APPENDIX G: SPECIALIST REPORTS

The information in this Appendix is ordered as detailed below.

- Biodiversity Assessment
- Cultural Heritage Statement
- Palaeontological Impact Assessment.

BIODIVERSITY ASSESSMENT

WITFIELD STORMWATER NETWORK AND ATTENUATION POND BIODIVERSITY ASSESSMENT

July 2016

VERSION

FINAL

REFERENCE

24/06/16_deltabec

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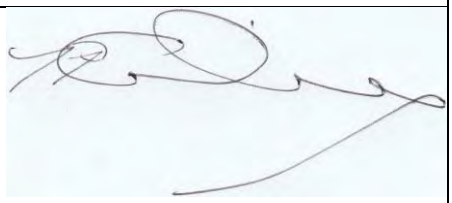
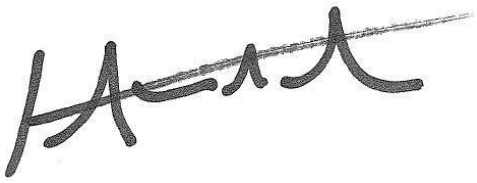
Report name	**Witfield Stormwater Network and Attenuation Pond Biodiversity Assessment**	
Reference code	**24/06/16_deltabec**	
Submitted to	**Delta BEC (Pty) Ltd**	
On behalf of	**Ekurhuleni Metropolitan Municipality**	
Report compiler	**Peter Kimberg** **BSc Hons Zoology** **SACNASP 400085/15**	
Peter Kimberg is a biodiversity consultant with 12 years of experience conducting ecological assessments. He has conducted assessments across southern Africa and in 15 countries in sub-Saharan Africa. He has extensive experience conducting biodiversity studies throughout South Africa, with considerable experience working within Gauteng, and is therefore familiar with the local conditions and local legislature.		
Report reviewer	**Andrew Husted** **MSc Aquatic Health** **SACNASP 400213/11**	
Andrew Husted, is Pr Sci Nat registered in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew 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 DWS, and also the Mondi Wetlands programme as a competent wetland consultant.		

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DECLARATION

I, **Peter Kimberg** 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.

The Biodiversity Company

22nd June 2016

EXECUTIVE SUMMARY

The Biodiversity Company was appointed by Delta BEC (Pty) Ltd. to undertake a biodiversity assessment for the proposed upgrade of the Witfield stormwater attenuation pond and canal. The studies were conducted in order to meet the requirements for a Water Use Licence Application (WULA) and a Basic Assessment process.

The biodiversity assessment comprises the following specialist disciplines:

- Aquatic ecosystems;
- Wetland ecosystems; and
- Terrestrial ecosystems (fauna and flora).

This report is based on the results of desktop assessments as well as a field survey conducted on the 13th June 2016.

The following conclusions were reached based on the results of this assessment:

- Based on the desktop assessment, 1 non FEPA seep wetland was identified within 500 m of the project area;
- The Gauteng C-Plan indicates the project area to be an Ecological Support Area (ESA) and not a Critical Biodiversity Area (CBA);
- Based on the field survey the wetlands associated with the proposed development were identified as channelled valley bottom wetlands.
- The wetland systems are in a seriously modified (Category E) state, suggesting the change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable;
- The change in geomorphic processes is great but some features are still recognizable.
- Vegetation composition has been largely altered and introduced, alien and/or increased ruderal species occur in approximately equal abundance to the characteristic indigenous wetland species.

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- The proposed construction of the attenuation pond and new outlet presents a risk to the wetland systems. The significance of the risks were rated as moderate prior to implementation of mitigation measures;
- Based on the *in situ* water quality results low DO concentration and saturation levels were identified as a limiting factor of aquatic ecosystems;
- Based on the SASS results, biotic integrity in the Elsburgspruit was severely impaired (PES Class E/F) at the time of the June 2016 survey (Table 16). This was attributed in part to limited habitat availability as shown by the IHAS results and the low DO concentrations;
- Due to the impaired baseline state of aquatic ecosystems the significance of the risks associated with the development were rated as low;
- With the exception of a few common bird species faunal diversity was low at the time of the survey. The faunal species expected to occur in the Witfield area are primarily human commensals;
- The likelihood of bird, mammal and invertebrate species of conservation concern occurring on site was assessed and with a few exceptions ranged from unlikely to low;
- Given the low probability of occurrence of species of conservation concern in the project area the significance of this impact was rated as low prior to implementation of mitigation
- This study area is situated within the Grassland Biome of southern Africa, more specifically the Soweto Highveld Grassland (Gm8), however very little of the original grassland remains in the project area;
- Based on the terrestrial vegetation the sensitivity of the vegetation communities ranged from medium to low;
- Given the transformed state of vegetation communities and the low level of sensitivity the significance of impacts on terrestrial vegetation ranged from moderate to low.

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1 INTRODUCTION

The Biodiversity Company (TBC) was appointed by Delta BEC (Pty) Ltd. to undertake a biodiversity assessment for the proposed upgrade of the Witfield stormwater attenuation pond and canal. The studies were conducted in order to meet the requirements for a Water Use Licence Application (WULA) and a Basic Assessment process.

The biodiversity assessment comprises the following specialist disciplines:

- Aquatic ecosystems;
- Wetland ecosystems; and
- Terrestrial ecosystems (fauna and flora).

This report is based on the results of desktop assessments as well as a field survey conducted on the 13th June 2016.

1.1 Background

The Ekurhuleni Metropolitan Municipality (EMM) is seeking to upgrade stormwater infrastructure in the Witfield area due to flooding and drainage problems.

Delta BEC was appointed by Ekurhuleni Metropolitan Municipality for the design, EIA, procurement, and construction supervision in order to improve the current stormwater management in the Witfield area. According to the Preliminary Design Report compiled by Messrs Bigen Africa, the houses located in the Witfield area are prone to flooding. The report further indicates that houses were permitted to be built over an existing stormwater culvert, which subsequently resulted in flooding. The Witfield Dam is located towards the south-east of the drainage area and the aim is to re-route all the stormwater into the dam to serve as an attenuation facility.

An existing wetland assessment report for the project area, compiled by Bigen Africa Consulting Engineers (Pty) Ltd. in 2005 was provided to TBC and was utilised in this assessment.

Based on the site investigations and hydraulic calculations completed by Delta BEC, 3 potential engineering solutions were proposed. Option 2 was identified as the preferred alternative for the project.

The proposed infrastructure associated with option 1 is shown in Figure 1. Option 2 includes an attenuation pond at the northern extent of the project area as well as a new outlet at the southern extent (Figure 2). The infrastructure associated with option 3 matches is similar to that of option 2 but with a smaller footprint in terms of stormwater pipelines.

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Figure 1: Option 1 for the proposed stormwater pipeline and new outlet

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Figure 2: Option 2 comprises a proposed stormwater pipeline, attenuation pond and new outlet

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Figure 3: Option 3 comprises a new stormwater pipeline, attenuation pond and outlet

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1.2 Scope of Work

The proposed Scope of Work (SoW) aims to meet the minimum requirements of the relevant Gauteng departments to conduct a biodiversity assessment. 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).

The biodiversity assessment will survey the available ecosystems, this will include the local terrestrial and aquatic (including wetlands) ecosystems

2 PURPOSE OF THE REPORT

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

3 LIMITATIONS

This assessment is based on a single dry season survey. Terrestrial vegetation is strongly seasonal with a substantial increase in the presence of plant species during the growing season (November to March). Additionally, many plant species can only be positively identified during the growing or flowering season.

According to the wetland definition used in the National Water Act, vegetation is the primary indicator, which must be present under normal circumstances (DWAF, 2005). However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

Owing to that fact that the area is situated in an urban environment and has been extensively transformed the implementation of the four wetland indicators was somewhat limited. As a result of this, the accuracy of the delineation may be affected, and desktop datasets and information has been collated to supplement this study.

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4 KEY LEGISLATIVE REQUIREMENTS

4.1 National Water Act (NWA, 1998)

The 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 (Act No. 36 of 1998) (NWA) 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.
- 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.
- 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. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

However, according to General Notice 1199 as published in the Government Gazette No. 32805 of 2009, it must be noted that as defined by the Replacement General Authorisation in terms of Section 39 of the National Water Act, on account of the extremely sensitive nature of wetlands and estuaries, the section 21(c) and (i) water use General Authorisation does not apply to:

- Any wetland or any water resource within a distance of 500 meters upstream or downstream from the boundary of any wetland.
- Any estuary or any water resource within a distance of 500 meters upstream from the salt mixing zone of any estuary.

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".

4.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations (No R. 983 and No R. 985) as amended in December 2014, 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.

Regulations pertaining to environmental impact assessments of the National Environmental Management Act, 1998 (Act No. 107 of 1998), with particular emphasis on Appendix 6 (Specialist reports).

5 PROJECT AREA

The study area is situated in Witfield, Boksburg within the Ekurhuleni Metropolitan Municipality.

The project area is situated in quaternary catchment C22B in the Upper Vaal Water Management Area (WMA_08) and the Highveld ecoregion. The Upper Vaal WMA is a pivotal WMA in the country which lies in the eastern interior of South Africa. It is situated in a semi-arid part of the country with a mean annual precipitation of 600 to 800 mm. Large quantities of water are transferred into the area from two neighboring areas, as well as water sourced from the Upper Orange River via Lesotho. Similarly, large quantities of water are transferred to three other WMAs, which are dependent on water from the Upper Vaal WMA to meet much of their requirements. The area is characterised by extensive urbanization and industrial and mining activity, and activities include livestock farming and rain fed cultivation (StatsSA, 2010).

The project area is situated in the Elsburgspruit Sub-Quaternary Reach (SQR) (C22B-1342).

5.1.1 National Freshwater Ecosystem Priority Areas (NFEPA)

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to 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 FEPAs are intended to be conservation support tools and are envisioned to guide the effective implementation of measures to achieve the National Environment Management

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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).

The SQR was assessed for the presence of river and wetland FEPAs. The Elsburgspruit SQR has no river or wetland FEPAs (Figure 4). Although wetlands and rivers are present within the 500 m buffer of the project area none of these are listed as FEPAs (Figure 4).

Figure 4: FEPA status of rivers and wetland within the 500 m buffer of the project area

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6 METHODOLOGY

6.1 Wetland Assessment

The National Wetland Classification System (NWCS, 2010) developed by the South African National Biodiversity Institute (SANBI) was considered for this study. This system comprises of a hierarchical classification process, defining a wetland based on the principles of the hydro geomorphic (HGM) approach at higher levels, and further includes structural features at the lower levels of classification (SANBI, 2009).

6.1.1 Desktop Assessment

Wetland specific information resources taken into consideration during the desktop assessment of the study area included:

- Aerial imagery (Google Earth).
- The National Freshwater Ecosystem Priority Areas (NFEPAs, 2011).
- Threatened Terrestrial Ecosystems for South Africa, 2009.
- National Protected Area Expansion Strategy, 2011.
- Contour data (5m).

