# Water Resource Assessment for the proposed Hartebeespoort Housing Development

# Gauteng

November 2017

**REFERENCE**

10650

**CLIENT**

**Prepared for:**

**Nemai Consulting**

147 Bram Fischer Drive, Ferndale, Randburg

www.nemai.co.za

**Prepared by:**

**The Biodiversity Company**

420 Vale Ave. Ferndale, 2194

Cell: +27 81 319 1225

Fax: +27 86 527 1965

info@thebiodiversitycompany.com

www.thebiodiversitycompany

| | |
|---|---|
| **Report Name** | **Water Resource Assessment for the proposed Hartebeespoort Housing Development** |
| **Reference** | **10650** |
| **Submitted to** | **Nemai** |
| **Report writer** | **Ivan Baker** |
| **Reviewer** | **Andrew Husted (Pr Sci Nat 400213/11)** |

## EXECUTIVE SUMMARY

The Biodiversity Company was commissioned to conduct a water resource assessment, consisting of an aquatic and a wetland assessment, as part of the Water Use Licence Application (WULA) for the proposed housing development located in the Hartebeespoort project site, east of Pretoria, Gauteng Province. A site visit was conducted on 7 November 2017 which would constitute an early wet season survey.

### Aquatic Assessment

According to desktop information, the aquatic systems are in a seriously modified state. This modified status was largely attributed to significant water and habitat quality modification in the catchment. The EI and ES of the system is also considered to be moderate.

| SQR | C22A-1315 SQR |
|---|---|
| **NFEPA's** | Four wetland features |
| **Present Ecological State** | Seriously Modified (Class E) |
| **Ecological Importance** | Moderate |
| **Ecological Sensitivity** | Moderate |

### Wetland Assessment

Two (2) HGM types were identified within the 500m project assessment boundary, namely a natural depression and a channelled valley-bottom wetland.

The wetland was determined to be in a largely modified (Class D) state. The HGM type had an overall intermediate level of services, with various services providing moderately high and high ecological services. The ecological importance and sensitivity as well as the hydrological/functional importance for both HGM units has been scored moderate whereas the direct human benefits has been scored low.

In the Province of Gauteng, a buffer zone of 30m and 50 m must be allocated to wetland areas within and beyond urban areas respectively. It has been assumed that taking into account the nature of the project, a 30 m buffer zone will be applicable to this project as a minimum. Buffer zones were suggested for the various HGM units to address the vulnerability of the wetlands to impacts, making use of the buffer tool. A buffer zone of between 16 – 18m during the construction phase of the project was determined for the two units. Additionally, a buffer zone of 15m during the operational phase, is recommended for both HGM units.

For this stage of the project it is advisable to prioritise the provincial buffer zone of 30 m and determine the feasibility of the project. The 30 m buffer must first be considered to guideline the proposed design and layout of the development. In the event that possible encroachment into the buffer zone is required to accommodate the development, there may be grounds for motivation to reduce the buffer to 18 m.

**Risk Assessment**

A site development plan will only be provided in the final report as the purpose of this assessment is to inform the layout, and only comments pertaining to expected impacts have been provided.

It is apparent that the channelled valley bottom wetlands direct and divert flow away from depression wetlands. The channels systems could be considered for stormwater attenuation and incorporated into the design with soft / engineering features.

# Table of Contents

## Tables



## Figures

**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

Wetland Ecologist

The Biodiversity Company

9 November 2017

# 1 INTRODUCTION

The Biodiversity Company was commissioned to conduct a water resource assessment, as part of the Basic Assessment (BA) and Water Use Licence Application (WULA) processes for the proposed housing development on portion (Ptn) 237 of Farm Hartebeespoort 238 JR within the boundaries of the City of Tshwane Municipality, Gauteng Province. A site visit was conducted on 7 November 2017 which would constitute an early wet season survey.

This report, after taking into consideration the findings and recommendations provided by the specialists herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

## 1.1 Project Description

The study area is 18.7480 hectares and is to be developed for the purpose of housing. The site is well situated to provide a sustainable human settlement in the form of a mixed housing typology. As part of the development there should be space allocated for retail and light industrial uses. Developing the site in this manner will contribute towards the densification strategy that is proposed along Stormvoel Road.

