Water Resource Assessment for the proposed Hekpoort Housing Development

2020

Hekpoort, Gauteng Province

January 2020

Client

GA Environment

Prepared for:

GA Environment

Prepared by:

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Report Name	**Water Resource Assessment for the Hekpoort Housing Development**	
Reference	**Hekpoort**	
Submitted to	**GA Environmental**	GA Environment
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Magalies River at site H2

Executive Summary

The Biodiversity Company was commissioned by GA Environment to conduct a water resource (wetlands and aquatic ecology) baseline and impact (risk) assessment for the proposed Hekpoort housing development; in Hekpoort, Gauteng Province. The assessment attempts to meet the provincial minimum requirements to conduct the relevant specialist assessments in support of the required authorisations. These include the requirements of the National Environmental Management Act 107 of 1998, specifically Appendix 6; and the requirements of the Water Use Authorisation in terms of Section 21(c) and (i) of the National Water Act (Act 36 of 1998) (NWA).

A single wet season survey was conducted for the proposed Hekpoort Housing Development on the 13th of January 2020. Desktop information for the sub-quaternary reach indicated that the Present Ecological State of the Magalies River reach is in a largely modified state, with the Ecological Importance being moderate, and the Ecological Sensitivity being very high. The riverine assessment determined the biotic and habitat integrity of the reach, through the assessment of water quality, habitat, fish community and macroinvertebrates assemblages. The results indicated that water quality parameters as measured *in situ* was adequate to support a diverse biotic community, however, the presence of excessive algal growth indicated eutrophic conditions within the reach. Further, elevated turbidity and presence of fine sediment within the system indicated erosion within the catchment, which would limit habitat quality. The Magalies River reach was classified as an upper foothills system, however, the habitat was variable with lowland features observed. Instream habitat was rated as diverse, capable of sustaining a diverse macroinvertebrate and fish community. The riparian delineation indicated that the proposed project footprint encroaches into the riparian zone. The integrity of the riparian zone was rated as moderately modified, the extensive presence of alien invasive plants contributed towards the modified state.

The biotic indices indicated a moderately modified macroinvertebrate community, with low abundances of sensitive taxa such as Leptophlebiidae and Lestidae. The macroinvertebrate metrics indicated water quality perturbations as the dominant driver of a modified community within the reach. The fish assessment indicated a moderately to largely modified community. It should be noted that sampling time was limited and therefore a more complete fish community would be expected should additional sampling be conducted. The presence of numerous juvenile *Enteromius* species indicated the system as an important recruitment and nursery for fish species in the catchment. The Present Ecological State of the system was rated as moderately to largely modified (or class D), which was a minor increase from the expected desktop state, however, falls below the recommended ecological category of largely natural.

As for wetland ecology, no wetlands have been identified, which has left the Magalies River as the only watercourse within the 500 m regulated area.

The construction of the Hekpoort Housing Development poses low to moderate risks during the construction phase. Moderate risks are associated with the activities proximate to the watercourse, including the clearing of riparian vegetation, levelling of the area, and operation of heavy machinery adjacent to the watercourse. The implementation of mitigation measures will not reduce the risks of clearing riparian areas and the operation of heavy machinery in the riparian zone as the activities will result in direct loss of riparian vegetation, bank modification and direct impact to the watercourse. However, should the proposed development avoid the

riparian zone, and the buffer be adhered to, the impacts to the watercourse will be reduced to low.

Aspect	Without mitigation	With mitigation
Construction Phase		
Access routes	Low	Low
Clearing vegetation (outside riparian zone)	Moderate	Low
Clearing riparian vegetation	Moderate	Moderate
Construction of laydown yard	Moderate	Low
Stormwater management	Low	Low
Operation of machinery & equipment	Moderate	Moderate
Operational Phase		
Site management	Low	Low
Storm water management	Low	Low

A professional opinion is required as per the NEMA regulations with regards to the proposed development, taking into account the current status of the aquatic ecosystems, and furthermore the nature and requirements of the project. The final summary opinion of the project area is as follows:

- The current ecological status of the Magalies River is classed as moderately modified;
- No species of conservational concern were collected during the study, however, the Magalies reach is designated as a fish sanctuary for *Enteromius motebensis*, which is listed as Near Threatened (IUCN, 2020);
- Numerous modifications to the reach were observed during the site visit, including channel, bed and bank erosion, and extensive alien vegetation encroachment;
- The proposed Hekpoort development footprint encroaches into the Magalies riparian zone, which would have significant impact to the riparian integrity and subsequent integrity of the Magalies River. It is therefore strongly recommended the footprint be modified to avoid the riparian zone and the applicable buffer be applied.

Should the project footprint be readjusted according to the above recommendation, the project can proceed with the implementation of adequate mitigation measures. In that instance, no fatal flaws are expected for the project.

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Document Guide

The table below provides the NEMA (2014) Requirements for Biodiversity Assessments, and also the relevant sections in the reports where these requirements are addressed:

Requirement	Page/ section
1 A specialist report prepared in terms of these Regulations must contain—	
a. details of—	
i. the specialist who prepared the report; and	Page i
ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 6
b. a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ix
c. an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
• (cA) an indication of the quality and age of base data used for the specialist report;	Section 7
• (cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8
d. the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1
e. a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
f. details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Section 7
g. an identification of any areas to be avoided, including buffers;	Section 7.4
h. a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	None
i. a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j. a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 7
k. any mitigation measures for inclusion in the EMPr;	Section 9
l. any conditions for inclusion in the environmental authorisation;	Section 9.3
m. any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n. a reasoned opinion—	Section 8.3
i. whether the proposed activity, activities or portions thereof should be authorised;	Section 9.3
(iA) regarding the acceptability of the proposed activity or activities; and	Section 9.3
ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 8.3
o. a description of any consultation process that was undertaken during the course of preparing the specialist report;	None
p. a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
q. any other information requested by the competent authority.	n/a
2 Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 1

Declaration

I, Christian Fry declare that:

- I act as the independent specialist in this application;
- I 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;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority 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 form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Christian Fry

Aquatic Specialist

The Biodiversity Company

January 2020

Declaration

I, Ivan Baker declare that:

- I act as the independent specialist in this application;
- I 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;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority 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 form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Ivan Baker

The Biodiversity Company

January 2020

1 Introduction

The Biodiversity Company was commissioned by GA Environmental to conduct a water resource (wetlands and aquatic ecology) baseline and impact (risk) assessment for the proposed Hekpoort housing development, Gauteng. The assessment attempts to meet the provincial minimum requirements to conduct the relevant specialist assessments in support of a the required authorisations. These include the requirements of the National Environmental Management Act 107 of 1998, specifically Appendix 6; and the requirements of the Water Use Authorisation in terms of Section 21(c) and (i) of the National Water Act (Act 36 of 1998) (NWA).

A single survey was conducted of the Magalies River reach on the 13th of January 2020, which constitutes a wet season survey.

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP), enabling informed decision making as to the ecological viability of the proposed development and to provide an opinion on the whether any environmental authorisation process or licensing is required for the proposed activities.

1.1 Objectives

The aim of the assessment was to provide information to guide the proposed Hekpoort Housing Development project with respect to the current state of the associated water resources in the project area. This was achieved through the following:

- The characterisation of the current state of the local river systems;
- The delineation and assessment of wetlands within 500m of the project area;
- A risk assessment for the proposed development; and
- The prescription of mitigation measures and recommendations for identified risks.

The following documents were considered in determining the SoW:

- Gauteng Department of Agriculture, Conservation & Environment (GDACE): Basic Assessment Report;
- Gauteng Department of Agriculture and Rural Development (GDARD): Checklist for biodiversity assessments; and
- GDARD requirements for biodiversity assessments version 3 (March 2014).

2 Key Legislative Requirements

2.1 National Water Act (Act No. 36 of 1998)

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

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

A watercourse means:

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

The NWA recognises that the entire ecosystem, and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS.

2.2 National Environmental Management Act (Act No. 107 of 1998)

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

3 Project Area

The project area lies in the town of Hekpoort in the Gauteng Province (Figure 3-1). The watercourse in the project area includes a reach of the Magalies River, a tributary of the Crocodile River, which have their confluence in the Haartebeepoort Dam. The Magalies River reach falls in the A21F quaternary catchment, within the Limpopo Water Management Area (WMA) (NWA, 2016) and the Western Bankenveld ecoregion (Dallas, 2007).