6.1.2 Wetland delineation

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 5. The outer edges of the wetland areas are 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 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, which must be present under normal circumstances. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

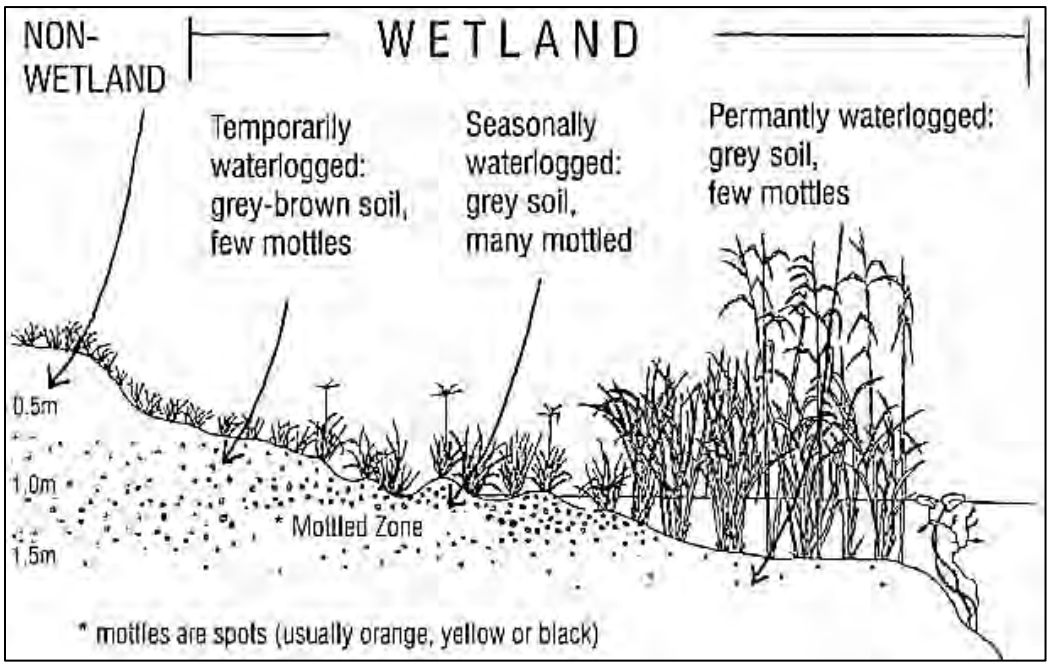

Figure 5: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (DWAF, 2005)

6.1.3 WET-Health

WET-Health is a tool designed to assess the health or integrity of a wetland. Wetland health is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. This technique attempts to assess hydrological, geomorphological and vegetation health in three separate modules.

Hydrology is defined in this context as the distribution and movement of water through a wetland and its soils. Geomorphology is defined in this context as the distribution and retention patterns of sediment within the wetland. Vegetation is defined in this context as the vegetation structural and compositional state.

The wetland is divided into hydro-geomorphic (HGM) units and their associated catchments. These are analysed separately for hydrological, geomorphological and vegetation health based on extent, intensity and magnitude of impact. This is translated into a health score.

The magnitude of impact for individual activities is the product of extent and intensity. The magnitude of individual activities in each HGM unit is combined in a structured and transparent way to calculate the overall impact of all activities that affect hydrological, geomorphological or vegetation health. Present State health categories, on an impact score scale of 1-6 (or health

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

6.2 Aquatic Ecosystems

6.2.1 Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES)

Desktop information was obtained from DWS (2014). The study site is situated in the upper reaches of the Elsburgspruit SQR (C22B-1342).

6.2.2 Field Survey

6.2.2.1 In Situ Water Quality

During the survey a portable Hach HQ40d multimeter was used to measure the following parameters in situ:

- pH;
- Electrical Conductivity (EC;
- 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.

6.2.2.2 Integrated Habitat Assessment System (IHAS)

The quality of the instream and riparian habitat influences the structure and function of the aquatic community in a stream; therefore assessment of the habitat is critical to any assessment of ecological integrity. The Integrated Habitat Assessment System (IHAS, version 2) was applied at each of the sampling sites in order to assess the availability of habitat biotopes for macroinvertebrates. The IHAS was developed specifically for use with the SASS5 index and rapid biological assessment protocols in South Africa (McMillan, 1998). The index considers sampling habitat and stream characteristics. The sampling habitat is broken down into three sub-sections namely Stones-In-Current (SIC), Vegetation (VEG), Gravel Sand & Mud (GSM) and other habitat/ general. It is presently thought that a total IHAS score of over 65% represents good habitat conditions, a score over 55% indicates adequate/fair habitat conditions (McMillan, 1998) (Table 1).

Table 1: Invertebrate Habitat Assessment System Scoring Guidelines

IHAS Score	Description
> 65%	Good
55-65%	Adequate/Fair
< 55%	Poor

6.2.2.3 Biotic Integrity Based on SASS5 Results

The monitoring of benthic macroinvertebrates forms an integral part of the monitoring of the health of an aquatic ecosystem as they are relatively sedentary and enable the detection of localised disturbances. Their relatively long life histories (±1 year) allow for the integration of pollution effects over time. Field sampling is easy and since the communities are heterogeneous and several phyla are usually represented, response to environmental impacts is normally detectable in terms of the community as a whole (Hellawell, 1977). Aquatic macroinvertebrates were sampled using the qualitative kick sampling method called SASS5 (South African Scoring System, version 5) (Dickens & Graham, 2002). The SASS5 protocol is a biotic index of the condition of a river or stream, based on the resident macroinvertebrate community, whereby each taxon is allocated a score according to its level of tolerance to river health degradation (Dallas, 1997). This method relies on churning up the substrate with your feet and sweeping a finely meshed SASS net (mesh size of 1000 micron), over the churned up area.

The SASS5 index was designed specifically for the assessment of perennial streams and rivers and is not suitable for assessment of impoundments, isolated pools, wetlands or pans (Dickens & Graham, 2002). In the Stones-In-Current (SIC) biotope the net is rested on the substrate and the area immediately upstream of the net disturbed by kicking the stones over and against each other to dislodge benthic invertebrates. The net is also swept under the edge of marginal and aquatic vegetation (VEG). Kick samples are collected from areas with gravel, sand and mud (GSM) substrates. Identification of the organisms is made to family level (Thirion et al., 1995; Davies & Day, 1998; Dickens & Graham, 2002; Gerber & Gabriel, 2002).

The endpoint of any biological or ecosystem assessment is a value expressed either in the form of measurements (data collected) or in a more meaningful format by summarising these measurements into one or several index values (Cyrus et al., 2000). The indices used for this study were SASS5 Score and Average Score per Taxon (ASPT). The ASPT score is calculated as follows: SASS5 Score/ No. of Taxa.

Reference conditions reflect the best conditions that can be expected in rivers and streams within a specific area and also 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 Highveld - upper ecoregion were obtained from Dallas (2007) (Table 2).

Table 2: Modelled reference conditions for the Highveld - upper ecoregion based on SASS5 and ASPT scores (adapted from Dallas, 2007)

SASS Score	ASPT*	Class	Description
> 240	> 6.8	**A**	Unimpaired. High diversity of taxa with numerous sensitive taxa.
190 - 240	6.3 - 6.8	**B**	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.
155 - 190	5.9 - 6.3	**C**	Moderately impaired. Moderate diversity of taxa.
120 - 155	5.3 - 5.9	**D**	Considerably impaired. Mostly tolerant taxa present.
< 120	< 5.3	**E/F**	Severely impaired. Only tolerant taxa present.

6.3 Terrestrial Fauna

6.3.1 Literature review

The approach for this survey is based upon the National Requirements for Biodiversity Assessments (2014) and the GDARD minimum requirements. The level of this study does not warrant intensive sampling but rather serves to combine the aspects of the regional vegetation unit (Mucina & Rutherford 2006) with the field study in order to formulate a series of conclusions and any subsequent recommendations. Many of the potential avifaunal triggers were referenced by the Southern Africa Bird Atlas Project (SABAP 2). Mammal information was referenced by Skinner and Chimimba (2005) while reptiles and amphibians were referenced from Bates et al. (2014) and Du Preez and Carruthers (2009) respectively. It must be stated that evaluation of species of concern was considered only after the field study which served to identify the potential for occurrence. Therefore, all species identified under the above mentioned references were not necessarily analysed in detail. Species nomenclature follows the aforementioned references throughout this document. The applicability of the information obtained from the literature sources was evaluated for the study area and the subsequent recommendations are to be used by the client in order to drive the development process in accordance with the relevant legislation.

6.3.2 Field Survey

A field survey was recorded on the 13th June 2016. During the survey the area was traversed and all faunal species recorded.

6.4 Terrestrial Vegetation

6.4.1 Desktop Assessment

The description of the regional vegetation relied on literature from Mucina & Rutherford (2006). Plant names follow Van Wyk & Van Wyk (1997), Van Wyk & Malan (1997), Henderson (2001), Van Oudtshoorn (2002), Schmidt (2007), van der Walt (2009) and Bromilow (2010). Aerial images (Google Earth) were assessed prior to the field survey in order to identify areas where disturbances took place, homogenous areas and areas where wetland conditions were likely to occur. Additionally the PRECIS list was consulted on the South African National Biodiversity Institute (SANBI) website for the 2628AA quarter degree grid square (SANBI, 2016).

The site visit took place on the 13th of June 2016. Random transects were walked in accessible areas and representative vegetation sampled. At the time of the assessment, the route alignment and a 100m around the route were sampled. Any additional information on any other feature thought to have ecological significance within the affected area, such as dominant species cover abundance, erosion, rocky cover, alien/exotic/invasive plants, as well as plant species of conservation concern and/or their habitat were also recorded. Plant identification and vegetation description relied on species recorded in the sampling plots and along the walked transects.

6.4.1.1 Vegetation Sensitivity

The following criteria and weighting was used to determine the vegetation sensitivity, function and conservation importance:

1. The status of the regional vegetation that is expected to occur on the study site, only where natural vegetation is still remaining (Table 3).

Table 3: Scoring of listed ecosystems

LISTED ECOSYSTEM*	SCORING
Primary state	3
Sub-climax state	2
Secondary state	1
No natural vegetation remaining	0

*This scoring is not applicable (N/A) for areas devoid of natural vegetation.

2. Whether the study area is situated within a Listed Ecosystem in terms of Section 52 of the National Environmental Management: Biodiversity Act (Act 10 of 2004) or in a vegetation that is classified as Vulnerable or Endangered (
3. Table **4**).

Table 4: Score of conservation status according to the listed terrestrial ecosystem status

LISTED ECOSYSTEMS	SCORING
Critically Endangered	3
Endangered	2
Vulnerable	1
Least threatened	0

4. Whether the vegetation or ecological feature is protected by legislation (Table 5).

Table 5: Score assigned to different tiers of legislation

LEGISLATION	SCORING
National legislation	3
Provincial policies and guidelines	2
Municipal or other protection	1
No legislated protection	0

5. The presence of suitable habitat for plants of conservation concern as well as the actual occurrence thereof (Table 6).

Table 6: Assessment of suitable habitat for different red or orange listed species

SUITABLE HABITAT / PRESENCE	SCORING
Confirmed presence of red listed species (Threatened)	3
Confirmed presence of Orange listed (Near threatened, Declining), and Suitable habitat and some likelihood of occurrence of Threatened species	2
Suitable habitat but unlikely to occur	1
No suitable habitat	0

6. Ecological Function: areas important to ecological processes such as ecological corridors, hydrological processes and important topographical features such as ridges (
7.
8.
9. **Table 7**).