Ptn 237 of Farm Hartebeespoort 238 JR is located within a mixed-use area of strategic importance. The main job opportunities in the region are located in this area, however poverty and unemployment are vast in the region. This alludes to the direction that proposals to develop the site should have a strong element of job creation. Given the nature and context of the site and its surroundings, the proposals to develop the site will focus around the following themes:

- Densification.
- Mixed Housing Typologies.
- Job creation.
- Mixed land Use.

## 1.2 Objectives

The aim of the assessment is to provide information to guide the proposed housing development with respect to the current of water resources in the area of study. As part of the water resource assessment, the following objective specifics were considered:

- The delineation and assessment of water resources within 500m of the project area;
- Evaluate the extent of site-related effects in terms of selected ecological indicators;
- A risk assessment for the proposed development;
- Provide recommendations for a buffer zone / area; and
- The prescription of mitigation measures and recommendations for identified risks.

# 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 National Water Act (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.

For the purposes of this project, a wetland area is defined according to the NWA (Act No. 36 of 1998): "Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".

Wetlands have one or more of the following attributes to meet the NWA wetland definition (DWAF, 2005):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

## 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 site (Portion 237) falls within the boundaries of the City of Tshwane Municipality, Gauteng Province (Figure 1). The project is situated in the quaternary catchments A23A, within the Limpopo Water Management Area (WMA 1) and Highveld Ecoregion. A watercourse is located within the project area, flowing from west to east, towards the Moreleta River.


**Figure 1: Locality map showing the general setting in relation to the project area**

# 4 LIMITATIONS

The following aspects were considered as limitations for the water resource assessment;

- The survey was conducted in the early wet season period, and also taking into account the level of on-site disturbances, the use of vegetation as a wetland indicator was limited. Due to this, greater emphasis has been placed on Soil Wetness and Soil Form.
- Wetland systems beyond the project area and identified at desktop level within 500 m of the project area were considered for the identification and desktop delineation, with wetland areas within the project area being ground truthed and the focus for the study.
- A site development plan (SDP) will be drafted after taking into consideration the specialist findings. Findings from the respective specialist reports will advise on areas to be avoided, and low sensitivity areas which may be better suited for the development. At this stage of the process only comments pertaining to expected impacts have been provided.
- Recommendations have been made towards a buffer zone as required by the provincial authority. Once a concept SDP is available, then the extent of the buffer zone will be re-investigated in order to determine a more accurate minimum requirement, which is not expected to be more than 30 m.

# 5 METHODOLOGY

## 5.1 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);
- City of Johannesburg wetland audit (2009);
- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- The National Freshwater Ecosystem Priority Areas (Nel, et al., 2011); and
- Contour data (5m).

## 5.2 Wetland Assessment

### 5.2.1 Wetland Delineation

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 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.

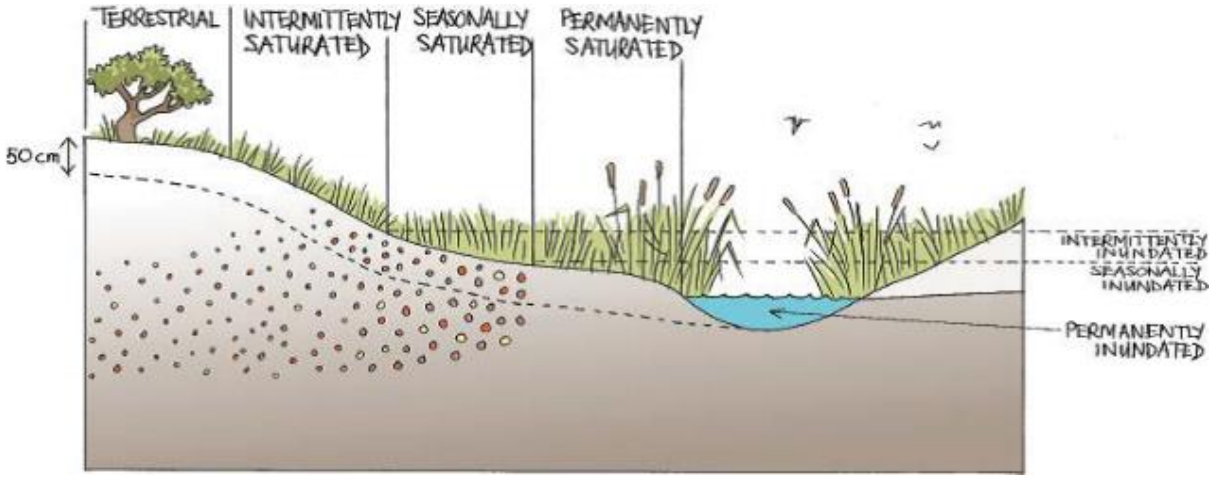


**Figure 2: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change**

### 5.2.2 Present Ecological Status (PES)

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 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 impact scores and Present State categories are provided in Table 1.