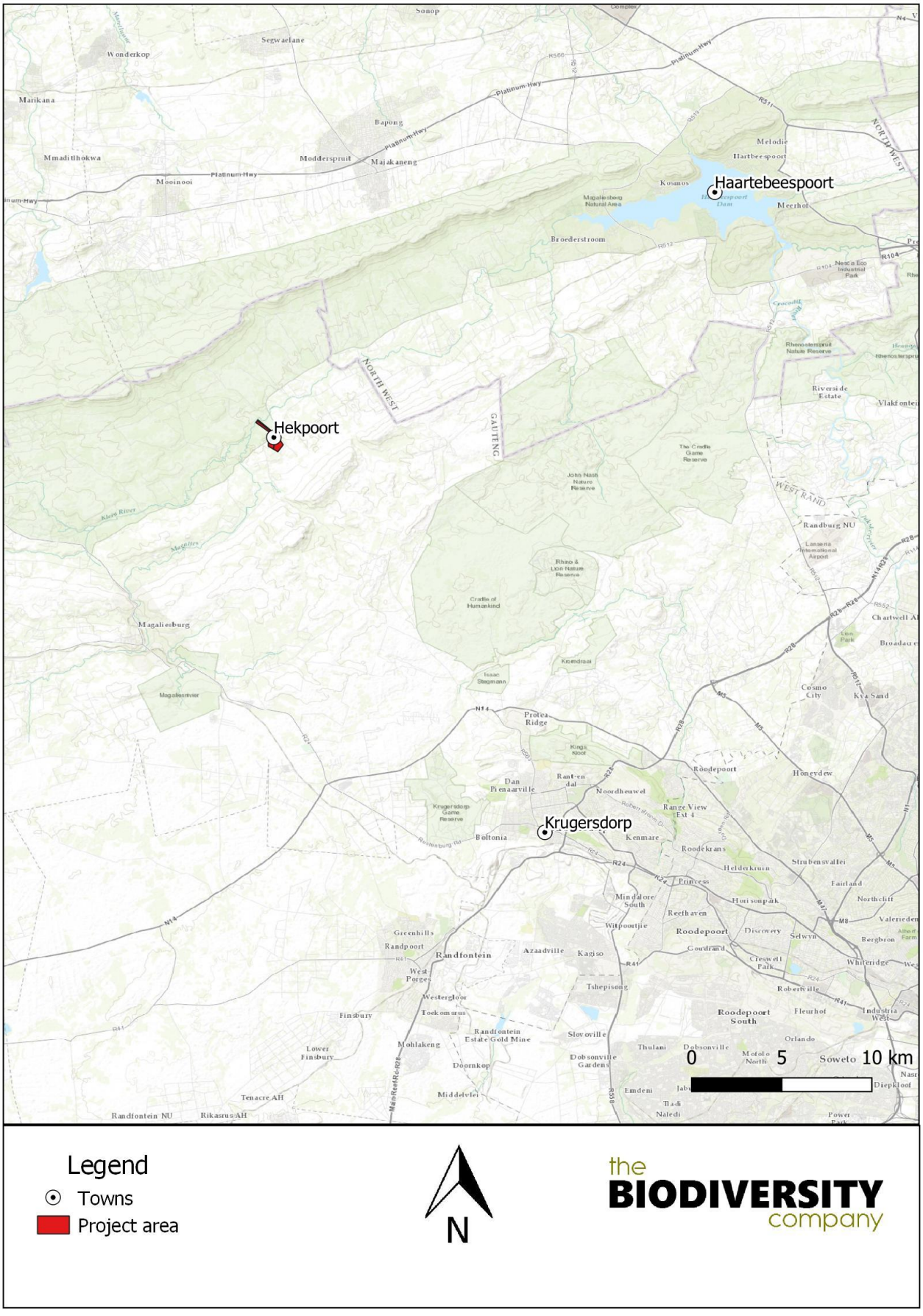


Figure 3-1 Project locality for the 2020 Hekpoort housing development

Figure 3-2 Illustration of the Magalies River reach within the project area

4 Methodology

4.1 Aquatic Assessment

4.1.1 *In Situ* Water Quality

During the survey a portable Exstick 2 multimeter was used to measure the following parameters *in situ*:

- pH;
- Conductivity;
- Dissolved Oxygen (DO); and
- Water Temperature.

Water quality has a direct influence on aquatic life forms. Although these measurements only provide a "snapshot", they can provide valuable insight into the characteristics and interpretation of a specific sample site at the time of the survey.

4.1.2 Habitat Assessment

Habitat availability and diversity are major attributes for the biota found in a specific ecosystem, and thus knowledge of the quality of habitats is important in an overall assessment of ecosystem health. Habitat assessment can be defined as the evaluation of the structure of the surrounding physical habitat that influences the quality of the water resource and the condition of the resident aquatic community (Barbour *et al*. 1996). Both the quality and quantity of available habitat affect the structure and composition of resident biological communities (USEPA, 1998). Habitat quality and availability plays a critical role in the occurrence of aquatic

biota. For this reason, habitat evaluation is conducted simultaneously with biological evaluations to facilitate the interpretation of results.

4.1.2.1 Intermediate Habitat Integrity Assessment

The aim of the Intermediate Habitat Integrity Assessment (IHIA) is to make an intermediate assessment of the habitat integrity of rivers according to a modified Habitat Integrity approach which can be applied in intermediate determination of the ecological Reserve for rivers in South Africa (DWS, 1999). The methodology is based on the qualitative assessment of a number of pre-weighted criteria which indicate the integrity of the in-stream and riparian habitats available for use by riverine biota.

The criteria considered indicative of the habitat integrity of the river were selected on the basis that anthropogenic modification of their characteristics can generally be regarded as the primary causes of degradation of the integrity of the river (Table 4-1) (DWS, 1999). The study assessed 5 km of the Magalies River, Blesbokspruit and the Magalies River.

Table 4-1 Criteria used in the assessment of habitat integrity (from Kleynhans, 1996).

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of high flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon *et al*., 1993 in: DWS, 1999). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993 in: DWS, 1999) is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon *et al*., 1992 in DWS, 1999)).
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river (Gordon *et al*., 1992). Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochtonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

The assessment of the severity of impact of modifications is based on six descriptive categories which are described in Table 4-2.

Table 4-2 Descriptive classes for the assessment of modifications to habitat integrity (from Kleynhans, 1996).

Impact Category	Description	Score
None	No discernible impact, or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1 - 5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	6 - 10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11 - 15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16 - 20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21 - 25

The habitat integrity assessment takes into account the riparian zone and the instream channel of the river. Assessments are made separately for both aspects, but data for the riparian zone are primarily interpreted in terms of the potential impact on the instream component (Table 4-3). The relative weighting of criteria remain the same as for the assessment of habitat integrity (DWS, 1999).

Table 4-3 Criteria and weights used for the assessment of habitat integrity and habitat integrity (from Kleynhans, 1996).

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
Total	100	Total	100

The negative weights are added for the instream and riparian facets respectively and the total additional negative weight subtracted from the provisionally determined intermediate integrity to arrive at a final intermediate habitat integrity estimate. The eventual total scores for the instream and riparian zone components are then used to place the habitat integrity in a specific intermediate habitat integrity category (DWS, 1999). These categories are indicated in Table 4-4.

Table 4-4 Intermediate habitat integrity categories (From Kleynhans, 1996)

Category	Description	Score (% of Total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0

4.1.3 Aquatic Macroinvertebrates

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour *et al.,* 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.,* 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

4.1.3.1 South African Scoring System version 5

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g. Chironomidae) to highly sensitive families (e.g. Perlidae). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Identification of organisms was made to family level (Thirion *et al.,* 1995; Dickens and Graham, 2002; Gerber and Gabriel, 2002).

Reference conditions reflect the best conditions that can be expected in rivers and streams within a specific area and reflect natural variation over time. These reference conditions are used as a benchmark against which field data can be compared. Modelled reference conditions for the Western Bankenveld – Upper and Lower Ecoregions were obtained from Dallas (2007). The biological bands for the Western Bankenveld - Upper and Lower Ecoregion are presented in Figure 4-1. Ecological categories based on biological banding are presented in Table 4-5.

Table 4-5 Biological Bands / Ecological categories for interpreting SASS data (adapted from Dallas, 2007)

Class	Ecological Category	Description
A	Natural	Unimpaired. High diversity of taxa with numerous sensitive taxa.
B	Largely natural	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.
C	Moderately modified	Moderately impaired. Moderate diversity of taxa.
D	Largely modified	Considerably impaired. Mostly tolerant taxa present.
E/F	Seriously Modified	Severely impaired. Only tolerant taxa present.

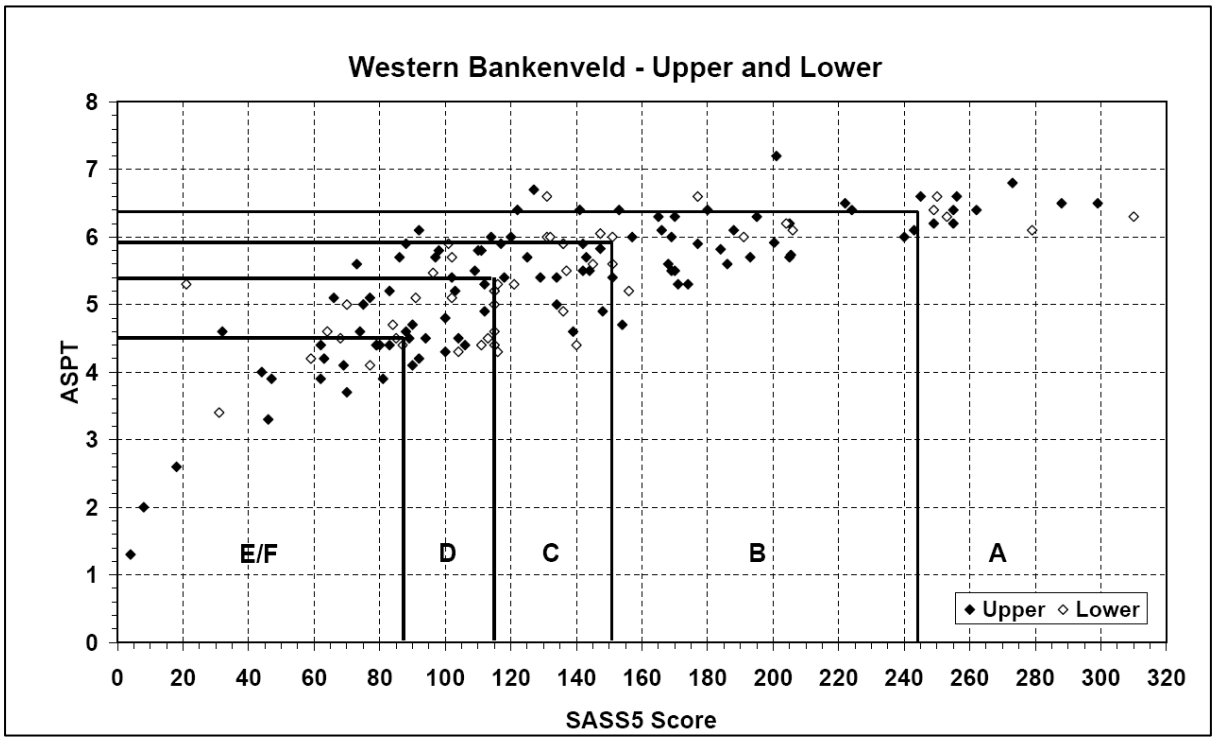


Figure 4-1 Biological Bands for the Western Bankenveld – Upper and Lower Ecoregion, calculated using percentiles (Dallas, 2007)

4.1.3.2 Macroinvertebrate Response Assessment Index

The Macroinvertebrate Response Assessment Index (MIRAI) was used to provide a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community from the calculated reference conditions for the SQR. This does not preclude the calculation of SASS5 scores if required (Thirion, 2007). The four major components of a stream system that determine productivity for aquatic macroinvertebrates are as follows:

- Flow regime;
- Physical habitat structure;
- Water quality;
- Energy inputs from the watershed; and

- Riparian vegetation assessment.

The results of the MIRAI will provide an indication of the current ecological category and therefore assist in the determination of the PES.

4.1.4 Fish Community Assessment

The information gained using the Fish Response Assessment Index (FRAI) gives an indication of the PES of the river based on the fish assemblage structures observed. Fish were captured through minnow traps, cast nets and electroshocking. All fish were identified in the field and released at the point of capture. Fish species were identified using the guide Freshwater Fishes of Southern Africa (Skelton, 2001). The identified fish species were compared to those expected to be present for the quaternary catchment. The expected fish species list was developed from a literature survey and included sources such as (Kleynhans *et al.,* 2007) and Skelton (2001). It is noted that the FRAI Frequency of Occurrence (FROC) ratings were calculated based on the habitat present at the sites.