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Table 7: Assessment of the potential ecological function of the vegetation community

ECOLOGICAL FUNCTION	SCORING
High: Sensitive vegetation communities with low inherent resistance or resilience towards disturbance factors; vegetation that are considered important for the maintenance of ecosystem integrity. Most of these vegetation communities represent late succession ecosystems with high connectivity with other important ecological systems.	3
Medium to high: Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with a high degree of connectivity with other ecological systems OR disturbed vegetation connected to an ecological and protected system e.g. ridge, wetland or river	2
Medium: Vegetation communities that occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree or limited connectivity with other ecological systems	1
Low: Degraded and highly disturbed vegetation with little ecological function	0

10. Conservation Importance: indication of the necessity to conserve areas based on factors such as the importance of the site on a national and/or provincial scale and on the ecological state of the area (degraded or pristine). This is determined by the presence of a high diversity, rare or endemic species and areas that are protected by legislation (Table 8).

Table 8: Assessment of the ecological importance of the vegetation community

Ecological importance	Scoring
High: Ecosystems with high species diversity and usually provide suitable habitat for a number of threatened species. OR protected ecosystems e.g. wetlands, riparian vegetation etc. These areas should be protected	3
Medium to high: Ecosystems with intermediate levels of species with the possible occurrence of threatened species	2
Medium: Ecosystems with intermediate levels of species diversity without any threatened species.	1
Low: Areas with little or no conservation potential and usually species poor (most species are usually exotic).	0

11. After conducting the sensitivity analysis the scores of each vegetation community area added up and then compared to Table 9 in order to determine vegetation sensitivity.

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Table 9: Vegetation sensitivity classification

Scoring	13-18	7-12	0-6
Sensitivity	High	Medium	Low

7 RESULTS AND DISCUSSION

7.1 Wetland Assessment

7.1.1 Desktop assessment

The desktop delineation identified the location of wetland areas associated with the project area. One non FEPA wetland was identified within 500 m of the project area, this has been classified as a seep. The location of the non FEPA wetland in relation to the project area is presented in Figure 6.

The Gauteng C-Plan indicates the project area only to be associated with an Ecological Support Area (ESA) and not a Critical Biodiversity Area (CBA). The location of the study area in relation to the Gauteng C-Plan is presented in Figure 7.

Ecological Support Areas (ESAs): Natural, near-natural, degraded or heavily modified areas required to be maintained in an ecologically functional state to support Critical Biodiversity Areas and/or Protected Areas. ESAs maintain the ecological processes on which Critical Biodiversity Areas and Protected Areas depend. These areas may include remaining floodplains, corridors, catchments and wetlands.

Contour data (5 m) and Google Earth imagery do suggest that wetland areas are present, most notably to the west of the project area.

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Figure 6: The project area in consideration of the local FEPA wetlands

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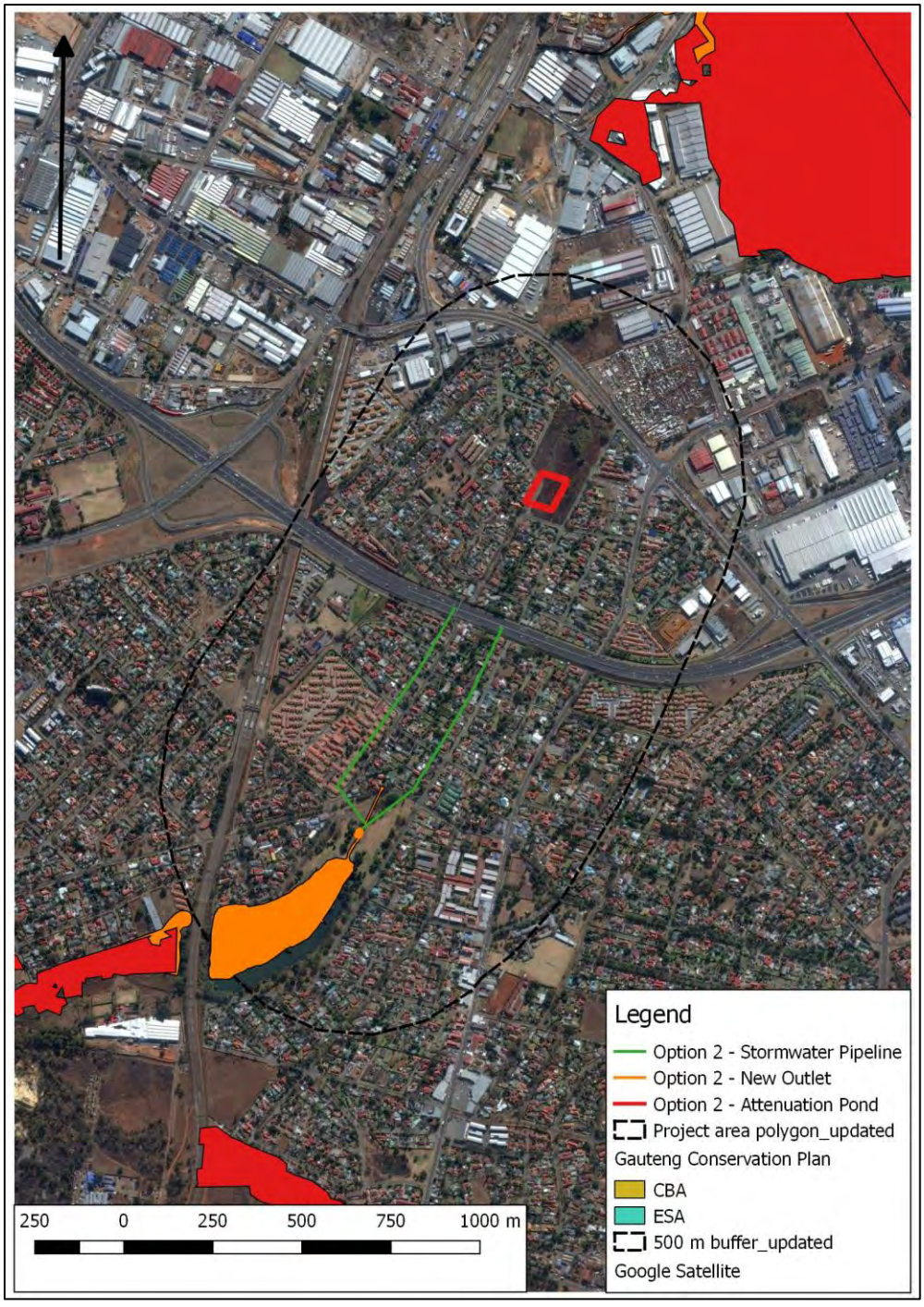

Figure 7: The project area in consideration of the Gauteng C-Plan

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7.1.2 Wetland delineation

The desktop findings were ground truthed, implementing the DWAF (2005) wetland guidelines. Wetland boundaries were ground truthed making use of soil forms, soil wetness, and vegetation to delineate wetland areas. Photographs of wetland indicators considered for the study are presented in Figure 8. The extent of the delineated wetland areas is presented in Figure 9. Additionally, for the purpose of the ground truthing exercise, the extent of the wetland areas also considered the following:

- The ability of the systems to receive run-off low following precipitation events under natural conditions, with limited base flow present for the project area;
- The identification of wetland indicators consistent with the definition of a natural (non-artificial) wetland; and
- Supporting drainage areas (channels) are not consistent with the definition of a channel-associated watercourse due to the absence of a natural channel or channel features that may contain regular or intermittent flow (NWA, 1998, Act No. 36 of 1998).

The survey was conducted during the dry season (June 2016) which is not ideal for the use of vegetation as a wetland indicator. Vegetation that was identified during the survey that was considered for the delineation of wetland boundaries include *Typha capensis, Imperata cylindrical, Cyperus sp, Verbena sp* and *Phragmites sp*.

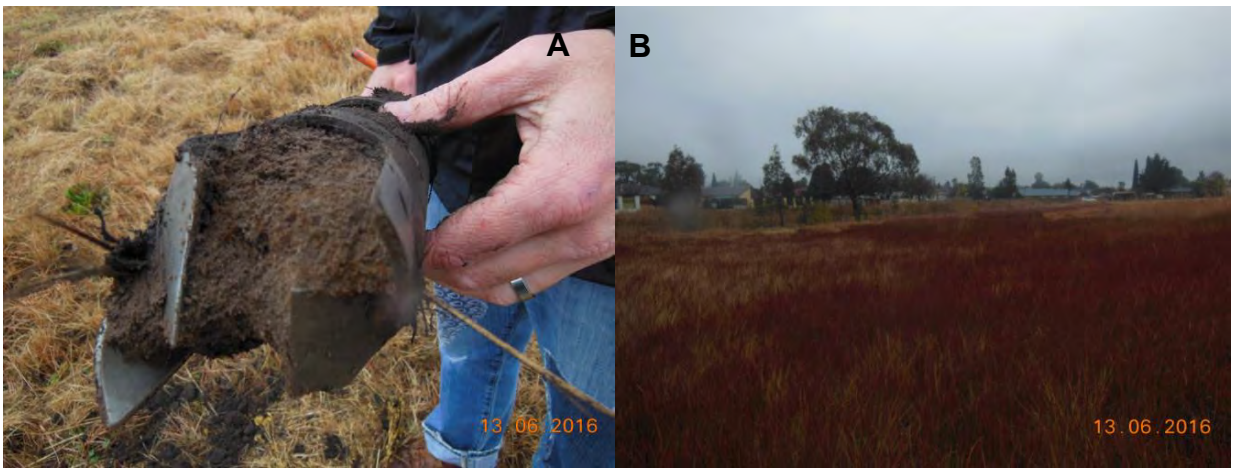

Figure 8: Photographs of wetland indicators. **A:** Soil wetness - Mottling. **B:** Vegetation – *Imperata cylindrica*

Based on the field survey the wetlands associated with the proposed development were identified as channelled valley bottom wetlands. Channelled valley bottom wetlands resemble floodplains, however, they are characterized by less active deposition of sediment and also the absence of oxbows and other floodplain features such as natural levees and meander scrolls (Kotze *et al*.,

2007). These systems are generally narrower and have a steeper gradient, with the contribution from lateral groundwater input relative to the main stream channel being generally greater. These systems contribute less towards flood attenuation and sediment trapping. Some nitrate and toxicant removal potential would be expected, particularly from the water being delivered from the adjacent hillslopes.