**Table 1: The PES categories (Macfarlane, et al., 2008)**

| Impact Category | Description | Impact Score Range | Present State Category |
|---|---|---|---|
| **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** |

### 5.2.3 Wetland Ecosystem Services

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

**Table 2: 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 |

### 5.2.4 Ecological Importance and Sensitivity (EIS)

The method used for the 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 3.

**Table 3: Description of EIS 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** |

### 5.2.5 Buffer Determination

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane, et al., 2015) was used to determine the appropriate buffer zone for the proposed activity.

# 6 RESULTS & DISCUSSIONS

## 6.1 Desktop Assessment

### 6.1.1 Geology and soils

According to the land type database (Land Type Survey Staff, 1972 - 2006) the development falls within the Ba7 land type. This land type is characterised by dystrophic and/or mesotrophic red soils which is wide spread.

The geology of the area is characterised by shale, quartzite, siltstone, chert and hornfels of the Silverton, Daspoort and Timeball Hill Formations (Transvaal Sequence); diabase.

### 6.1.2 NFEPAs for Sub-Quaternary Catchments

The tributary of the Moreleta River has no NFEPA catchments associated with it (Nel et al., 2011).

### 6.1.3 Aquatic Present Ecological Status for Sub-Quaternary Catchments

This section provides further desktop information regarding the reaches of the Pienaars River SQR with regards to the Present Ecological Status (PES) including the Ecological Importance, Ecological Sensitivity and anthropogenic impacts within each SQR (Table 4).

**Table 4: Desktop information for the A23A-1074 SQR**

| | |
|---|---|
| **NFEPA's** | None |
| **Present Ecological State** | Largely Modified (Class D) |
| **Ecological Importance** | Moderate |
| **Ecological Sensitivity** | High |

### 6.1.4 Wetland NFEPAs

Two (2) NFEPAs (a valley head seep and an unchannelled valley-bottom wetland) have been identified by means of desktop studies. These NFEPA are divided into four sections each. The valley head seeps are the result of man-made depressions most likely used to help regulate water in a small sewage treatment facility next to these depressions. These depressions are not in use any more and are currently characterised by poor water quality and temporary wet soils. The fact that these depressions are manmade, these systems are regarded as artificial systems. In addition to this, these systems are characterised by temporary wetness as well as poor quality makes which has caused modifications to these systems. The unchannelled valley-bottom wetlands are extensively buffered by a railway ballast, see Figure 4.


**Figure 3: NFEPA wetlands present within the project's 500m buffer zone**

**Figure 4: The nearby railway ballast**

## 6.2 Wetland Assessment

The survey included assessing all the wetland indicators as well as assessing the Present Ecological Score (PES) or health of the wetland, the wetland's ability to provide goods and services (Eco-Services) and the Ecological Importance and Sensitivity (EIS) of the wetlands.

The wetland delineation and HGM units are shown in Figure 5. The wetland classification as per SANBI guidelines (Ollis *et al*. 2013) is presented in Table 7. Two (2) HGM units was identified within the 500m project assessment boundary. The wetland system is interrupted by local developments, which has resulted in drainage channels/gullies canalizing storm water into the wetlands. The delineated wetland areas are considered to be a natural depression (HGM 1) and channelled valley-bottom wetlands (HGM 2).

**Table 5: Wetland classification as per SANBI guideline (Ollis *et al*. 2013)**

| Wetland Name | Level 1 | Level 2 | | Level 3 | Level 4 | | |
|---|---|---|---|---|---|---|---|
| | System | DWS Ecoregion/s | NFEPA Wet Veg Group/s | Landscape Unit | 4A (HGM) | 4B | 4C |
| HGM 1 | Inland | Highveld | Western bankenveld | Slope | Natural depression | Endo-heric | With channelled outflow |
| HGM 2 | Inland | Highveld | Western bankenveld | Valley floor | Channelled valley-bottom | N/A | N/A |

A channelled valley-bottom (HGM 2) flows from west to east out of the natural depression (HGM 1). HGM 2 then flows into a concrete channel in the eastern side of the project site, see Figure 5.