4.1.5 Present Ecological Status

Ecological classification refers to the determination and categorisation of the integrity of the various selected biophysical attributes of ecosystems compared to the natural or close to natural reference conditions (Kleynhans and Louw, 2007). For the purpose of this study ecological classifications have been determined for biophysical attributes for the associated watercourse. This was completed using the river ecoclassification manual by Kleynhans and Louw (2007).

4.2 Wetland Assessment

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

4.2.1 Desktop assessment

The following information sources were considered for the desktop assessment;

- Information as presented by the South African National Biodiversity Institutes (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org);
- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- The National Freshwater Ecosystem Priority Areas (Nel, et al., 2011);
- Contour data (5 m).

4.2.2 Wetland Delineation

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 4-2. The outer edges of the wetland areas were identified by considering the following four specific indicators:

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

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

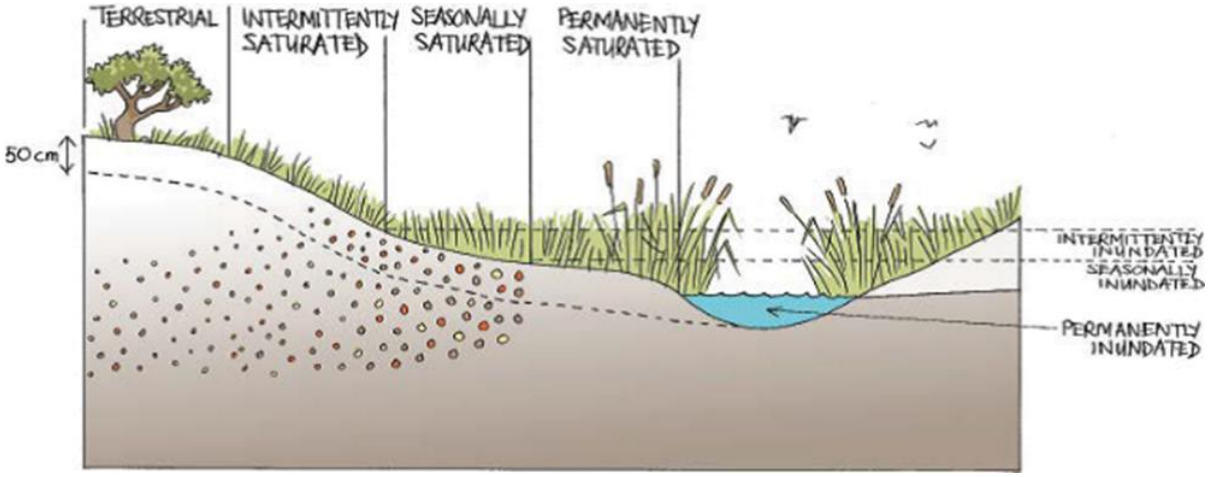


Figure 4-2 Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013)

4.2.3 Wetland Functional Assessment

Wetland Functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands, as well as for humans. Ecosystem services serve as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze et al. 2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 4-6).

Table 4-6 Classes for determining the likely extent to which a benefit is being supplied

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

4.2.4 Determining the Present Ecological Status (PES) of wetlands

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The PES categories are provided in Table 4-7.

Table 4-7 The Present Ecological Status categories (Macfarlane, et al., 2009)

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

4.2.5 Determining the Ecological Importance and Sensitivity (EIS) of Wetlands

The method used for the Ecological Importance and Sensitivity (EIS) determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 4-8, (Rountree et al., 2012).

Table 4-8 Description of Ecological Importance and Sensitivity categories

EIS Category	Range of Mean	Recommended Ecological Management Class

Very High	3.1 to 4.0	A
High	2.1 to 3.0	B
Moderate	1.1 to 2.0	C
Low Marginal	< 1.0	D

4.2.6 Ecological Classification and Description

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

4.2.7 Determining Buffer Requirements

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

4.3 Risk Assessment

4.3.1 DWS Risk Assessment

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines. The significance of the impact is calculated according to Table 4-9.

Table 4-9 Significance ratings matrix

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s)impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

5 Limitations

The following aspects were considered as limitations;

- The water resource assessment was based on the results of a single high flow / wet season survey only. Therefore, temporal trends of the system could not be generated and interpreted. Furthermore, the biota collected during the survey does not represent a comprehensive list of species potentially found within the reach, this is due to time constraints in the field;
- During the site assessment, various wetland checks and transects were carried out in areas identified as potential wetland areas, these being within the 500 m regulated area. No evidence of wetlands was noted, and therefore no wetland assessment was completed for this assessment;
- Areas characterised by external wetland indicators have been the focus for this study. Areas lacking these characteristics, i.e. crop fields, have not been focussed on; and
- The GPS used for water resource delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side.

6 Expertise of the Specialists

6.1 Andrew Husted

Mr. Andrew Husted is an aquatic ecologist, specializing in freshwater systems and wetlands, who graduated with a MSc in Zoology. He is SACNASP registered (Pri Sci Nat 400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Mr Husted is an Aquatic, Wetland and Biodiversity Specialist with 12 years' experience in the environmental consulting field. Andrew is an accredited wetland practitioner, recognised by the relevant South African authorities, and also the Mondi Wetlands programme as a competent wetland consultant.

6.2 Christian Fry

Mr. Christian Fry is an aquatic ecologist, specializing in freshwater ecosystems. He completed his MSc in Aquatic Science at the University of Johannesburg. He has four years' work experience in the field of aquatic ecology and has conducted numerous studies in Southern and Western Africa. He is SACNASP registered (Pri Sci Nat. 119082) in the field of Aquatic Science

6.3 Ivan Baker

Ivan Baker is SACNASP registered (Cand. Sci Nat 119315) in environmental science and geological science. Ivan is a wetland and ecosystem service specialist, a hydropedologist and pedologist that has completed numerous specialist studies ranging from basic assessments to EIAs. Ivan has carried out various international studies following FC standards. Ivan completed training in Tools for Wetland Assessments with a certificate of competence and completed his MSc in environmental science and hydropedology at the North-West University of Potchefstroom.

7 Results and Discussion

7.1 Desktop Assessment

7.1.1 National Freshwater Ecosystem Priority Area Status

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach for the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*. 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (NEM:BA) (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011).

A single SQR was assessed for NFEPAs, including the Magalies River (A21F-1116). According to Nel *et al*. (2011), the Magalies River SQR has a single freshwater priority area designated to it (Table 7-1 and Figure 7-1). The reach is designated as a fish support area for *Enteromius motebensis*.

Table 7-1 NFEPAs listed for SQRs associated with the project area

Type of FEPA map category	Biodiversity features
A21F-1116	
Fish Support Area	*Enteromius motebensis*

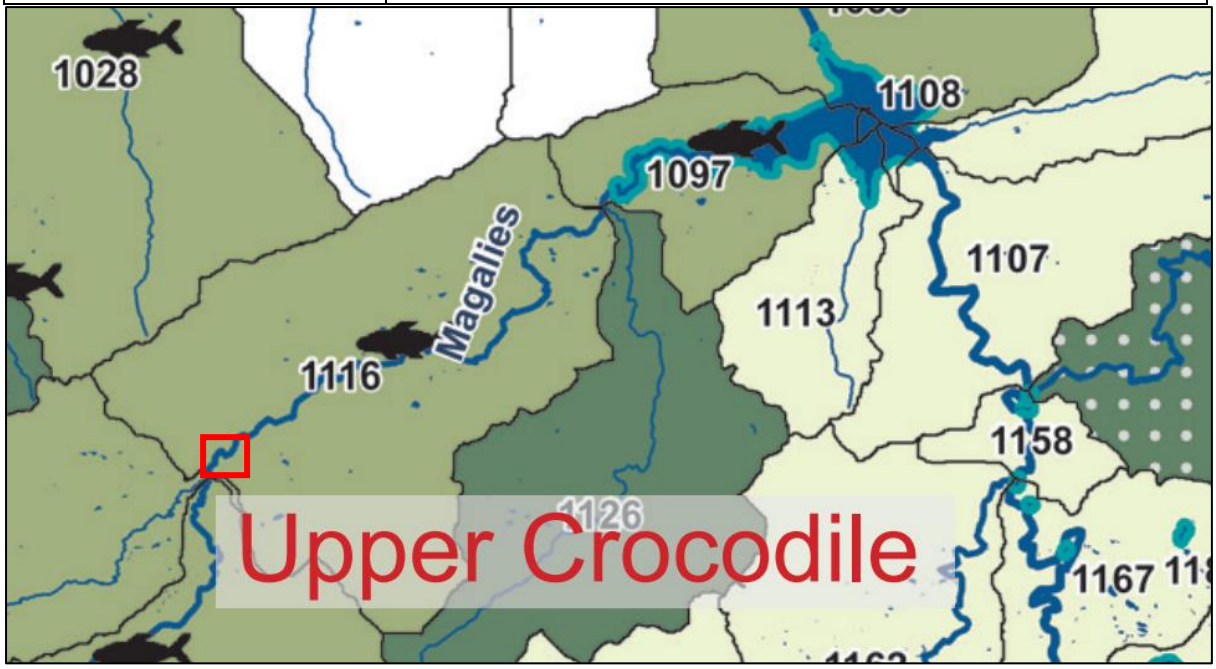


Figure 7-1 Illustration of NFEPAs associated with the Hekpoort Housing Development (Indicated in red box)

7.1.2 Desktop Present Ecological Status

Desktop information was obtained from DWS (2020) for the relevant SQRs and is summarised in Table 7-2. The desktop PES of the reach of the Magalies River associated with the Hekpoort Housing Development is a class D or largely modified. The confidence in this classification is low due to the long distance of the considered SQR (26 km). The ecological importance and sensitivity of the river reach was rated as moderate and very high, respectively. The defined Default Ecological Category for the river was class A or largely natural. The current gradient of the considered river reach in proximity to the project area was found to be a class D geoclass. This classifies the reach as upper foothills zone.

Table 7-2 The desktop information pertaining to the A21F-1116 Sub Quaternary Reach

Component/Catchment	Magalies River (A21F-1116)
Present Ecological Status	Largely Modified (class D)
Ecological Importance Class	Moderate
Ecological Sensitivity	Very high
Default Ecological Category	Largely natural (class A)

7.1.3 Vegetation Types

The distribution of the Moot Plains Bushveld (SVcb 8) vegetation type is distributed throughout the North-West and Gauteng province. The main vegetation belt is located directly south of the Magaliesberg through Maanhaarrand from the Selons River Valley in the West, ultimately stretching east to the Hartebeespoort Dam. This vegetation type also stretches from the Crocodile river in the east to Rustenburg in the west just north of the Magaliesberg in a narrow stretch (Mucina & Rutherford, 2006).