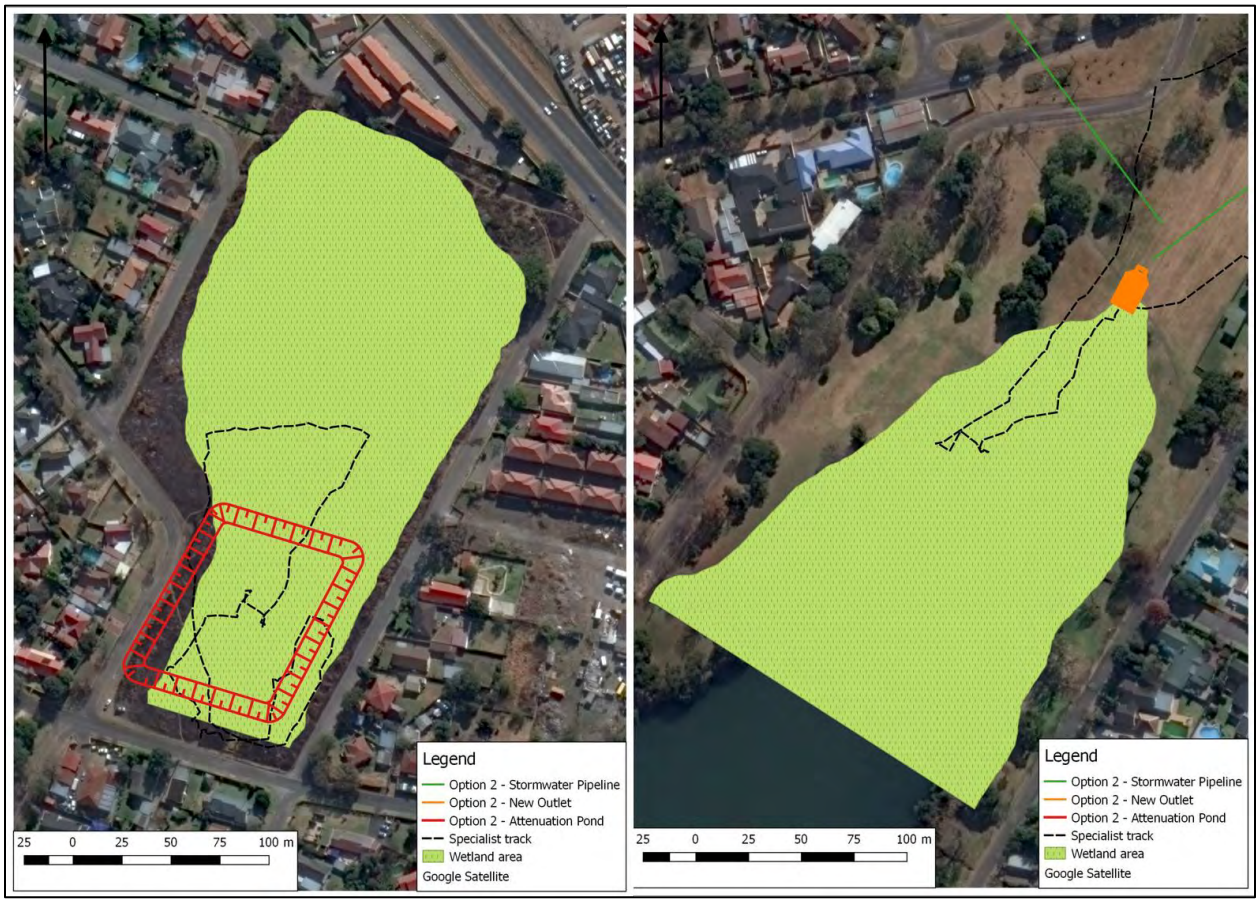

Figure 9: The delineated wetland areas for the study

7.1.3 Wetland health assessment

Three modules, namely hydrology, geomorphology and vegetation, were assessed to ascertain the health of the wetlands. The local wetlands have been impacted on by local development and activities, photographs of some of the identified impacts are presented in Figure 10.

The Present Ecological Status (PES) for the assessed wetland system, the channelled valley bottom wetland is presented in Table 10.

Table 10: Summary of the scores for the wetland PES

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Description	Rating	Description	Rating	Description
Channelled valley bottom	E	Moderately Modified	E	Moderately Modified	D	Moderately Modified
Overall PES Class					E: Seriously Modified	

The wetland systems are in a seriously modified (Category E) state, suggesting the change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable. Noticeable modifications to the systems include the following:

- The development of the area which has resulted in watercourse corridors lost and the hydrology of the systems managed by stormwater systems, and the structure of the channels lost.
- Increased stormwater and run-off inputs from the surrounding urban developments and access routes.
- Manicured recreational areas and mowing of open areas adjacent to the wetlands.
- The construction of dams, above and below the project area have also contributed to altered flow dynamics across the system.

A summary of the ecological descriptions for the three modules is as follows:

- The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.
- The change in geomorphic processes is great but some features are still recognizable.
- Vegetation composition has been largely altered and introduced, alien and/or increased ruderal species occur in approximately equal abundance to the characteristic indigenous wetland species.

Figure 10: Photographs of identified impacts for the project area. **A:** Stormwater inputs. **B:** Illegal dumping. **C:** Landscaping. **D:** Mowing of vegetation

7.2 Aquatic Ecosystems

7.2.1 Present Ecological State (PES), Ecological Importance (EI) and Ecological Sensitivity (ES)

The Present Ecological Status (PES) category of the reach is classed as seriously modified (Class E) (Table 11). Anthropogenic impacts in the SQR include a serious degree of modification of instream habitats, riparian & wetland habitats, flow and water quality.

The EI of the reach was rated as moderate (Table 11). Factors that contribute to the moderate EI include:

- Low importance of riparian/ wetland instream vertebrates (excluding fish);

- Moderate habitat diversity;
- Low instream habitat integrity;
- Low riparian and wetland habitat integrity; and
- High importance of natural riparian and wetland vegetation.

The Ecological Sensitivity (ES) of the reach is classified as moderate (Table 11). Factors that contributed to this included:

- High sensitivity of fish communities to modification of water quality;
- Moderate sensitivity of aquatic macroinvertebrate communities to modified water quality;
- High sensitivity of both fish and aquatic macroinvertebrate communities to lack of flow; and
- Low stream size sensitivity to modified flow.

Table 11: Summary of the status of the Elsburgspruit SQR (C22B-1342)

Present Ecological Status (PES)	Seriously modified (Class E)
Ecological Importance (EI)	Moderate
Ecological Sensitivity (ES)	Moderate

7.2.2 Field Survey

Sampling of aquatic ecosystems was conducted in the vicinity of the proposed attenuation pond.

7.2.2.1 In situ water quality

In situ water quality measurements were taken within the sampling reach. These results are important to assist in the interpretation of biological results because of the direct influence water quality has on aquatic life forms. The results of the survey are presented in Table 12.

Table 12: *In situ* water quality results during the June 2016 survey (measurements exceeding the Target Water Quality Range are shown in **RED**)

Site	pH	EC (µS/cm)	DO (mg/l)	DO Saturation (%)	Temperature (°C)
TWQR*	**6.5 - 9.0**	**< 700**	**< 5.00**	**80 - 120**	**5 - 30**
WIT1	7.3	180	**4.3**	**48%**	13

** Target Water Quality Range*

Based on the *in situ* water quality results low DO concentration and saturation levels were identified as a limiting factor of aquatic ecosystems (Table 12). The maintenance of adequate Dissolved Oxygen (DO) is critical for the survival of aquatic biota as it is required for the respiration of all aerobic organisms (DWAF, 1996). Therefore, DO concentration provides a useful measure of the health of an ecosystem (DWAF, 1996). When DO levels drop below the TWQR, aquatic biota are exposed to life threatening physiological stresses (suffocation) that if they persist, result in a river devoid of life. The source of low DO concentrations in the Elsburgspruit at the time of the June 2016 survey weren't clear but may be due to effluents with increased Biological Oxygen Demand (BOD).

7.2.2.2 Integrated Habitat Assessment System (IHAS)

Whilst on site, anthropogenic impacts were noted and these were primarily associated with the urban nature of the site and its surroundings.

The IHAS results for the June 2016 survey are presented in Table 13.

Table 13: IHAS score measured in the Elsburgspruit during the June 2016 survey

Site	IHAS Score	Habitat Availability
WIT1	47	Poor

Based on the IHAS results, habitat availability in the Elsburgspruit was poor at the time of the survey (Table 13). The poor habitat availability was attributed to the low flow level and well as the limited Stones-In-Current (SIC) habitats. The substrate in the stream consisted predominantly of rubble.

7.2.2.3 Biotic Integrity Based on SASS5 Results

The SASS results are presented in Table 14. A total of 5 aquatic macroinvertebrate taxa were measured in the Elsburgspruit during the June 2016 survey (Table 14). Based on the ASPT results

the aquatic macroinvertebrate community was composed primarily of tolerant taxa (Intolerance Rating < 5).

Table 14: SASS5 results recorded in the Elsburgspruit during the June 2016 survey

Site	SASS Score	No of taxa	ASPT*
WIT1	16	5	3.2

* Average Score per Taxon

Based on the SASS results, biotic integrity in the Elsburgspruit was severely impaired (PES Class E/F) at the time of the June 2016 survey (Table 15). This was attributed in part to limited habitat availability as shown by the IHAS results and the low DO concentrations.

The results of the field survey matched the desktop assessment results which predicted a PES Class E for the Elsburgspruit SQR (see section 7.2.1above).

Table 15: Present Ecological State of the Elsburgspruit based on the results of the June 2016 survey

Site	Present Ecological State (PES) Class	Description
WIT1	**E/F**	Severely impaired. Only tolerant taxa present.

7.3 Terrestrial Fauna

During the field survey diversity was low with very few faunal species observed. Observed species included common bird species only.

7.3.1 Faunal Species of Conservation Concern

7.3.1.1 Avifauna

Based on the South African Bird Atlas Project 2 database (SABAP2, 2016) 350 bird species have been recorded in the project area.

Based on that assessment 2 species of conservation concern have previously been recorded in QDGS 2628AA (Table 16). It should be noted that the SABAP2 database provides a list of previously observed bird species for the entire QDGS. Based on the SABAP2 1 record exists of *Oxyura maccoa* (Maccoa duck) in the QDGS (Table 16). This species can therefore be regarded as an incidental and its likelihood of occurrence in the project area is regarded as low (Table 16).

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Phoenicopterus roseus (Greater flamingo) has been recorded in the QDGS on 15 occasions and its likelihood of occurrence in the project area is therefore rated as moderate (Table 16). Given the high level of disturbance and human density it is unlikely that this species would be resident at the site, it is more likely to occur as an occasional visitor.

Table 16: Likelihood of occurrence of bird species of conservation concern in the project area

Species	Common Name	SAPAB 2		IUCN (2016)	SA Red Data List (Birdlife, 2015)	Likelihood of Occurrence
		No of records	Most recent			
Oxyura maccoa	Maccoa Duck	1	2015-06-30	NT	NT	Low
Phoenicopterus roseus	Greater Flamingo	15	2016-06-28	LC	NT	Moderate

7.3.1.2 Mammals

Table 17 lists 2 mammal species of conservation concern that could potentially be present in the project area. The probability of occurrence of these species was assessed based on factors such as habitat preference, distributional range and sensitivity to disturbance (Table 17). No indigenous mammal species were observed on the site during the June 2016 survey.

Chrysospalax villosus (Rough-haired golden mole) is a South African endemic that is rated as Critically Endangered (CE) in the South African Red Data Book of Mammals (EWT, 2012). Based on the IUCN it it has very specific habitat requirements comprising wetlands and grasslands near to waterbodies and has been recorded from only 11 locations in Gauteng, Mpumalanga and KwaZulu-Natal (IUCN, 2015). This species is considered to be sensitive to the impacts associated with urbanization. Given the degree of habitat transformation at the Witfield site this species is unlikely to occur at the site (Table 17).

Lutra maculicollis (Spotted-necked otter) has a wide distributional range extending upwards from South Africa through Central and into West Africa (IUCN, 2016). The Spotted-necked Otter inhabits freshwater habitats where water is un-silted, unpolluted, and rich in small to medium sized fishes (IUCN, 2016). Given the high human density and degree of disturbance of the project area *L. maculicollis* was rated as unlikely to occur in the project area (Table 17).