**Figure 5: The delineated wetland areas**
Left to right, HGM 1 and the confluence of the two-channelled valley-bottom wetlands

### 6.2.1 Wetland PES

The PES results are described in the sections below with Table 8 showing the combined results. A summary of aspects that have impacted on the wetland systems is discussed below. Photographs of onsite aspects impacting on the wetlands is presented in Figure 6.

**Figure 6: Photographs of aspects that have contributed to modification of the wetland**
Top: Left to right *Iris spp., Campuloclinium macrocephalum and Eucalyptus*)
Bottom: Left to right, sewage spill, intense littering and the dumping of building material

## HYDROLOGY

The hydrology of HGM 1 and HGM 2 has been scored largely and moderately modified respectively due to increased water inputs. These increased water inputs are the result of artificial surfaces in the catchment that decreases infiltration and ultimately increases run-off, see. Additionally, dirt roads within the project site and bare soil contributes even further to these increased run-offs. Large drainage channels/stormwater channels flow into HGM1 which is the main source of water.

**Figure 7: Example of artificial surfaces within the project boundaries**

## GEOMORPHOLOGY

The geomorphology of HGM 1 is moderately modified due to a degree of drains and gullies diverting flows into the wetland. Deposits of fan-like accumulated sediment is typically found in similar systems where a source characterised by high energy flows into a system which reduces the energy thereof and therefore induces deposition of sediments. HGM 2 has been scored largely modified due to signs of erosion within the stream channel as well as channel straightening. Channel straightening typically occurs where a meandering stream undergoes an increase in energy which forces the stream to continue in a straight path by means of eroding it's banks.

## VEGETATION

The vegetation of both the HGM units has been scored seriously modified due to a large extent of artificial surfaces within the wetlands' catchments. Indigenous vegetation has been cleared to accommodate any form of infrastructure. Invading vegetation plays an additionally role in increasing the vegetation aspect's modification. Hydrophytic vegetation present onsite include the pictures illustrated in Figure 8 accompanied by the wetland soils (which also acts as a wetland indicator) which support these vegetation species.

**Figure 8: Wetland indicators**
Top; left to right, *Typha capensis,* a G-horizon and a soft plinthic layer
Bottom; left to right, *Phragmites mauritius*, *Iris spp.* and *Cortoderia spp.*

**Table 6: The PES results for the project area**

| Wetland | Area (ha) | Hydrology | | Geomorphology | | Vegetation | |
|---|---|---|---|---|---|---|---|
| | | Rating | Score | Rating | Score | Rating | Score |
| HGM 1 | 1,5 | D: Largely Modified | 5,0 | C: Moderately Modified | 3,3 | E: Seriously Modified | 6,5 |
| Overall PES Score | | 4,9 | | Overall PES Class | | D: Largely Modified | |
| | | | | | | | |
| Wetland | Area (ha) | Hydrology | | Geomorphology | | Vegetation | |
| | | Rating | Score | Rating | Score | Rating | Score |
| HGM 2 | 16,00 | C: Moderately Modified | 3,5 | D: Largely Modified | 5,2 | E: Seriously Modified | 6,5 |
| Overall PES Score | | 4,8 | | Overall PES Class | | D: Largely Modified | |

### 6.2.2 Ecosystem Services Assessment

The Ecosystem services provided by the HGM units present at the site were assessed and rated as per the WET-EcoServices method (Kotze et al., 2008). The summarised results for the HGM units are shown in Table 9.

Both of the HGM units have an intermediate level of EcoServices. The similarities between the two units is illustrated in Table 7. The only noteworthy distinction between the two systems is the ability of HGM 1 to assimilate phosphates and toxins as well as the storage of carbon.