This vegetation type is dominated by *Acacia* species in the plains and bottomlands as well as woodlands. Grass species dominates the herbaceous layer with thorny Savanna dominant throughout (Mucina & Rutherford, 2006).

The conservation status of this vegetation type is vulnerable with a target percentage of 19%. Approximately 13% of this vegetation type is currently conserved (mainly within the Magaliesberg Nature Reserve). Approximately 28% of this vegetation type has been replaced by urban sprawl, built-up areas and cultivation (Mucina & Rutherford, 2006).

7.1.4 Digital Elevation Model

According to the Digital Elevation Model (DEM) for the 500 m regulated area, no convex topographical features or depressions that might indicate wetland areas are present on-site (see Figure 7-2).

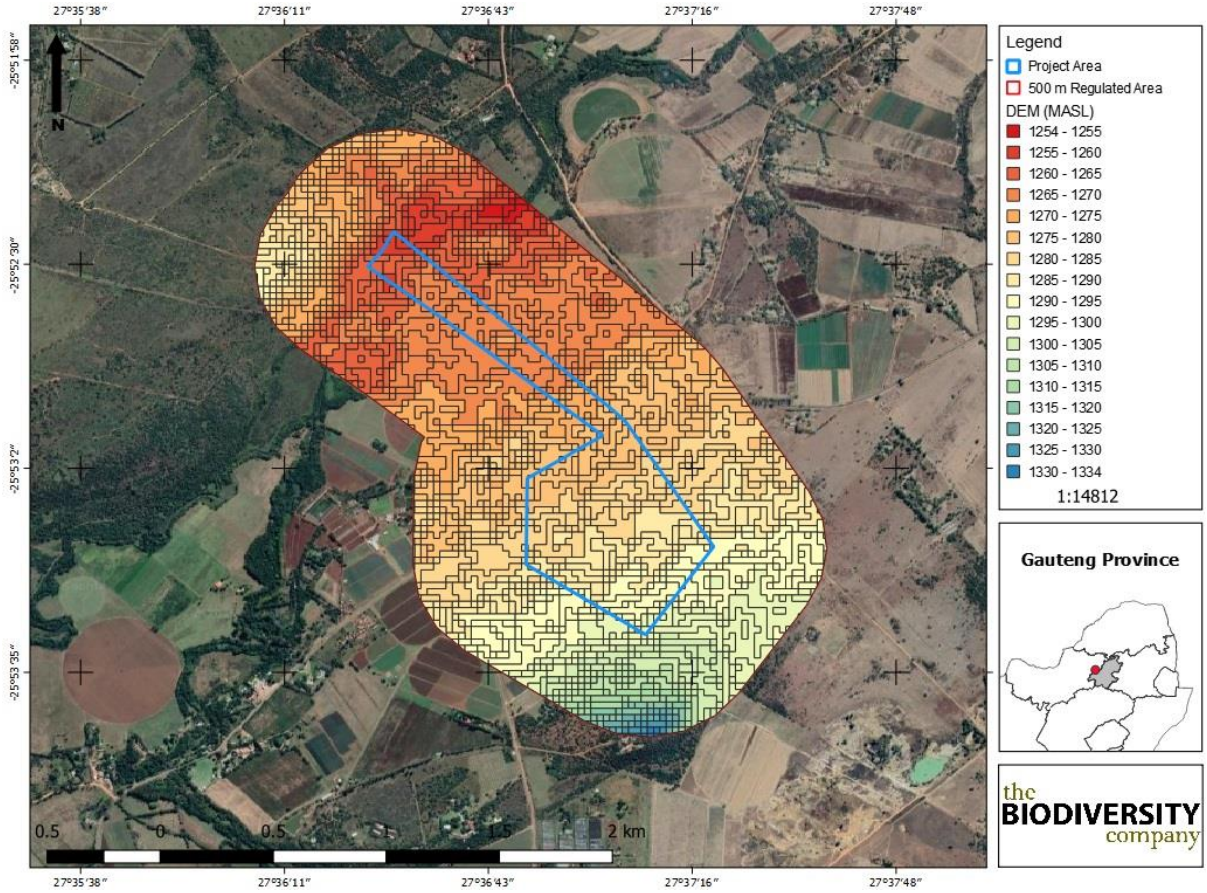


Figure 7-2 Digital elevation model

7.1.5 Climate

This region is characterised by a summer rainfall with dry winter months (Figure 7-3). The mean annual precipitation ranges from 500 mm in the west to approximately 700 mm in the east with frost frequently occurring during winter months (Mucina & Rutherford, 2006). The mean monthly minimum and maximum temperatures are 33,6℃ and -3,1℃ for June and January respectively.

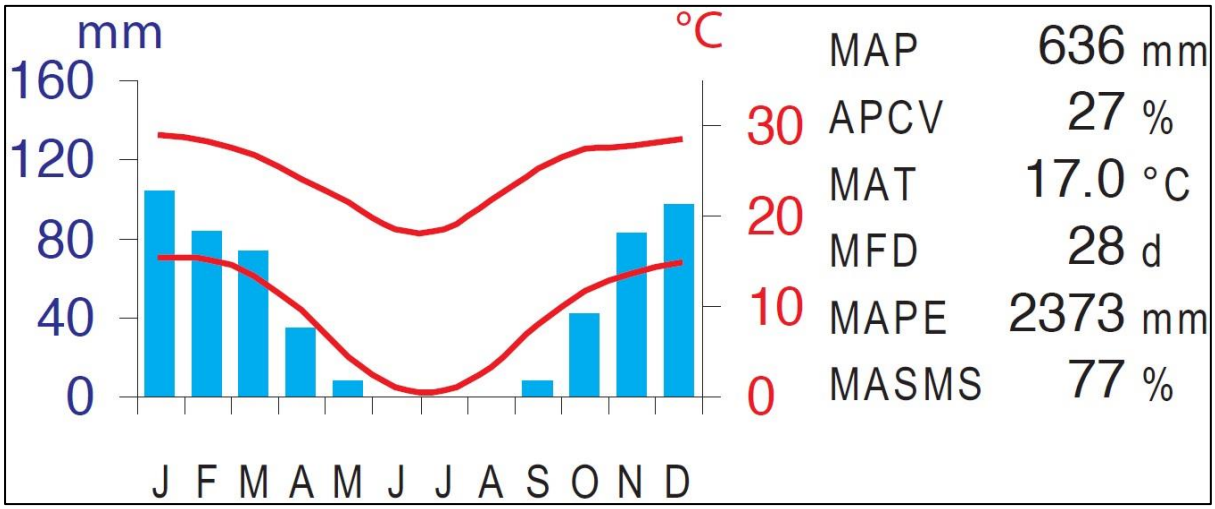


Figure 7-3 Climate for the Moot Plains Bushveld (SVcb 8) vegetation type (Mucina & Rutherford, 2006)

7.1.6 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006) the development falls within the Ea30 land type. This land type consists of Red-Yellow Apedal soils which are freely drained. The soils tend to have a high base status and is deeper than 300 mm.

This region is characterised by minor carbonates and clastic sediments together with volcanics from the Pretoria Group. Mafic bushveld intrusions are scattered throughout the larger area with soils characterised by high levels of clay and loam. Red-and Yellow-Apedal soils are abundant together with Melanic and Vertic clays. Common land types include Ba, Ae, Ac, Fb and Ea (Mucina & Rutherford, 2006).

7.1.7 NFEPA Wetlands

No NFEPA wetlands have been identified within the proposed project area or its 500 m regulated area.

7.1.8 Inland Water Areas

No inland water areas have been determined by means of the “2527” quarter degree square data set.

7.1.9 Topographical River Lines

Two different topographical river lines have been identified within the 500 m regulated area by means of the “2527” quarter degree square topographical data. These systems have been classified as perennial and non-perennial (see Figure 7-4).

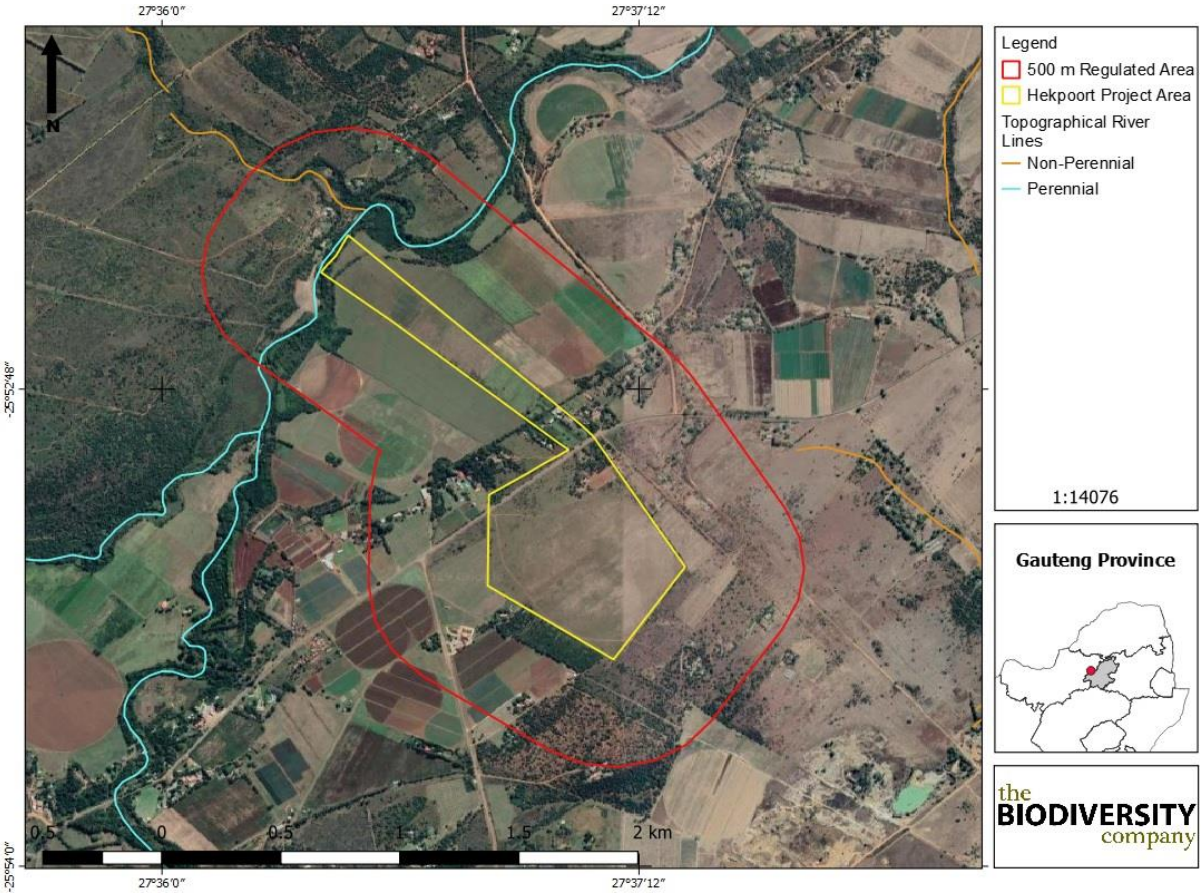


Figure 7-4 Topographical river lines identified within the 500 m regulated area

7.2 Wetland Assessment

Potential wetlands were delineated in accordance with the DWAF (2005) guidelines (Figure 7-5). During the site assessment, various wetland checks and transects were carried out in areas identified as potential wetland areas according to topographical and external wetland indicators (i.e. leached soils, greener areas etc.)