Dasymus incomtus (African marsh rat) has a wide distributional range that extends from the Western Cape northwards through to the Democratic Republic of the Congo (DRC) (IUCN, 2016). In South Africa this species is restricted to the moister eastern and southern portions of the country. The Witfield project area is situated right at the edge of this species' distribution (IUCN,

2016). This species occurs in a wide variety of habitats, including forest and savanna habitats, swampland and grasslands (IUCN, 2016). Given the degree of disturbance and the location of the site at the margin of this species' distribution the likelihood of occurrence is rated as unlikely (Table 17).

Table 17: Likelihood of occurrence of mammal species of conservation concern in the project area

Species name	Common name	IUCN (2016)	SA Red Data Book Mammals	Likelihood of Occurrence
Chrysospalax villosus	Rough-haired golden mole	VU	CE	Unlikely
Lutra maculicollis	Spotted-necked otter	NT	NT	Unlikely
Dasymys incomtus	African marsh rat	LC	NT	Unlikely

7.3.1.3 Invertebrates

Three invertebrate species of conservation concern that may occur in the project area are listed in Table 18. *Lepidochryspos praeterita* and *Chrysoritis aureus* are both butterfly species which are listed as Endangered on the South African Red List (Mecenero *et al*., 2013).

An expected species list for degree square 2628 was obtained from the Atlas of African Lepidoptera (ADU, 2016). Based on that assessment 150 Lepidoptera species have been recorded in degree square 2628. Based on the Atlas of African Lepidoptera neither of the expected species of conservation concern have been recorded in degree square 2628 since 1980 (ADU, 2016). These species were therefore been rated as unlikely to occur in the project area (Table 18).

Table 18: Invertebrate species of conservation concern along with their conservation statuses and likelihood of occurrence

Scientific name	Common name	IUCN (2016)	SA Red list category	Likelihood of occurrence
Lepidochryspos praeterita	Highveld blue	Unlisted	Endangered	Unlikely
Chrysoritis aureus	Heidelberg copper	Unlisted	Endangered	Unlikely

7.4 Terrestrial Vegetation

7.4.1 Desktop Assessment

This study area is situated within the Grassland Biome of southern Africa, more specifically the Soweto Highveld Grassland (Gm8). Other vegetation units in close proximity to the study area

include the Eastern Temperate Freshwater Wetland (Gm10) (Figure 11) (Mucina and Rutherford 2006).

The **Soweto Highveld Grassland** is best described as a short to medium-high, tufted grassland occurring on a moderately undulating landscape. The dominant species in this vegetation unit is *Themeda triandra.* Other graminoids prominent in the vegetation unit is *Elionurus muticus, Eragrostis racemosa, Heteropogon contortus* and *Tristachya leucothrix.* The status of the vegetation type is endangered (Driver *et al*., 2005 and Mucina and Rutherford*.,* 2006), and whilst the conservation target is 24%, only a small extent is currently protected and almost half is considered to be transformed, mostly by cultivation, urbanization, mining and building of road infrastructure (Mucina & Rutherford, 2006). This vegetation unit is listed as a **vulnerable,** terrestrial ecosystem (RSA, 2011).

According to Mucina and Rutherford (2006) the freshwater wetlands in the surrounding the study area categorised as **Eastern Temperate Freshwater Wetland** (AZf3) vegetation unit (Figure 11). The landscape can be described as flat or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hygrophilous vegetation of temporarily flooded grasslands and ephemeral herb lands. Some 15% of the *Eastern Temperate Freshwater Wetlands* have been transformed to cultivated land, urban areas or plantations. In some places, intensive grazing and use of wetlands as drinking pools by cattle and sheep cause major damage to the wetland vegetation (Mucina and Rutherford 2006). According to the 2011 National List of Threatened Terrestrial Ecosystems for South Africa the Eastern Temperate Freshwater Wetland vegetation unit is listed as **Vulnerable** (RSA 2011).

7.4.1.1 Protected species list

The national (SANBI 2016) data bases were consulted to determine the presence of species of conservation concern within the study area. The national species list included thirteen possible species of conservation concern within the 2628AA quarter degree grid square (QDS) (Table 19). The provincial species data was not available to the specialist at the time of compilation of the report. It will be included upon receipt from GDARD.

Figure 11: Vegetation types associated with the project area

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Table 19: Plant species of conservation concern in the 2628AA quarter degree grid square (SANBI, 2016)

Family	Species	Threat status
APOCYNACEAE	*Stenostelma umbelluliferum*	NT
ASPHODELACEAE	*Trachyandra erythrorrhiza*	NT
ASTERACEAE	*Cineraria austrotransvaalensis*	NT
CRASSULACEAE	*Adromischus umbraticola*	NT
FABACEAE	*Pearsonia bracteata*	NT
ORCHIDACEAE	*Holothrix randii*	NT
ASTERACEAE	*Cineraria longipes*	VU
FABACEAE	*Indigofera hybrida*	VU
MESEMBRYANTHEMACEAE	*Khadia beswickii*	VU
ASTERACEAE	*Callilepis leptophylla.*	Declining
GUNNERACEAE	*Gunnera perpensa*	Declining
HYPOXIDACEAE	*Hypoxis hemerocallidea*	Declining
PROTEACEAE	*Leucadendron daphnoides*	EN

7.4.2 Vegetation Communities

The following vegetation communities were identified within the project area:

- Wetland and moist grassland;
- Secondary grassland; and
- Transformed park areas.

Each broad vegetation communities are geographically represented in Figure 12 and discussed below.

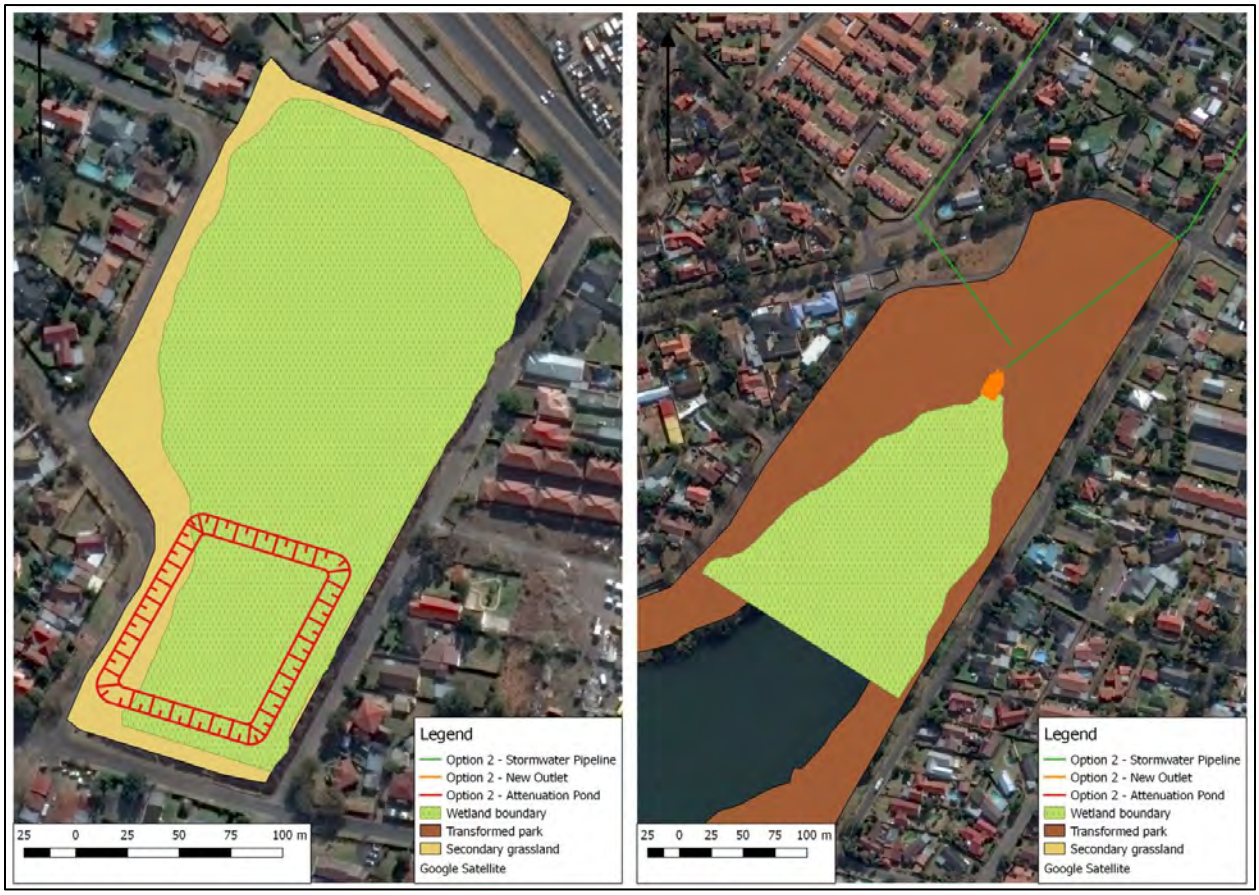

Figure 12: Vegetation communities identified within the project area

7.4.3 Wetland and moist grassland

Wetland and moist grassland communities are limited to section directly adjacent to the drainage line as well its tributaries (Figure 13). The banks have been invaded in the most instances by *Pennisetum clandestinum* (Kikuyu Grass). There are numerous alien invasive woody trees along the riparian area including *Salix babylonica* (Willow) and *Eucalyptus* species (Blue Gum). The vegetation in this unit was dominated by a thick grass layer. Within the grass layer *Imperata cylindrical* (Cotton Wool Grass) was the dominant species. *Typha capensis* (Bulrush) and *Phragmites australis* (Giant Reed) were present in patches throughout the channel in the northern section of the study area.

Figure 13: Wetland and moist grassland. **A:** Large sections of the banks were invaded with *Pennisetum clandestinum.* **B:** Large sections of *Imperata cylindrica* (Cotton Wool Grass) **C:** Sedges and *Salix babylonica* present along the dam edge within the city park

7.4.4 Secondary and transformed grassland

Secondary grasslands develop where the original, primary (undisturbed) grassland vegetation was removed by anthropogenic disturbance such as cultivation (Figure 14). After such disturbances cease, pioneer grassland species, as well as weedy plants, colonise the disturbed areas leading to a secondary grassland state with lower species diversity as opposed to the primary (climax) state prior to any disturbances. Where grasslands were historically disturbed although no cultivation took place (e.g. compaction of the soils), the result could also resemble a secondary grassland state with limited species diversity. Primary grasslands are species rich ecosystems, which once disturbed, are difficult, if not impossible to restore.

Species diversity included mainly invasive species such and the dominant invasive species were *Tagetes minuta* (Khaki Weed) *Cirsium vulgare* (Scotch Thistle) and *Bidens pilosa* (Black jack). The grass species included but were not limited to; *Themeda triandra* (Red Grass), *Eragrostis lehmanniana* (Lehmann's Grass) *Hyparrhenia hirta* (Common Thatching Grass) and *Urochloa mosambicensis* (Bushveld Signal Grass). Hardly any indigenous forbs were present.