**Table 7: The Eco-Services being provided by the wetland units**

| Wetland Unit | | | | | HGM1 | HGM2 |
|---|---|---|---|---|---|---|
| Ecosystem Services Supplied by Wetlands | Indirect Benefits | Regulating and supporting benefits | Flood attenuation | | 2.5 | 2.4 |
| | | | Streamflow regulation | | 1.5 | 1.3 |
| | | | Water Quality enhancement benefits | Sediment trapping | 1.2 | 1 |
| | | | | Phosphate assimilation | 2.5 | 1.9 |
| | | | | Nitrate assimilation | 2 | 1.5 |
| | | | | Toxicant assimilation | 2.2 | 1.8 |
| | | | | Erosion control | 2.3 | 2.3 |
| | | | Carbon storage | | 2.7 | 2 |
| | Direct Benefits | Biodiversity maintenance | | | 1.4 | 1.4 |
| | | Provisioning benefits | Provisioning of water for human use | | 0.9 | 0.9 |
| | | | Provisioning of harvestable resources | | 0.2 | 0.2 |
| | | | Provisioning of cultivated foods | | 0.2 | 0.2 |
| | | Cultural benefits | Cultural heritage | | 0 | 0 |
| | | | Tourism and recreation | | 1 | 0.7 |
| | | | Education and research | | 2.3 | 2.3 |
| Overall | | | | | 22.8 | 20.1 |
| Average | | | | | 1.5 | 1.3 |

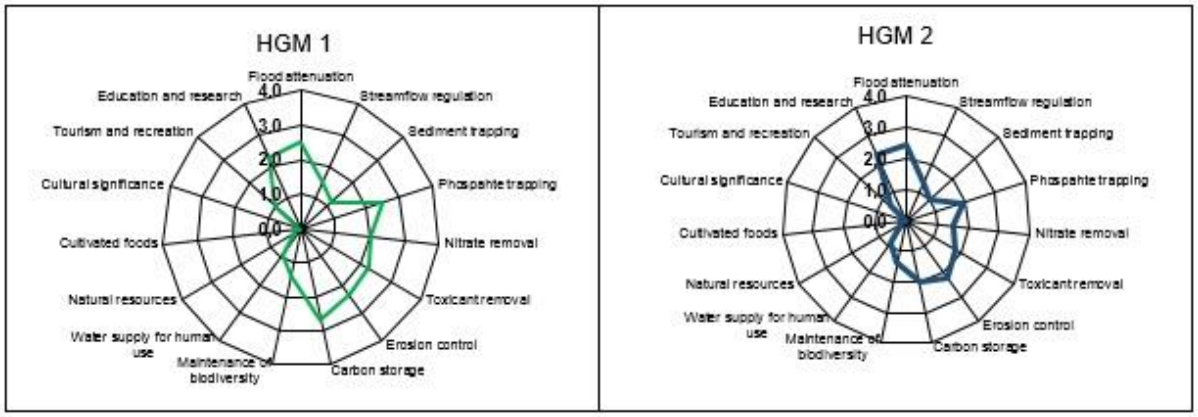


**Figure 9: The spider diagram for Eco-Services rendered by the HGM units**

### 6.2.3 Ecological Importance & Sensitivity (EIS)

The EIS assessment was applied to the HGM units described in the previous section in order to assess the levels of sensitivity and ecological importance of the wetland. The results of the assessment are shown in Table 8.

For HGM 1, the ecological importance and sensitivity as well as the hydrological/functional importance has been scored high. This scoring is supported by the moderate EI and high ES classification for the A23A-1074 SQR. The direct human benefits have been scored low. For HGM 2, the ecological importance and sensitivity has been scored moderate whereas the direct human benefits have been scored low.

**Table 8: The EIS results for the wetland units**

| WETLAND IMPORTANCE AND SENSITIVITY | |
|---|---|
| ***HGM 1*** | |
| | **Importance** |
| **ECOLOGICAL IMPORTANCE & SENSITIVITY** | **2.3** |
| **HYDROLOGICAL/FUNCTIONAL IMPORTANCE** | **2.1** |
| **DIRECT HUMAN BENEFITS** | **0.8** |
| ***HGM 2*** | |
| | **Importance** |
| **ECOLOGICAL IMPORTANCE & SENSITIVITY** | **1.3** |
| **HYDROLOGICAL/FUNCTIONAL IMPORTANCE** | **1.8** |
| **DIRECT HUMAN BENEFITS** | **0.7** |

### 6.2.4 Buffer Zones

Buffer zones have been used in land-use planning to protect natural resources and limit the impact of one land-use on another. A buffer zone has been prescribed for this project to server as a “barrier” between the proposed development and the wetland system.

In the Province of Gauteng, the GDARD requires a buffer zone of 30m and 50 m (GDARD, 2014) must be allocated to wetland areas within and beyond urban areas respectively. It has been assumed that taking into account the nature of the project, a 30 m buffer zone will be applicable to this project as a minimum.