According to DWAF (2005), hydromorphic soils are the most important wetland indicator when identifying and classifying wetlands. Even though many wetland checks and transects were carried out, positions “A” and “B” were focussed on given the pronounced floodplain feature in close proximity to the Magalies River (due to grey/leached colours) and patches of leached soils potentially indicating seeps (point “A” and “B” respectively (Figure 7-5)).

The soil form identified within the potential wetland areas were all classified as Shortlands soil forms, which is a terrestrial soil form (DWAF, 2005). Even though some facultative plant species were present, these sites have been deemed not to have sufficient wetland indicators. As for point “B”, it is the specialist’s opinion that the grey patterns visual on Figure 7-5 are a result of pivot irrigation and not wetland features. These areas are characterised by a Bainsvlei soil form, which is characterised by plinthic formation. The latter mentioned plinthic conditions are well below 50 cm, ultimately resulting in a terrestrial soil form as opposed to a hydromorphic soil form.

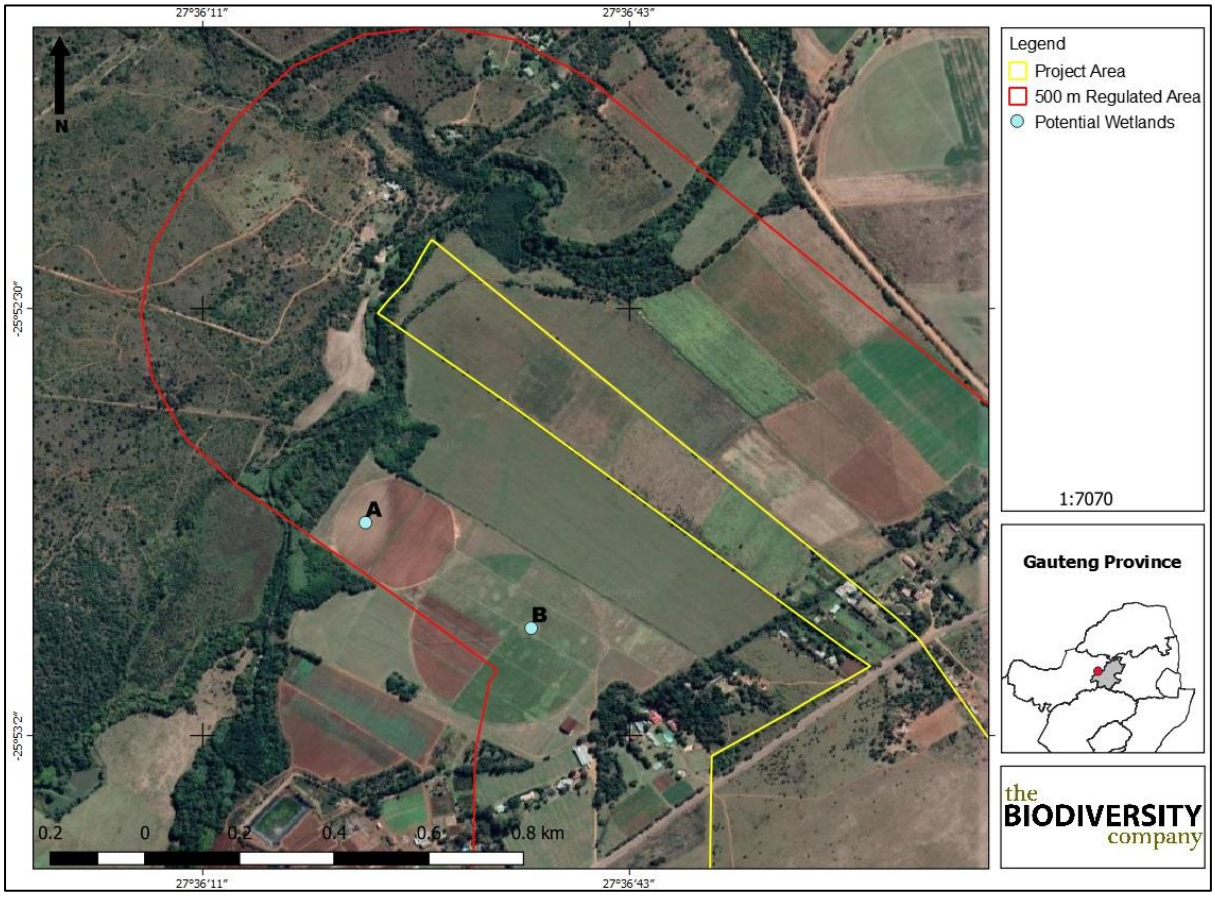


Figure 7-5 Potential wetland areas indicated

Figure 7-6 Relevant soil horizons. A-Soft Plinthic horizon. B-Red Structured horizon

In addition to the desktop checks, the site was traversed by foot and vehicle, ultimately resulting in the identification of various patches overgrown with hydrophytic plant species like *Imperata cylindrica* and *Cyperus sexangularis*) (see Figure 7-7). These patches were also characterised by terrestrial soil, with not hydromorphic properties located within 50 cm of the surface.

According to Ollis (2013), there is a distinct difference between a riparian and a wetland area. A riparian area is characterised by alluvial soils whilst wetland areas are dominated by distinct hydromorphic properties (i.e. gleying, oxidation/reduction processes etc.). Vegetation-wise, riparian areas are often dominated by riparian trees whereas wetlands would be covered in hydrophytic vegetation (even though hydrophytes also could be present in riparian areas). Lastly, wetlands are characterised by a permanent, seasonal and/or a temporary zone, where riparian areas are often fully inundated throughout all four seasons. Given these descriptions, the Magalies River has been identified as a riparian/aquatic system and has been assessed accordingly.

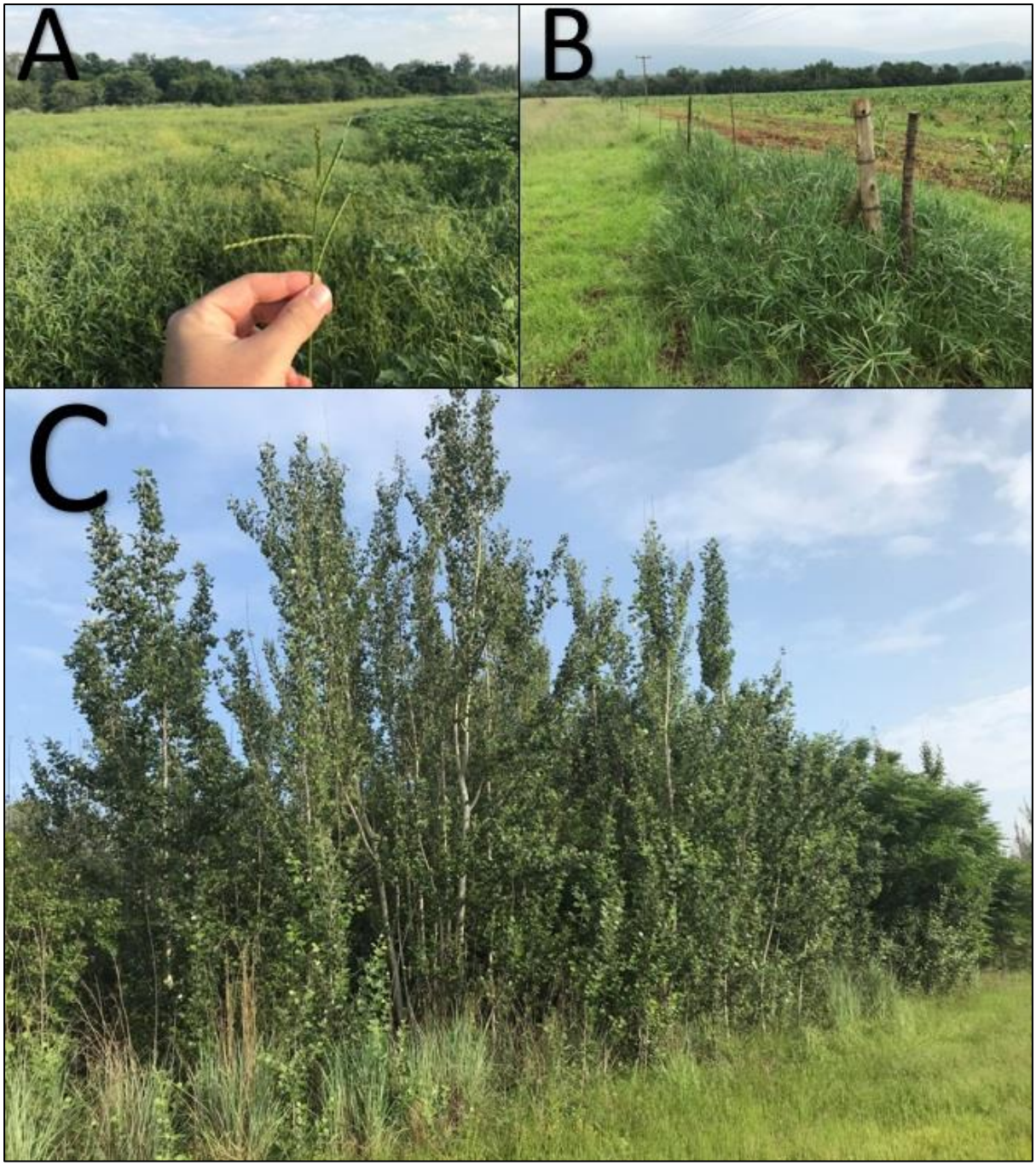


Figure 7-7 Hydrophytic plant species identified on-site. A- Paspalum distichum. B: Cyperus sexangularis. C: Populus alba.

