands, rivers and estuaries* (Macfarlane & Bredin, 2017)) were therefore applied to aid in watercourse classification and determining the need and extent of aquatic buffer zones. This model considers potential impacts of the proposed activity on the integrity of the freshwater ecosystems and calculates a buffer zone that will be effective to mitigate the consequences of potential impacts. The calculated buffer zones for each habitat type is summarized in Table 4.1 and applied to each habitat that is listed in section 4.

One exception where the buffer size can be relaxed is where roads and infrastructure are present where a large buffer is illogical and will not serve a purpose but will sterilize unnecessary areas for cultivation. A buffer of 65m is calculated for the river and its tributaries. This is used as a minimum guideline and is

enlarged to >100m where the topography requires a larger buffer and where wetlands are integrated with riparian zones.

5.3 **Ecological corridors and priority areas**

Considering the fact that these properties formed part of a Protected Area and the fact that the MTPA provides for ecological corridors in the site area, special consideration was given to provide land for corridors and to conserve important biodiversity and ecosystems. The proposed corridors and conservation areas have been designed to create corridors around sensitive habitats across the entire study area with the objective of including functional ecosystems and to connect terrestrial and freshwater habitats and minimize fragmentation and isolation of habitat (Figure 2.1).

6. Conclusion and Recommendations

The investigation and assessment concludes that the aquatic ecosystems and wetlands vary in ecological status and integrity and will not be significantly affected by the proposed activities if the appropriate buffer zones are adhered to. Generic mitigation measures will apply with regards to pollution, erosion and other environmental aspects.

7. References

Acocks, J. P. H. 1988. Veld types of South Africa. Botanical Research Unit. 146p.

Alexander, G.& Marais, J. 2007.A guide to the reptiles of southern Africa. Struik Publishers.408 pp.

Animal Demographic Unit (ADU). 2010. Reptile Atlas - Southern African reptile conservation assessment. Department of Zoology, University of Cape Town.

Taylor M.R. et al, 2015. The 2015 Eskom Red Data Book of birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & De Villiers, M.S. 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. Suricata 1. SANBI, Pretoria.

Branch, B. 1988.Field guide to the snakes and other reptiles of Southern Africa.Struik Publishers, Cape Town.328 pp.

Child MF, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert HT, editors. The 2016 Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa

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

Du Preez, L. & Carruthers, V. 2009. A complete guide to the frogs of Southern Africa.Struik Nature, Cape Town.

Ferrar, A.A. & Lötter, M.C. 2007. Mpumalanga Biodiversity Conservation Plan Handbook. Mpumalanga Tourism & Parks Agency, Nelspruit.

Gibbons, G., Maclean, G. 1997. Roberts' Multimedia: Birds of Southern Africa. Southern African Birding cc.

Harrison, J.A., Allan, D.G., Underhill, M., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. 1997. The atlas of Southern African Birds. Volume 1: Non-passerines. Avian Demography Unit. Birdlife SA. Pp 786.

Harrison, J.A., Allan, D.G., Underhill, M., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. 1997. The atlas of Southern African Birds. Volume 2: Passerines. Avian Demography Unit. Birdlife SA. Pp 786.

IUCN Red List of Threatened Species. 2018 (This document is regularly updated: the current version is version 13 (March 2017)) The IUCN Red List of Threatened Species is compiled and produced by the IUCN Species Programme based on contributions from a network of thousands of scientific experts around the world.

These include members of the IUCN Species Survival Commission Specialist Groups, IUCN Red List Partners, and many others, including experts from universities, museums, research institutes and non-governmental organizations. Website: www.iucn.org/redlist

Lötter. M.C. 2006. Mpumalanga Biodiversity Conservation Plan CD-Rom. Mpumalanga Tourism & Parks Board, Nelspruit.

Mackenzie G.C. & Roundtree. 2007. Draft riparian delineation methods prepared for theDepartment of Water Affairs and Forestry, Version 1.

Mecenero S, Ball JB, Edge DA, Hamer ML, Henning GA, Krüger MA, Pringle EL, Terblanche RF and Williams. 2013. Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas.

Minter, L.R., M. Burger, J. A. Harrison, H.H. Braack, P.J. Bishop, &Kloepfer, D. eds. 2004. *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland.*SI/MAB Series #9.Smithsonian Institution, Washington, DC.

Mucina, L. & Rutherford, M.C. (eds.) 2006. Vegetation of South Africa, Lesotho & Swaziland, Sterlizia 19. South African National Biodiversity Institute, Pretoria.

National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEMBA). 2007. Species Listing Schedule A and B amended.

Nel, JL., K.M. Murray, A.M. Maherry, C.P. Petersen, D.J. Roux, A. Driver, L. Hill, H. Van Deventer, N. Funke, E.R. Swartz, L.B. Smith-Adao, N. Mbona, L. Downsborough, S. Nienaber. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. 1801/2/11.

Pooley, E. (Editor). 1998. A Field Guide To the Wild Flowers of Kwazulu Natal and the Eastern Region. Natal Floral Publications Trust, Durban. Pp 630

Rouget M., Reyers B., Jonas Z., Desmet P., Driver A., Maze K., Egoh B., & Cowling R.M. 2004. Technical Report Volume 1: Terrestrial Component. In: South African National Biodiversity Assessment 2004: Priorities for biodiversity conservation in South Africa. Pretoria. SANBI.

Schmidt, E., Lotter, M., McCleland, W. 2002. Trees and shrubs of Mpumalanga and the Kruger National Park. Jacana, Jhb.

SKINNER, J.D. & CHIMIMBA, C.T. 2005. The mammals of the Southern African subregion. London: Cambridge University press.

Van Oudtshoorn F.P. 1991. Gids tot Grasse van Suid-Afrika. Briza, PTA. Pp 301.

http://www.bmmlworldheritage.org/docs/NominationDossier2017/APPENDIX%20F%20Nkomazi%20IMP.pdf

http://www.dwa.gov.za/iwqs/rhp/state_of_rivers/Komati_River_Report_2014_Final.pdf

Appendixes

APPENDIX 1: SPECIALIST DETAILS