Figure 14: Secondary and transformed grassland. **A:** Large sections of the grassland were mowed prior to the site visit. **B:** *Tagetes minuta* dominated present within the secondary grassland. **C:** Litter and rubble dumping present within the secondary grassland

7.4.5 Park and other transformed vegetation:

The southern part of the study area is situated within a city park. Vegetation in the city park is planted and does not resemble the expected Soweto Highveld Grassland in any way. Hardly any indigenous species was found in the city park as to be expected. There was numerous alien invasives and garden plants present within the city park.

Figure 15: Transformed park vegetation. **A:** *Pennisetum clandestinum* lawn. **B:** Various conifer species. **C:** *Planatus* species.

7.4.6 Vegetation Sensitivity Analysis

As per Table 20 below, the result of the sensitivity assessment indicated that moist grassland had a medium sensitivity whilst the secondary grassland and transformed areas had a low sensitivity. The sensitivity scores are geographically represented in Figure 16.

Table 20: Sensitivity scoring of vegetation groups within the study area

Vegetation community	Conservation Status of regional Vegetation unit	State of vegetation	Legislated protection	Plants of conservation concern	Ecological Function	Conservation Importance	Total Score out of max of 18
Moist grassland	1	1	3 Watercourse	1	2	2	**10 Medium**
Secondary and disturbed grassland	1	1	0	1	1	1	**4 Low**
Transformed (Parks)	N/A	0	0	0	1	0	**1 Low**

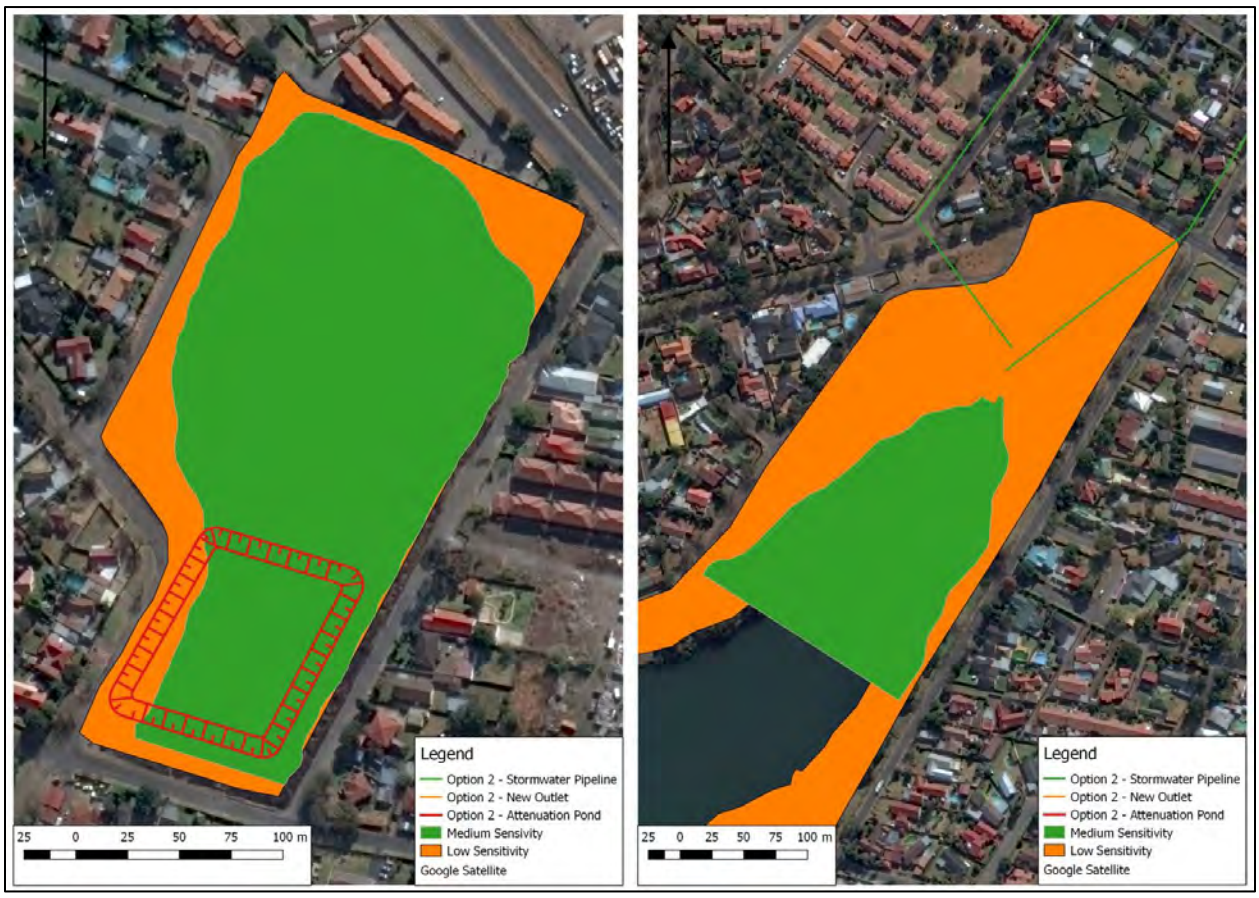

Figure 16: Vegetation sensitivity map

8 RISKS ASSESSMENT

The risk matrix assesses impacts in terms of consequence and likelihood. Consequence is calculated based on the following formula:

Consequence = Severity + Spatial Scale + Duration

Significance is calculated as:

Significance \Risk= Consequence X Likelihood.

The significance of the impact is calculated according to Table 21.

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Table 21: Significance ratings

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.

8.1 Wetland Assessment

The proposed construction of the attenuation pond and new outlet presents a risk to the wetland systems, due to the excavations and associated activities required. Wetland habitats at the northern and southern extents of the project area will be and lost as a result of the development.

Potential risks to the wetland systems are listed in Table 22.

Table 22: The risk assessment activities, aspects and potential impacts

Activity	Aspect	Impact
Upgrade of stormwater canals	Excavations of attenuation pond & new outlet	Loss of wetland areas. Damage to wetlands (or loss). Altered hydrological regime. Siltation of wetland. Impaired water quality. Loss of biodiversity.
	Construction activities	
	Storm water management	

The significance of risks posed to wetland habitats are rated in Table 23.

Table 23: Wetland risk assessment - prior to mitigation

Aspect	Significance	Risk Rating
Excavations of attenuation pond and new outlet	**61**	Moderate
Construction activities	**65**	Moderate

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Storm water management	**124**	Moderate

The significance of the risks were rated as moderate prior to implementation of mitigation measures.

8.1.1 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 serve as a "barrier" between the proposed development and the wetland systems.

In the Province of Gauteng, the GDARD requires buffers of 32 m and 100 m to be established for rivers/streams in urban and non-urban settings respectively. Additionally, a buffer zone of 30 m (GDARD, 2014) must be allocated to wetland areas inside urban areas.

8.1.2 Mitigation Measures

The mitigation measures that should be considered for the project are as follows:

- The delineated wetland area must be avoided where possible. Laydown yards, camps and storage areas must be beyond the wetland and buffer areas. Where possible, existing access routes and paths must be made use of, and new routes limited;
- 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 (if possible) to reduce the erosion potential of the exposed surfaces;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel; and
- Prevent uncontrolled access of vehicles through wetlands that can cause a significant adverse impact on the hydrology and soil structure of these areas through rutting (which can act as flow conduits) and through the compaction of soils.

8.2 Aquatic Ecosystems

The urban nature of the catchment has resulted in a critical level of modification of the Elsburgspruit. Anthropogenic impacts on the system can be separated into water quality modifying activities and habitat modifying activities. In addition to current impacts to the aquatic ecosystems associated with the project area, further potential impacts may arise due to the proposed development. Potential impacts associated with the development are listed in Table 24.

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Table 24: Aquatic ecosystem risk assessment - prior to mitigation

Aspect	Significance	Risk Rating
Decreased water quality	**50**	Low
Deterioration of habitat quality	**45**	Low

As the construction activities are situated in close proximity to aquatic ecosystems, there is potential for pollutants entering these systems. Potential sources include hydrocarbons and soils entering the system through surface runoff.

As the proposed activities include excavations in order to construct the attenuation ponds there is potential for further sedimentation of the aquatic systems.

Due to the impaired baseline state of aquatic ecosystems the significance of the risks associated with the development were rated as low (Table 24).

8.2.1 Mitigation Measures

Mitigation measures include the following:

- Construction activities and vehicles could cause spillages of lubricants, fuels and construction material which could runoff into aquatic ecosystems. All vehicles and equipment must be maintained, and all re-fuelling and servicing of equipment is to take place in demarcated areas away from aquatic ecosystems;
- No equipment may be washed within the watercourse, nor may dumping of construction material into the drainage system take place; and
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel.

8.3 Terrestrial Fauna

Potential impacts on terrestrial ecosystems include the following:

- Loss of species of conservation concern;

With the exception of a few common bird species faunal diversity was low at the time of the survey. The faunal species expected to occur in the Witfield area are primarily human commensals. The likelihood of bird, mammal and invertebrate species of conservation concern occurring on site

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was assessed and with a few exceptions ranged from unlikely to low. The only exception is Greater flamingo. This species is attracted to wetland habitats and has been recorded in the degree square. However due to the level of disturbance and high human density it is unlikely that this species will be resident at the site. The high human density and degree of transformation of the area represents a shift to severely sub-optimal conditions for all but the most tolerant faunal species. Given the low probability of occurrence of species of conservation concern in the project area the significance of this impact was rated as low prior to implementation of mitigation (Table 25).

Table 25: Terrestrial fauna risk assessment – prior to mitigation

Aspect	Significance	Risk Rating
Impact of species of conservation concern	30	Low

8.3.1 Mitigation Measures

The intentional killing of any animals including snakes, lizards, birds or other animals should be prohibited.

8.4 Terrestrial Vegetation

Potential impacts on terrestrial vegetation have been grouped into four (4) main categories:

- Loss of plant species due to vegetation clearing;
- Exposure of the soil to erosion;
- Spread of alien invasive vegetation; and
- Soil compaction and subsequent disturbance of the soil seedbank.

All four impacts were assessed according to the impact assessment criteria and the results are presented in Table 26.

Table 26: Vegetation risk assessment (prior to mitigation)

Impact	Significance	Risk Rating
Loss of vegetation	50	Low
Soil erosion	47	Low
Increase in alien vegetation	94	Moderate

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Soil compaction	41	Low

8.4.1 Mitigation Measures

Proposed mitigation measures include the following:

- Prohibit vehicular or pedestrian access into areas beyond the demarcated project footprint;
- After construction, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land must be left in a condition as close as possible to that prior to construction;
- Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. The grassland can be removed as sods and re-established after construction is completed;
- Protect all areas susceptible to erosion (especially the sloped rocky grassland) and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas and
- Alien invasive species, in particular category 1 species that were identified within the study area should be removed from the development footprint and immediate surrounds, prior to construction or soil disturbances. By removing these species, the spread of seeds will be prevented into disturbed soils which could thus have a positive impact on the surrounding natural vegetation.