Various drainage lines were identified on-site, which lacked hydromorphic soils and, to an extent, hydrophytic plant species. These systems have therefore been deemed not to be wetland areas and as a result have not been assessed accordingly (see Figure 7-8).

Figure 7-8 Example of drainage line on-site

It is the opinion of the specialist that the soil forms distributed throughout the region do not promote the formation of wetland conditions. According to a pedology assessment carried out for the proposed development (The Biodiversity Company, 2020), two dominant soil forms are located throughout the project area, namely the Glenrosa soil form and the Shortlands soil form. According to DWAF (2005), the Shortlands soil form is characterised by deep infiltration, which disallows the accumulation of water within the upper 50 cm. As for the Glenrosa soil form, a permeable lithic horizon is located approximately 30 cm below the surface, which also promotes rapid and deep infiltration.

7.3 Riverine Ecology

To characterise the Magalies River reach, two sampling points were selected for the project. Site photographs and GPS coordinates for the sampled river reaches are presented in Table 7-3 and illustrated in Figure 7-9.

Table 7-3 Photos and co-ordinates for the sites sampled (photos taken January2020)

Site	Upstream	Downstream

H1		
GPS coordinates	25°52'28.95"S 27°36'25.04"E	
H2		
GPS coordinates	25°52'11.68"S 27°36'54.06"E	

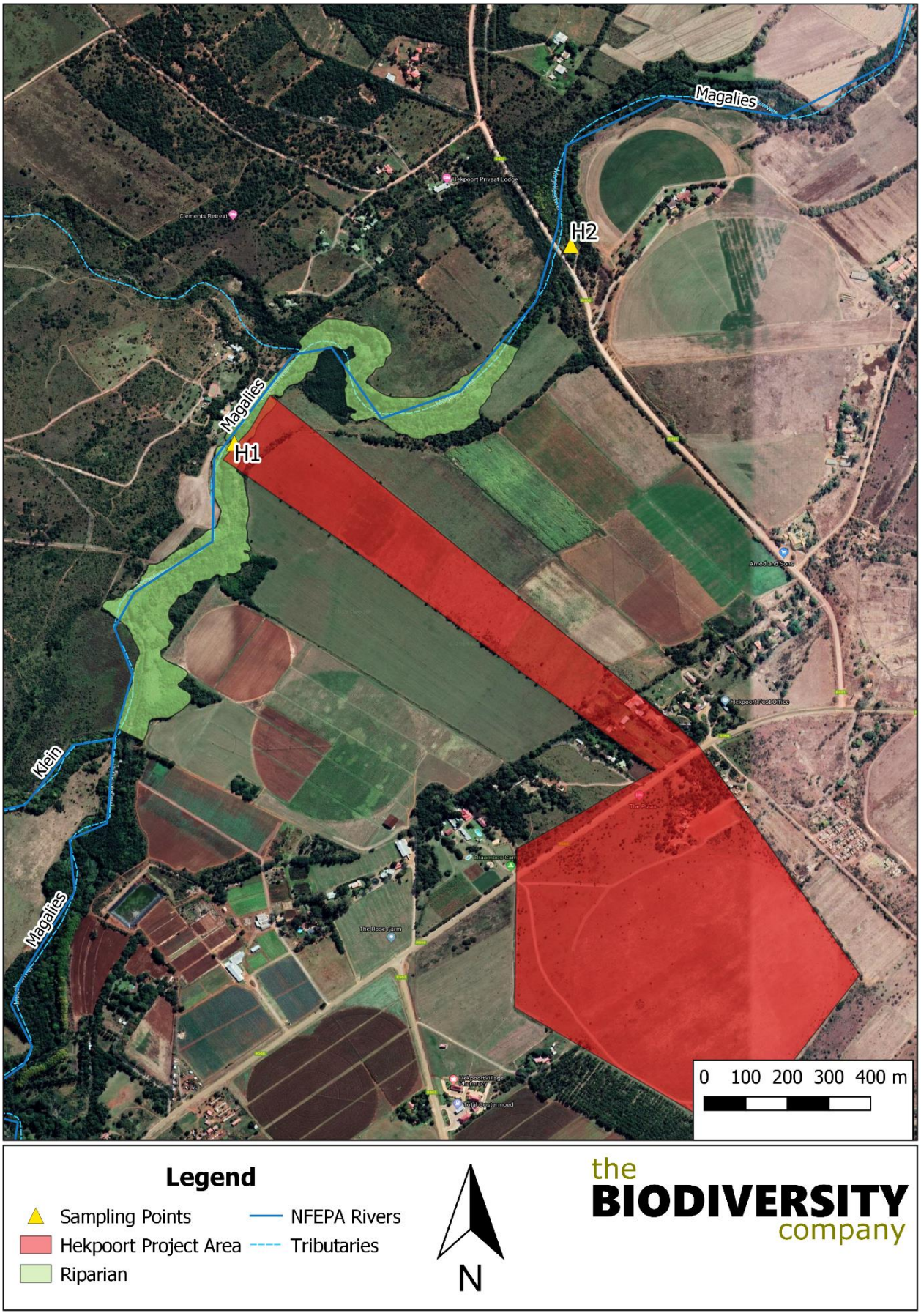


Figure 7-9 Sampling points for the 2020 Hekpoort housing development

7.3.1 *In situ* Water Quality

In situ water quality analyses was conducted at both sites assessed during the survey. These results are important to assist in the interpretation of biological results due to the direct influence water quality has on aquatic life forms. The results of the survey are presented in Table 7-4. Results were compared to Target Water Quality Range (TWQR) for aquatic ecosystems (DWS, 1996).

Table 7-4 In situ water quality results for the Hekpoort sites (January 2020)

Site	pH	Conductivity (µS/cm)	DO (mg/l)	Temperature (°C)
TWQR*	**6.5-9.0**	**-**	**>5.00**	**5-30**
H1	7.6	464	5.24	21.7
H2	7.9	364	6.34	23.1

***TWQR – Target Water Quality Range**

According to the *in situ* water quality analysis the water quality within the reach was adequate to support local aquatic biota, and would not limit the diversity and abundances of local aquatic biota. It should be noted these results are limited to *in situ* analysis. Excessive algae was noted at site H2, indicating eutrophic conditions within the reach, and indicating water quality perturbations within the reach.

7.3.2 Habitat Assessment

7.3.2.1 Intermediate Habitat Integrity Assessment

The results for the instream and riparian habitat integrity assessment for the Magalies River are presented in Table 7-5. The reach includes 5 km of each system assessed during the study.

Table 7-5 Results for the Magalies River habitat integrity assessment

Instream	Average	Score
Water abstraction	12	6,72
Flow modification	14	7,28
Bed modification	10	5,2
Channel modification	10	5,2
Water quality	13	7,28
Inundation	12	4,8
Exotic macrophytes	9	3,24
Exotic fauna	10	3,2
Solid waste disposal	8	1,92

Total Instream	55.16	
Category	D	
Riparian	**Average**	**Score**
Indigenous vegetation removal	10	5.2
Exotic vegetation encroachment	15	7.2
Bank erosion	10	5.6
Channel modification	5	2.4
Water abstraction	10	5.2
Inundation	5	2.2
Flow modification	10	4.8
Water quality	10	5.2
Total Riparian	**62.2**	
Category	**C**	

According to the IHIA result, the instream habitat integrity of the Magalies River reach was classed as largely modified (class D): A large loss of natural habitat, biota and basic ecosystem functions has occurred. Modifications to the Magalies River are attributed to instream impoundments, channel and bank erosion, and water quality modifications. These modifications have impacted instream habitat diversity and quality, inundating habitat with sediment from upstream erosion. The riparian zone assessment indicate the reach to be in a moderately modified state (class C). Riparian zone modifications were attributed to indigenous vegetation clearing and extensive alien invasive vegetation encroachment into the riparian zone, particularly Mulberry trees which fall under the family Moraceae (Figure 7-10).

Figure 7-10 Invasive species within the riparian zone (Mulberry trees)

7.3.2.2 Riparian Delineation

The proposed Hekpoort Housing Development is situated along the banks of the Magalies River. A riparian delineation was conducted using aerial imagery (Figure 7-11) (Google Earth 2020). As indicated in the IHIA section, the riparian zone was found to be in a moderately modified state, largely attributed to alien invasive vegetation.

Figure 7-11 Riparian delineation for the Hekpoort housing development

7.3.3 Aquatic Macroinvertebrates

7.3.3.1 Invertebrate Habitat and Biotope Assessments

A biotope rating of available habitat was conducted at each site assessed to determine the suitability of habitat to macroinvertebrate communities. The Magalies River within the project area were classed as upper foothills. Each geoclass has different weightings for the various biotopes according to importance value (Table 7-6). The categories were calculated according to the biotope rating assessment as applied in Tate and Husted (2015). The results of the biotope assessment are presented in Table 7-7. A rating system of 0 to 5 was applied, 0 being not available and 5 being abundant and diverse.

Table 7-6 Biotope weightings for upper foothill geoclass

Biotope	Upper Foothills
Stones in current (SIC)	20
Stones out of current (SOOC)	10
Bedrock	5
Aquatic vegetation	1
Marginal vegetation in current	2
Marginal vegetation out of current	2
Gravel	3
Sand	1
Mud	1

Table 7-7 Biotope scores at each site during the high flow survey (January 2020)

Biotope	H1	H2
Stones in current	0	2
Stones out of current	2	3
Bedrock	0	3
Aquatic Vegetation	2	2
Marginal Vegetation in Current	0	1
Marginal Vegetation Out of Current	3	2.5
Gravel	2	2
Sand	2	3
Mud	1	2
Biotope Score	12	20,5

Weighted Biotope Score (%)	16	47
Biotope Category (Tate and Husted, 2015)	**E**	**D**

The Magalies River site H1 assessed in this study was assigned a biotope category of class E, indicating limited habitat availability for aquatic macroinvertebrates, while the H2 on the Magalies River was classed as D, indicating some limitations to habitat diversity. Further habitat limitations to local aquatic biota included instream sedimentation and excessive algal growth.

7.3.3.2 South African Scoring System (version 5)

The aquatic macroinvertebrate results for the study are presented in Table 7-8.