The wetland buffer zone tool was also used to calculate a more appropriate buffer for the proposed mixed-use development. The model shows that the largest risk posed by the project during the construction phase is that of “increased sediment inputs and turbidity”. During the operational phase a very high risk is posed by the altered flow patterns, this is largely due to the extent of hardened surfaces. Buffer zones were suggested for the various HGM units to address the vulnerability of the wetlands to impacts. A buffer zone of between 16 – 18m during the construction phase of the project was determined for the two units. Additionally, a buffer zone of 15m during the operational phase, is recommended for both HGM units.

For this stage of the project it is advisable to prioritise the provincial buffer zone of 30 m and determine the feasibility of the project. The 30 m buffer must first be considered to guideline the proposed design and layout of the development. In the event that possible encroachment into the buffer zone is required to accommodate the development, there may be grounds for motivation to reduce the buffer to 18 m.

**Table 9: The risk results from the wetland buffer model for the proposed project.**

| | Threat Posed by the proposed land use / activity | Desktop Threat Rating |
|---|---|---|
| Construction Phase | 1. Alteration to flow volumes | VL |
| | 2. Alteration of patterns of flows (increased flood peaks) | L |
| | 3. Increase in sediment inputs & turbidity | H |
| | 4. Increased nutrient inputs | VL |
| | 5. Inputs of toxic organic contaminants | VL |
| | 6. Inputs of toxic heavy metal contaminants | M |
| | 7. Alteration of acidity (pH) | N/A |
| | 8. Increased inputs of salts (salinization) | N/A |
| | 9. Change (elevation) of water temperature | VL |
| | 10. Pathogen inputs (i.e. disease-causing organisms) | VL |
| Operational Phase | 1. Alteration to flow volumes | M |
| | 2. Alteration of patterns of flows (increased flood peaks) | VH |
| | 3. Increase in sediment inputs & turbidity | L |
| | 4. Increased nutrient inputs | L |
| | 5. Inputs of toxic organic contaminants | M |
| | 6. Inputs of toxic heavy metal contaminants | M |
| | 7. Alteration of acidity (pH) | L |
| | 8. Increased inputs of salts (salinization) | L |
| | 9. Change (elevation) of water temperature | L |
| | 10. Pathogen inputs (i.e. disease-causing organisms) | L |

| PHASES | BUFFER | |
|---|---|---|
| | HGM 1 | HGM 2 |
| Construction Phase | 18m | 16m |
| Operational Phase | 15m | 15m |

# 7 RISK ASSESSMENT

The project is for the proposed housing development. A formal risk assessment has not been completed for this study, and the study has assumed that the wetlands and recommended buffer zones will be adhered to. In light of this, the expected project aspects and associated risks, with accompanying risks without mitigation is provided in Table 10. It must be mentioned that this is only an indication for this stage of the project, and these risks may change.

**Table 10: Impacts without mitigation identified for the proposed project**

| Activity | Aspect | Risks | Impact |
|---|---|---|---|
| **Construction of development** | Removal of vegetation | **Moderate** | Impeding the flow of water.<br>Altered surface flow dynamics. |
| | Stripping and stockpiling of top soil | **Moderate** | |
| | Compaction of areas | **Moderate** | |

| | | | |
|---|---|---|---|
| | Application of road surface aggregate | **Moderate** | Erosion of watercourse.<br>Sedimentation of the water resource.<br>Flow sediment equilibrium change.<br>Water quality impairment. |
| | Geotechnical sites | **Low** | |
| | Storm water run-off | **Moderate** | |
| | Drainage patterns change development | **Low** | |
| | Excavation for servitudes and tanks | **Low** | |
| | Clearing of areas for infrastructure | **Low** | |
| | Additional Associated Infrastructure | **Low** | |
| | Operation of equipment and machinery | **Low** | |
| | Vehicle activity | **Low** | |
| | Domestic and industrial waste | **Low** | |
| | Storage of chemicals, mixes and fuel | **Low** | |
| | Spills and leaks | **Low** | |
| **Operation of development** | Drainage patterns change due to development | **Moderate** | Altered surface flow dynamics.<br>Water quality impairment. |
| | Storm water management | **Moderate** | |
| | Spills and leaks | **Moderate** | |
| | Domestic and industrial waste | **Moderate** | |
| | Traffic / vehicle and pedestrian activity | **Moderate** | |

### 7.1 Recommendations

The following recommendations are provided:

- Recommendations have been made towards a buffer zone as required by the provincial authority. A minimum buffer zone of 30 m is recommended for the SDP.
- The drafting of the SDP must avoid all wetland areas and the prescribed 30 m buffer zone.
- A SDP must be designed based on the wetland findings and must be made available for the study, and the associated risks determined. Mitigation measures must then also be prescribed for the identified risks.
- The status and functioning of the recommended buffer area can be improved through a dedicated vegetation strategy and a landscape management plan, which should include soft engineering approaches.
- An integrated alien plant control program (as per the AIS Regulations) should be developed for the buffer and other open spaces within the property, including delineated water resources.
- Make use of preventative construction techniques (source controls), such as to limit the amount of impervious material near watercourses as far as possible, and to demarcate setbacks from the watercourse in the form of a buffer zone with a natural vegetation cover.
- Consider green engineering measures such as water polishing or naturally vegetated attenuation ponds to improve water quality. Other structural control measures include grass swales, infiltration trenches and basins, wet ponds, and constructed wetlands.
- Discharged storm water must be released in a controlled manner with a diffuse flow pattern and be accompanied by energy dissipating interventions to prevent erosion.

## 8 CONCLUSIONS

According to desktop information, the aquatic systems are in a seriously modified state. This modified status was largely attributed to significant water and habitat quality modification in the catchment. The EI and ES of the system is also considered to be moderate and high respectively.

Two (2) HGM types were identified within the 500m project assessment boundary, namely a natural depression and a channelled valley-bottom wetland.

The wetland was determined to be in a largely modified (Class D) state. The HGM type had an overall intermediate level of services, with various services providing moderately high and high ecological services. The ecological importance and sensitivity as well as the hydrological/functional importance for both HGM units has been scored moderate whereas the direct human benefits has been scored low.

In the Province of Gauteng, a buffer zone of 30m and 50 m must be allocated to wetland areas within and beyond urban areas respectively. It has been assumed that taking into account the nature of the project, a 30 m buffer zone will be applicable to this project as a minimum. Buffer zones were suggested for the various HGM units to address the vulnerability of the wetlands to impacts, making use of the buffer tool. A buffer zone of between 16 – 18m during the

construction phase of the project was determined for the two units. Additionally, a buffer zone of 15m during the operational phase, is recommended for both HGM units.

For this stage of the project it is advisable to prioritise the provincial buffer zone of 30 m and determine the feasibility of the project. The 30 m buffer must first be considered to guideline the proposed design and layout of the development. In the event that possible encroachment into the buffer zone is required to accommodate the development, there may be grounds for motivation to reduce the buffer to 18 m.

A site development plan will only be provided in the final report as the purpose of this assessment is to inform the layout, and only comments pertaining to expected impacts have been provided.

It is apparent that the channelled valley bottom wetlands direct and divert flow away from depression wetlands. The channels systems could be considered for stormwater attenuation and incorporated into the design with soft / engineering features.

# 9 REFERENCES

Department of Water Affairs and Forestry (DWS). (2005a). A practical field procedure for identification and delineation of wetlands and riparian areas. Pretoria: Department of Water Affairs and Forestry.

Department of Water Affairs and Forestry (DWS). 2013. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Draft. Compiled by RQS-RDM.

Kotze, D., Marneweck, G., Batchelor, A., Lindley, D. & Collins, N. 2008. WET- EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands.

Land Type Survey Staff. (1972 - 2006). Land Types of South Africa: Digital Map (1:250 000 Scale) and Soil Inventory Databases. Pretoria: ARC-Institute for Soil, Climate, and Water.

Macfarlane, D; Kotze, D; Ellery, W; Walters, D; Koopman, V; Goodman, P; Goge, M. 2008. WET-Health: A Technique for Rapidly Assessing Wetland Health.

Nel JL, Murray KM, Maherry AM, Petersen CP, Roux DJ, Driver A, Hill L, Van Deventer H, Funke N, Swartz ER, Smith-Adao LB, Mbona N, Downsborough L and Nienaber S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

Ollis DJ, Snaddon CD, Job NM, and Mbona N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria.

Soil Classification Working Group (SCWG). 1991. Soil classification: a taxonomic system for South Africa. Memoirs on the Agricultural Natural Resources of South Africa no. 15. Department of Agricultural Development, Pretoria.

South African National Biodiversity Institute (SANBI). 2009. Further Development of a Proposed National Wetland Classification System for South Africa. Primary Project Report. Prepared by the Freshwater Consulting Group (FCG) for the South African National Biodiversity Institute (SANBI).