9 CONCLUSION

The following conclusions were reached based on the results of this assessment:

- Based on the desktop assessment, 1 non FEPA seep wetland was identified within 500 m of the project area;
- The Gauteng C-Plan indicates the project area to be an Ecological Support Area (ESA) and not a Critical Biodiversity Area (CBA);
- Based on the field survey the wetlands associated with the proposed development were identified as channelled valley bottom wetlands.
- The wetland systems are in a seriously modified (Category E) state, suggesting the change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable;

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- The change in geomorphic processes is great but some features are still recognizable.
- Vegetation composition has been largely altered and introduced, alien and/or increased ruderal species occur in approximately equal abundance to the characteristic indigenous wetland species.
- The proposed construction of the attenuation pond and new outlet presents a risk to the wetland systems. The significance of the risks were rated as moderate prior to implementation of mitigation measures;
- Based on the *in situ* water quality results low DO concentration and saturation levels were identified as a limiting factor of aquatic ecosystems;
- Based on the SASS results, biotic integrity in the Elsburgspruit was severely impaired (PES Class E/F) at the time of the June 2016 survey. This was attributed in part to limited habitat availability as shown by the IHAS results and the low DO concentrations;
- Due to the impaired baseline state of aquatic ecosystems the significance of the risks associated with the development were rated as low;
- With the exception of a few common bird species faunal diversity was low at the time of the survey. The faunal species expected to occur in the Witfield area are primarily human commensals;
- The likelihood of bird, mammal and invertebrate species of conservation concern occurring on site was assessed and with a few exceptions ranged from unlikely to low;
- Given the low probability of occurrence of species of conservation concern in the project area the significance of this impact was rated as low prior to implementation of mitigation
- This study area is situated within the Grassland Biome of southern Africa, more specifically the Soweto Highveld Grassland (Gm8), however very little of the original grassland remains in the project area;
- Based on the terrestrial vegetation the sensitivity of the vegetation communities ranged from medium to low;
- Given the transformed state of vegetation communities and the low level of sensitivity the significance of impacts on terrestrial vegetation ranged from moderate to low.

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CULTURAL HERITAGE STATEMENT

CULTURAL HERITAGE STATEMENT FOR THE PROPOSED WITFIELD STORMWATER NETWORK, EKURHULENI METROPOLITAN MUNICIPALITY, GAUTENG PROVINCE

Report No: 2016/JvS/055
Status: Final
Revision No: 0
Date: June 2016

Prepared for:
Delta Built Environment Consultants
Representative: Ms J Steyn

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Declaration:

I, J.A. van Schalkwyk, declare that I do not have any financial or personal interest in the proposed development, nor its developers or any of their subsidiaries, apart from the provision of heritage assessment and management services, for which a fair numeration is charged.

J A van Schalkwyk (D Litt et Phil)
Heritage Consultant
June 2016

1. Introduction

Delta Built Environment Consultants was appointed by Ekurhuleni Metropolitan Municipality (EMM) for the design, EIA, procurement, and construction supervision in order to improve the current stormwater management in the Witfield area.

According to the Preliminary Design Report compiled by Messrs Bigen Africa, the houses located in the Witfield area are prone to flooding. A preliminary design report was compiled with proposals to mitigate the effects of the flooding, as well as cost estimates for the different designs. The report further states that houses were permitted to be built over an existing stormwater culvert, which subsequently resulted in flooding.

The Witfield Dam is located towards the south east of the drainage area and currently the aim is to reroute all the stormwater into the dam to serve as an attenuation facility (Fig. 1 below).

Fig. 1. Layout of the proposed development.

2. Terms of reference

In accordance with Section 38 of the National Heritage Resources Act (NHRA), No. 25 of 1999, an independent heritage consultant was appointed by Delta Built Environment Consultants to conduct a desktop heritage assessment to determine if the proposed development would have an impact on any sites, features or objects of cultural heritage significance. This report forms part of the Environmental Impact Assessment (EIA) as required by the EIA Regulations in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended and is intended for submission to the South African Heritage Resources Agency (SAHRA).

This includes:

- Conducting a desk-top investigation of the area.

The objectives were to

- Identify possible archaeological, cultural and historic sites within the proposed development areas;
- Evaluate the potential impacts of construction, operation and maintenance of the proposed development on archaeological, cultural and historical resources;
- Recommend mitigation measures to ameliorate any negative impacts on areas of archaeological, cultural or historical importance.

The investigation has been influenced by the following factors:

- It is assumed that the description of the proposed project, provided by the client, is accurate.
- No site visit was undertaken.
- It is assumed that the public consultation process undertaken as part of the Environmental Impact Assessment (EIA) is sufficient and that is does not have to be repeated as part of the heritage impact assessment.
- The unpredictability of buried archaeological remains.
- This report does not consider the palaeontological potential of the site.

3. Location of the study area and review of the region

The study area is located in the Witfield region of Ekurhuleni Metropolitan Municipality. It is approximately 5km northeast of the centre of Germiston and roughly a similar distance northwest of Boksburg (Fig. 1).

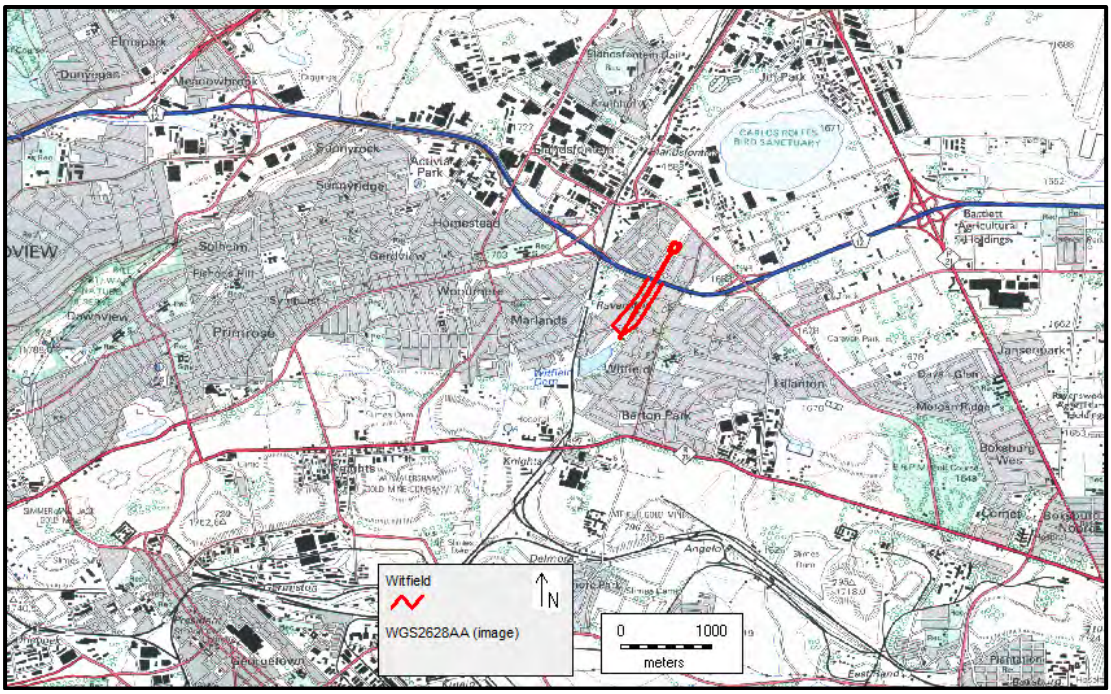

Fig. 1. Location of the proposed development in regional context.

The study area is located in a highly urbanised region of the East Rand. In the past it was largely used for agricultural purposes, as can be determined from the 1939 version of the 1:50 000 version of the topocadastral map (Fig. 2). As the need for housing increased, these faming activities were replaced. This phenomenon happened in the past fifty years. Therefore most of the built fabric, date from this period. The result was that any historic farmsteads older than 60 years that may have existed have either disappeared or have been 'upgraded'.

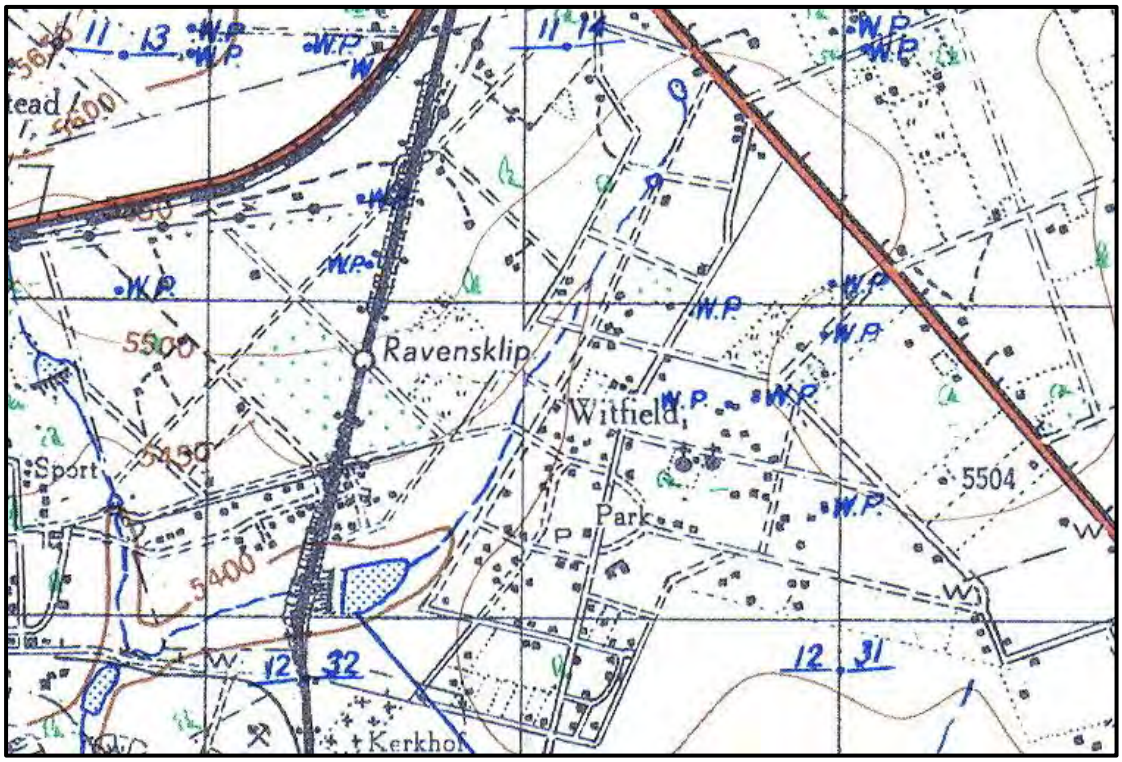

Fig. 2. The 1939 version of the topocadastral map.

The town of Germiston was laid out in 1887 on the farm Elandsfontein, and was known by that name until 1904, when it was officially renamed Germiston after a farm near Glasgow in Scotland, birthplace of John Jack, a gold-mining pioneer. It has the largest railway junction in South Africa (Raper 2007). Some of the mines in the region are/were Knights, Rose Deep and Wits Deep Gold Mine

On 15 October 1886 Pieter JJD Kilian informed the Transvaal State Secretary that he had discovered a profitable gold-reef on the farm Vogelfontein (which was state property) and on 9 February 1887 it was declared public diggings together with the adjoining farm Leeuwpoort. The proclamation came into force on 21 March 1887, which can be regarded as the founding day of Boksburg, named after the then State Secretary, WE Bok. Prospectors poured in as seekers after gold began crowding in tents. In 1887 the first 547 building plots were sold. After Johannesburg Boksburg is the oldest town on the Witwatersrand (Praagh 1906).