Table 7-8 Macroinvertebrate assessment results recorded during the study (January 2020)

Site	H1	H2
SASS Score	117	120
No. of Taxa	24	24
ASPT*	4.9	5
Category (Dallas, 2007)**	**C**	**C**

*ASPT: Average score per taxon
**Western Bakenveld – Upper and Lower Ecoregion

Based on the Average Score Per Taxon (ASPT) the aquatic macroinvertebrate communities for the sampled reaches comprised primarily of tolerant taxa (Intolerance Rating < 5) during the high flow study within the Magalies River system. The macroinvertebrate communities were similar between the up and downstream sites, indicating stable conditions within the reach. According to biological bands, the biotic integrity of the reach was considered moderately modified.

7.3.3.3 Macroinvertebrate Response Assessment Index

The Macroinvertebrate Response Assessment Index (MIRAI) methodology was conducted according to Thirion, (2007). Data collected from the SASS5 method was applied to the MIRAI model. The MIRAI model provides a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community (assemblage) from the reference condition (unmodified river). Results for the reaches assessed are presented in and Table 7-9.

Table 7-9 MIRAI Score for the Magalies River reach (2020)

Invertebrate Metric Group	2020
Flow Modifications	84,7
Habitat	82,0
Water Quality	64,2
Ecological Score	76,6
Category	**C**

The MIRAI results for the Magalies River indicated the reach is moderately modified (class C). The driver predominantly contributing to the modified state is water quality impairment within the reach.

7.3.4 Fish Assessment

7.3.4.1 Expected Species and Fish Collected

Fish sampling was conducted at sites H1 and H2. Fish were collected using electrofishing techniques in all available biotopes. A total of three indigenous species were collected during the study (Table 7-10 and Table 7-11), and a single exotic species (*Micropterus salmoides*). No species of conservational concern were collected during the study. It should be noted that sampling was limited by spatial and temporal scales, and should additional sampling be conducted additional species would likely be collected. Numerous juvenile specimens were collected within the reach, indicating the importance of the system for spawning and recruitment.

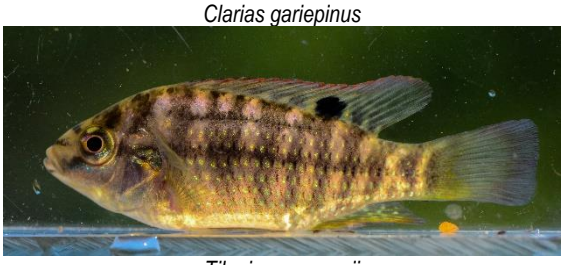
Table 7-10 Fish community assessment for the 2020 study

Expected Species	Species Collected
Amphilius uranoscopus (pfeffer, 1889)	-
Enteromius anoplus weber, 1897	–
Labeobarbus marequensis smith, 1841	-
Enteromius paludinosus peters, 1852	√
Labeobarbus polylepis boulenger, 1907	-
Enteromius trimaculatus peters, 1852	–
Enteromius unitaeniatus günther, 1866	-
Clarias gariepinus (burchell, 1822)	√
Chiloglanis pretoriae van der horst, 1931	-
Pseudocrenilabrus philander (weber, 1897)	-
Tilapia sparrmanii smith, 1840	√

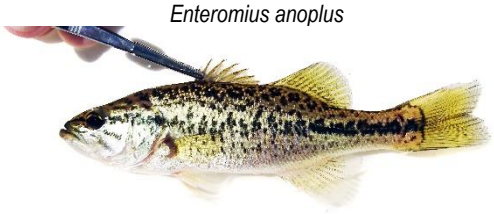
Table 7-11 Photographs of fish species collected during the survey

Clarias gariepinus

Enteromius anoplus



Tilapia sparrmanii



Micropterus salmoides

7.3.4.2 Fish Response Assessment Index

The results indicate that the Magalies River fish community was moderately to largely modified during the survey (Table 7-12). The modified fish community is attributed to flow modifications and instream continuity within the reach, and the absence of habitat features such as cobbles. Should additional sampling be conducted within the reach, it is likely that fish would be collected.

Table 7-12 Fish Response Assessment Index for the Magalies River

FRAI% (Automated)	59.8
EC FRAI	C/D

7.3.5 Present Ecological State

The Present Ecological State of each reach assessed for the study is presented in Table 7-13. The findings of the study were based on a single survey, of which time constraints limit sampling effort within the reaches, and therefore the confidence of the findings are low.

The results indicate that the Magalies River reach was in a moderately to largely modified state during the 2020 study (Table 7-13). This is attributed to the water quality modifications within the reach, modifications to instream continuity, and furthermore modifications to the instream and riparian zone due to agriculture and exotic vegetation encroachment.

Table 7-13 The Present Ecological Status of the Magalies River reach

Category	Ecological Category
Instream Assessment	D
Riparian Assessment	C
Macroinvertebrate Response Assessment Index	C
Fish Response Assessment Index	C/D
EcoStatus	**C/D**

7.4 Buffer Zones

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane et al. 2014) was used to determine the appropriate buffer zone for the proposed activity. The buffer size for the delineated wetlands has been calculated at 40 m pre-mitigation and 22 m post-mitigation (see Figure 7-12).

Only one threat (*Increased Sediment Inputs and Turbidity*) is expected to decrease in significance given the application of mitigation measures. The decrease in this significance rating has resulted in a decrease of the calculated buffer zone (from 40 m to 22 m) (see Figure 7-12 and Table 7-14).

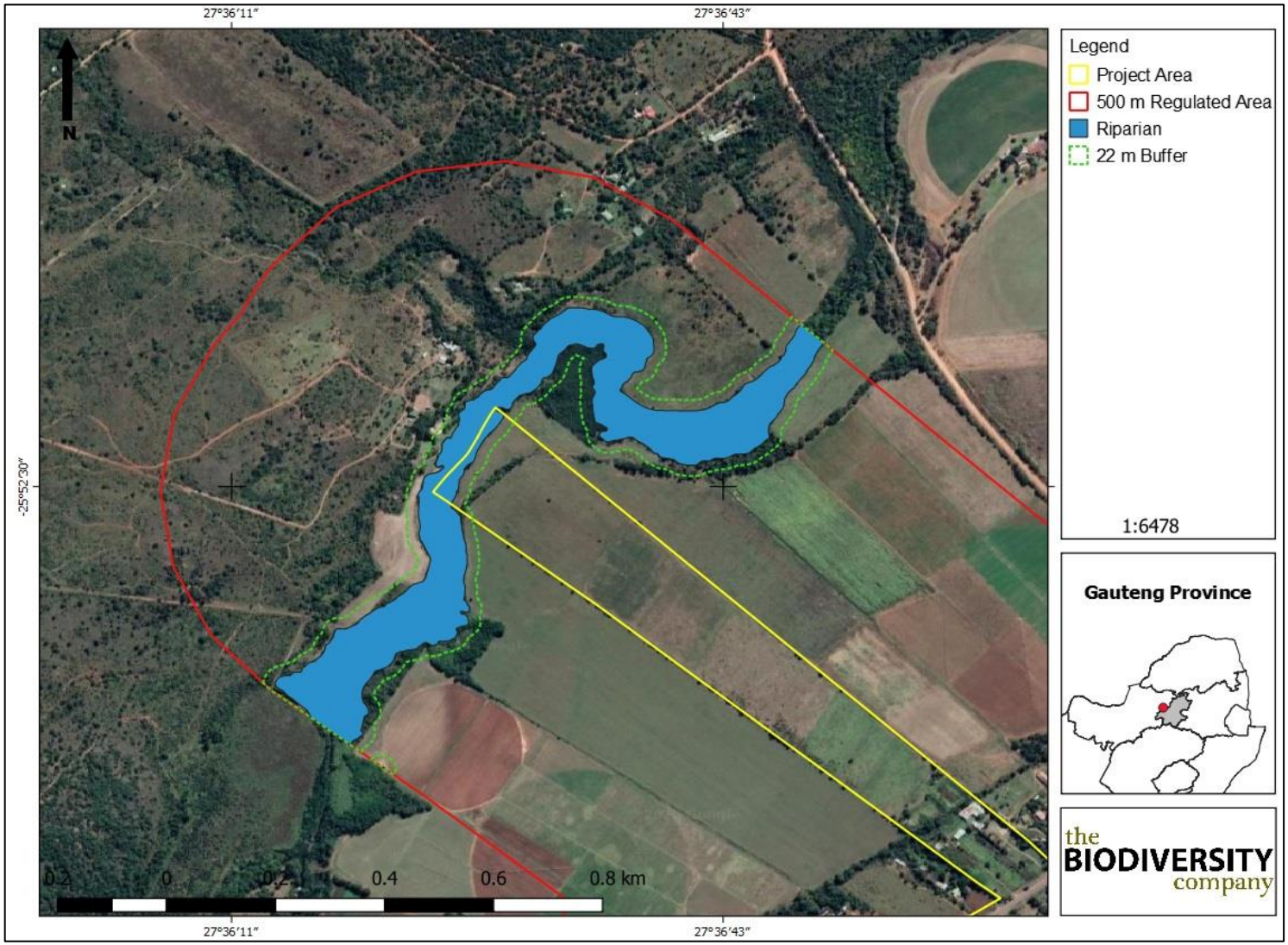


Figure 7-12 Extent of recommended buffer zones

Table 7-14 Threats posed during the construction- and operational phase for the delineated wetlands

Threat Posed by the proposed land use / activity		Specialist Rating	Refined Class	Specialist justification for refined threat ratings.
Construction Phase	Alteration to surface runoff flow volumes	Very Low	Very Low	
	Alteration of patterns of flows (increased flood peaks)	Low	Very Low	
	Increase in sediment inputs & turbidity	Very High	High	Demarcate wetland / buffer areas and manage as No Go areas, except for activities required for the pipe installation. Construction within wetlands should take place within the dry season, where feasible. Make use of existing access routes as much as possible. Minimise the topsoil removal footprint area for plinths. Install silt fences. Undertake concurrent rehabilitation of cleared areas
	Increased nutrient inputs	Very Low	N/A	
	Inputs of toxic organic contaminants	Very Low	Very Low	
	Inputs of toxic heavy metal contaminants	Low	Very Low	
	Alteration of acidity (pH)	Low	Very Low	
	Increased inputs of salts (salinization)	N/A	N/A	
	Change (elevation) of water temperature	Very Low	Very Low	
	Pathogen inputs (i.e. disease-causing organisms)	Very Low	Very Low	
Operational Phase	Alteration to flow volumes	High	High	
	Alteration of patterns of flows (increased flood peaks)	High	High	
	Increase in sediment inputs & turbidity	Moderate	Moderate	
	Increased nutrient inputs	Moderate	Moderate	
	Inputs of toxic organic contaminants	Moderate	Moderate	
	Inputs of toxic heavy metal contaminants	Moderate	Moderate	

	Alteration of acidity (pH)	Very Low	Very Low	
	Increased inputs of salts (salinization)	Very Low	Very Low	
	Change (elevation) of water temperature	Very Low	Very Low	
	Pathogen inputs (i.e. disease-causing organisms)	Moderate	Moderate	

8 Impact and Risk Assessment

The proposed project is for the construction of the Hekpoort housing development. Development-related activities can have significant impacts on biodiversity and ecosystem services, often causing irreversible and large-scale habitat loss across large areas or areas important for the provision of important ecosystem services.

The assessment pertained to the watercourse (Magalies River and its riparian zone) and the associated riparian area within the project area. As no wetland resources were identified within the project area, the risk and impact sections will be limited to the Magalies River watercourse. According to the riparian delineation, the project area encroaches into the riparian zone (Figure 7-11), which elevates the risks to the water resources. It is highly recommended that the proposed development avoid the riparian zone, and the implementation of the correct buffer be adhered to. This mitigation will reduce the potential impacts to the watercourse significantly.

A DWS aspect and impact register / risk assessment was conducted as part of the Water Use authorisation and is presented in Section 8.1.

8.1 DWS Risk Assessment

Findings from the DWS aspect and impact register / risk assessment are provided in Table 8-1, Table 8-2 and Table 8-3.

Table 8-1 Potential risk posed by the Hekpoort Housing Development

Risk Assessment Completed by Christian Fry (119082)		
Activity	**Aspect**	**Impact**
Construction Phase	Access routes	Loss of aquatic habitat Erosion of watercourse. Loss of indigenous vegetation Exotic vegetation proliferation Sedimentation of the watercourse. Flow sediment equilibrium change Water quality impairment Flow modifications Loss of biodiversity
	Clearing vegetation (outside riparian zone)	
	Clearing riparian vegetation	
	Construction of laydown yards	
	Stormwater Management	
	Operation of machinery & equipment	
Operational Phase	Site management	Flow modifications Water quality modifications Erosion Habitat modifications
	Storm water management	

Table 8-2 DWS Risk Impact Matrix for the proposed project

	Severity					Consequence		
Aspect	**Flow Regime**	**Water Quality**	**Habitat**	**Biota**	**Severity**	**Spatial scale**	**Duration**	**Consequence**
Construction Phase								
Access routes	1	2	2	1	1.5	2	1	4.5
Clearing vegetation (outside riparian zone)	2	2	4	2	2.5	3	3	8.5
Clearing riparian vegetation	4	4	5	5	4.5	3	3	10.5
Construction of laydown yard	2	2	2	3	2.25	2	2	6.25
Stormwater management	3	2	3	2	2.5	3	2	7.5
Operation of machinery & equipment	1	3	3	3	2.25	3	2	7.25
Operational Phase								
Site management	1	2	2	2	1.75	2	4	7.75
Storm water management	2	2	1	1	1.5	2	4	7.5

Table 8-3 DWS Risk Impact Matrix for the proposed project continued

Aspect	**Frequency of activity**	**Frequency of impact**	**Legal issues**	**Detection**	**Likelihood**	**Sig.**	**Without mitigation**	**With mitigation**
Construction phase								
Access routes	1	3	1	2	7	31.5	**Low**	**Low**
Clearing vegetation (outside riparian zone)	2	3	1	2	8	68	**Moderate**	**Low**
Clearing riparian vegetation	2	4	5	2	13	136.5	**Moderate**	**Moderate**
Construction of laydown yard	2	2	5	2	11	68.75	**Moderate**	**Low**

Stormwater management	2	2	1	2	7	52.5	**Low**	**Low**
Operation of machinery & equipment	2	2	5	2	11	82.5	**Moderate**	**Moderate**
Operational phase								
Site management	3	1	1	1	6	46.5	**Low**	**Low**
Storm water management	2	2	1	2	7	52.5	**Low**	**Low**

(*) denotes - In accordance with General Notice 509 "Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below

The construction of the Hekpoort Housing Development poses low to moderate risks during the construction phase. Moderate risks are associated with the activities proximate to the watercourse, including the clearing of riparian vegetation, levelling of the area, and operation of heavy machinery adjacent to the watercourse. The implementation of mitigation measures will not reduce the risks of clearing riparian areas and the operation of heavy machinery in the riparian zone as the activities will result in direct loss of riparian vegetation, bank modification and direct impact to the watercourse. However, should the proposed project area be relocated to avoid the riparian zone, and the buffer be adhered to, the impacts to the watercourse will be reduced to low.

Further impacts to the watercourse include sedimentation due to surface runoff from the project area, which can be mitigated through implementation of a stormwater management plan prior to construction (e.g. the installation of berms and silt traps). Sensitive areas should be clearly demarcated by an appropriately qualified person, and these areas should be avoided by all activities, including on site staff as watercourses are used for clothes washing and sanitary practices, which have a detrimental impact to local ecology.

The disturbances of land poses a risk for alien invasive plants (AIP) proliferation, numerous AIPs were observed on site, and these species would likely spread post construction. Therefore, a site management plan is required, including an AIP control plan. Further, the increase in surface runoff from the development can be expected due to hard surfaces, posing a risk to the watercourse through bank erosion, water quality contamination, and instream sedimentation. A storm water management plan should be implemented during construction and during the operational phase. Should this be adequately implemented, the risks to the system of considered low.

9 Mitigation Measures

9.1 Mitigation Measure Objectives

The focus of mitigation measures should be to reduce the significance of potential impacts associated with the commercial development and thereby to:

- Prevent the unnecessary destruction of, and fragmentation, of the vegetation community (including the riparian area);
- Prevent the loss of the faunal community (including potentially occurring species of conservation concern) associated with these vegetation communities; and
- Limiting the construction area to the defined project areas and only impacting those areas where it is unavoidable to do so otherwise.

9.2 General mitigation measures

The following general mitigation measures are provided:

- The aquatic and riparian areas outside of the specific project site area must be avoided where possible;
- The project should be relocated to outside of the riparian buffer zone, which would significantly reduce potential impacts to the riparian zone;

- The construction vehicles and machinery must make use of existing access routes as much as possible, before adjacent areas are considered for access;
- Laydown yards, camps and storage areas must be beyond the aquatic areas. Where possible, the construction of the road and crossings must take place from the existing footpath and not from within the aquatic systems;
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces;
- Temporary storm water channels and preferential flow paths should be filled with aggregate and/or logs (branches included) to dissipate and slow flows limiting erosion;
- Prevent uncontrolled access of vehicles through the river system that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas;
- All chemicals, construction materials and toxicants to be used for the construction must be stored within bunded areas;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced in a designated area;
- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the aquatic systems;
- All removed soil and material must not be stockpiled within the system. Stockpiling should take place away from the watercourse. All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- No dumping of construction material on-site may take place;
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported; and

- An alien invasive plant management plan needs to be compiled and implemented post construction to control current invaded areas and prevent the growth of AIPs on cleared areas.

9.3 Professional opinion

A professional opinion is required as per the NEMA regulations with regards to the proposed development. Taking into account the current status of the aquatic ecosystems, and furthermore the nature and requirements of the project. The final summary opinion of the project area is as follows:

- The current PES of the Magalies River is classed as moderately modified;
- No species of conservational concern were collected during the study, however, the Magalies reach is designated as a fish sanctuary for *Enteromius motebensis*, which is listed as Near Threatened (IUCN, 2020);
- Numerous modifications to the reach were observed during the site visit, including channel, bed and bank erosion, and extensive alien vegetation encroachment;
- The proposed Hekpoort development footprint encroaches into the Maglies riparian zone, which would have significant impact to the riparian integrity and subsequent integrity of the Magalies River. It is therefore strongly recommended the footprint be modified to avoid the riparian zone and the applicable buffer be applied; and
- Should the project footprint be readjusted according to the above recommendation, the project can proceed with the implementation of adequate mitigation measures.

10 Conclusion

A single wet season survey was conducted for the proposed Hekpoort Housing Development on the 13th of January 2020. Desktop information for the sub-quaternary reach indicated that the Present Ecological State of the Magalies River reach is in a largely modified state, with the Ecological Importance being moderate, and the Ecological Sensitivity being very high. The riverine study assessed the biotic and habitat integrity of the reach, through the assessment of water quality, habitat, fish community and macroinvertebrates assemblages. The results indicated that water quality parameters as measured *in situ* was adequate to support a diverse biotic community, however, the presence of excessive algal growth indicated eutrophic conditions within the reach. Further, elevated turbidity and presence of fine sediment within the system indicated erosion within the catchment, which would limit habitat quality. The Magalies River reach was classified as an upper foothills system, however, the habitat was variable with lowland features observed. Instream habitat was rated as diverse, capable of sustaining a diverse macroinvertebrate and fish community. The riparian delineation indicated that the proposed project footprint encroaches into the riparian zone. The integrity of the riparian zone was rated as moderately modified, the extensive presence of alien invasive plants contributed towards the modified state. As for wetland ecology, no wetlands have been identified, which has left the Magalies River as the only watercourse within the 500 m regulated area.

The biotic indices indicated a moderately modified macroinvertebrate community, with low abundances of sensitive taxa such as Leptophlebiidae and Lestidae. The macroinvertebrate metrics indicated water quality perturbations as the dominant driver of a modified community within the reach. The fish assessment indicated a moderately to largely modified community. It should be noted that sampling time was limited and therefore a more complete fish community would be expected should additional sampling be conducted. The presence of numerous juvenile *Enteromius* species indicated the system as an important recruitment and nursery for fish species in the catchment. The Present Ecological State of the system was rated as moderately to largely modified, which was a minor increase from the expected desktop state, however, falls below the recommended ecological category of largely natural.

The construction of the Hekpoort Housing Development poses low to moderate risks during the construction phase. Moderate risks are associated with the activities proximate to the watercourse, including the clearing of riparian vegetation, levelling of the area, and operation of heavy machinery adjacent to the watercourse. The implementation of mitigation measures will not reduce the risks of clearing riparian areas and the operation of heavy machinery in the riparian zone as the activities will result in direct loss of riparian vegetation, bank modification and direct impact to the watercourse. However, should the proposed project area be relocated to avoid the riparian zone, and the buffer be adhered to, the impacts to the watercourse will be reduced to low.

Should the project footprint be readjusted according to the above recommendation, the project can proceed with the implementation of adequate mitigation measures. In that instance, no fatal flaws are expected for the project.

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