Fig. 3. The dense urban development in the region.

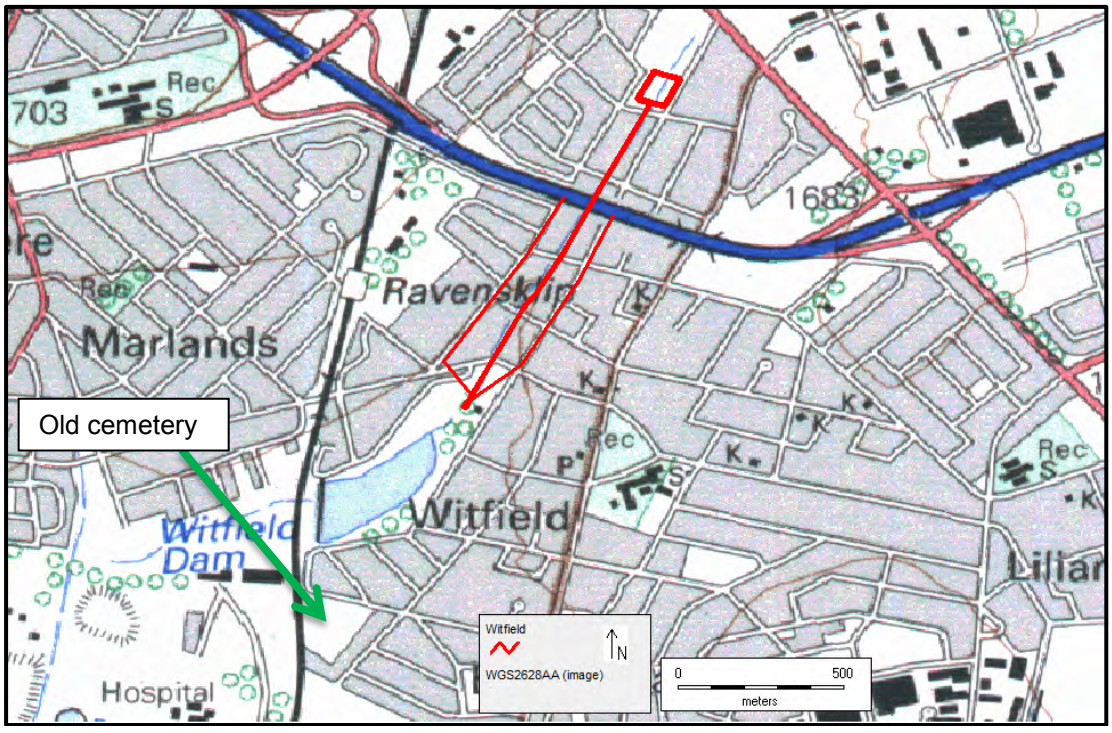

Fig. 4. Layout of the proposed development.

The only know site of cultural heritage significance in the larger region is an old cemetery in Abrahamson Road, approximately 750 m southwest of the southern end of the proposed development (Fig. 4) (see Schoeman & van Doornum 2001).

4. Summary and recommendations

From the above it can be determined that:

- The area has a low possibility for heritage sites, especially dating to the pre-colonial era.
- As a result of the dense urbanisation and the fact that houses were built over the canal, any heritage sites or features that might have occurred here in the past, would have been destroyed.

Impact assessment:

Impact analysis of cultural heritage resources under threat of the proposed development, is based on the present understanding of the development:

- It is my opinion that there would be no impact as a result of the proposed development of the stormwater network and as such I request SAHRA for granting of exemption from doing a HIA for the site.

Reasoned opinion as to whether the proposed activity should be authorised:

- From a heritage point of view it is recommended that the proposed development be allowed to continue, on condition of acceptance of the mitigation measures presented below.

Conditions for inclusion in the environmental authorisation:

- Should archaeological sites or graves be exposed during construction activities, it must immediately be reported to a heritage practitioner so that an investigation and evaluation of the finds can be made.

5. Reference

5.1 **Data bases**

Chief Surveyor General
Environmental Potential Atlas, Department of Environmental Affairs and Tourism.
Heritage Atlas Database, Pretoria.
National Archives of South Africa
SAHRA Archaeology and Palaeontology Report Mapping Project (2009)

5.2 **Literature**

Acocks, J.P.H. 1975. *Veld Types of South Africa*. Memoirs of the Botanical Survey of South Africa, No. 40. Pretoria: Botanical Research Institute.

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SRK Consulting, 2003. *State of the environment report: Ekurhuleni Metropolitan Municipality*.

5.3 **Maps and aerial photographs**

1: 50 000 Topocadastral maps
Google Earth

APPENDIX 1: INDEMNITY AND TERMS OF USE OF THIS REPORT

The findings, results, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and the author reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although all possible care is taken to identify all sites of cultural importance during the investigation of study areas, it is always possible that hidden or sub-surface sites could be overlooked during the study. The author of this report will not be held liable for such oversights or for costs incurred as a result of such oversights.

Although the author exercises due care and diligence in rendering services and preparing documents, he accepts no liability and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of the information contained in this document.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

APPENDIX 2. RELEVANT LEGISLATION

All archaeological and palaeontological sites, and meteorites are protected by the National Heritage Resources Act (Act no 25 of 1999) as stated in Section 35:

(1) Subject to the provisions of section 8, the protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority: Provided that the protection of any wreck in the territorial waters and the maritime cultural zone shall be the responsibility of SAHRA.

(2) Subject to the provisions of subsection (8)(a), all archaeological objects, palaeontological material and meteorites are the property of the State. The responsible heritage authority must, on behalf of the State, at its discretion ensure that such objects are lodged with a museum or other public institution that has a collection policy acceptable to the heritage resources authority and may in so doing establish such terms and conditions as it sees fit for the conservation of such objects.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority-

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

In terms of cemeteries and graves the following (Section 36):

(1) Where it is not the responsibility of any other authority, SAHRA must conserve and generally care for burial grounds and graves protected in terms of this section, and it may make such arrangements for their conservation as it sees fit.

(2) SAHRA must identify and record the graves of victims of conflict and any other graves which it deems to be of cultural significance and may erect memorials associated with the grave referred to in subsection (1), and must maintain such memorials.

(3) No person may, without a permit issued by SAHRA or a provincial heritage resources authority-

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)(a) unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant and in accordance with any regulations made by the responsible heritage resources authority.

The National Heritage Resources Act (Act no 25 of 1999) stipulates the assessment criteria and grading of archaeological sites. The following categories are distinguished in Section 7 of the Act:

- **Grade I**: Heritage resources with qualities so exceptional that they are of special national significance;
- **Grade II**: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
- **Grade III**: Other heritage resources worthy of conservation, and which prescribes heritage resources assessment criteria, consistent with the criteria set out in section 3(3), which must be used by a heritage resources authority or a local authority to assess the intrinsic, comparative and contextual significance of a heritage resource and the relative benefits and costs of its protection, so that the appropriate level of grading of the resource and the consequent responsibility for its management may be allocated in terms of section 8.

Presenting archaeological sites as part of tourism attraction requires, in terms 44 of the Act, a Conservation Management Plan as well as a permit from SAHRA.

(1) Heritage resources authorities and local authorities must, wherever appropriate, co-ordinate and promote the presentation and use of places of cultural significance and heritage resources which form part of the national estate and for which they are responsible in terms of section 5 for public enjoyment, education. research and tourism, including-

(a) the erection of explanatory plaques and interpretive facilities, including interpretive centres and visitor facilities;
(b) the training and provision of guides;
(c) the mounting of exhibitions;
(d) the erection of memorials; and
(e) any other means necessary for the effective presentation of the national estate.

(2) Where a heritage resource which is formally protected in terms of Part I of this Chapter is to be presented, the person wishing to undertake such presentation must, at least 60 days prior to the institution of interpretive measures or manufacture of associated material, consult with the heritage resources authority which is responsible for the protection of such heritage resource regarding the contents of interpretive material or programmes.

(3) A person may only erect a plaque or other permanent display or structure associated with such presentation in the vicinity of a place protected in terms of this Act in consultation with the heritage resources authority responsible for the protection of the place.

APPENDIX 3. SPECIALIST COMPETENCY

Johan (Johnny) van Schalkwyk

J A van Schalkwyk, D Litt et Phil, heritage consultant, has been working in the field of heritage management for more than 30 years. Based at the National Museum of Cultural History, Pretoria, he has actively done research in the fields of anthropology, archaeology, museology, tourism and impact assessment. This work was done in Limpopo Province, Gauteng, Mpumalanga, North West Province, Eastern Cape, Northern Cape, Botswana, Zimbabwe, Malawi, Lesotho and Swaziland. Based on this work, he has curated various exhibitions at different museums and has published more than 60 papers, many in scientifically accredited journals. During this period he has done more than 2000 impact assessments (archaeological, anthropological, historical and social) for various government departments and developers. Projects include environmental management frameworks, road-, pipeline-, and power line developments, dams, mining, water purification works, historical landscapes, refuse dumps and urban developments.

PALEONTOLOGICAL IMPACT ASSESSMENT

Palaeontological Impact Assessment for the proposed Witfield Stormwater Management project, Gauteng Province.

Desktop Study

For

Delta Built Environment Consultants

07 June 2016

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Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 20 year PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Delta Built Environment Consultants. The views expressed in this report are entirely those of the author and Delta and no other interest was displayed during the decision making process for the project.

Specialist: …….. Prof Marion Bamford……..

Signature: …… 

Executive Summary

The desktop Palaeontological Impact Assessment for the proposed stormwater management project in the suburb Witfield, southwest of OR Tambo International Airport, Gauteng Province, concludes that there is very little likelihood of any fossils of scientific interest being found during the excavation for stormwater drainage because the rocks are mostly much too old to contain any fossils. There are some outcrops of Dwyka Group and Vryheid Formation that could possibly contain plant fossils but as the surface has been highly disturbed by the urban development, and further by the periodic flooding, the likely hood of finding fossils of any scientific value is extremely small. If however fossils are found once excavation has begun then a palaeontologist should be called to assess their value and make a representative collection.

Palaeontological Impact Assessment for the proposed Witfield Stormwater Management project, Gauteng Province

1. Background

Delta Built Environment Consultants was appointed by Ekurhuleni Metropolitan Municipality (EMM) for the design, EIA, procurement, and construction supervision in order to improve the current stormwater management in the Witfield area.
According to the Preliminary Design Report compiled by Messrs Bigen Africa, the houses located in the Witfield area are prone to flooding. A preliminary design report was compiled with proposals to mitigate the effects of the flooding, as well as cost estimates for the different designs. The report further states that that houses were permitted to be built over an existing stormwater culvert, which subsequently resulted in flooding.
The Witfield Dam is located towards the south east of the drainage area and currently the aim is to reroute all the stormwater into the dam to serve as an attenuation facility."

There are three options for the routes and dams for this project but they are all within the same space in the suburb.

The National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) requires that the proposed development must be preceded by the relevant impact assessment, in this case for palaeontology. SAHRA has requested a desktop palaeontological assessment Case ID: 9540

This report complies with the requirements of the NEMA and environmental impact assessment (EIA) regulations (GNR 982 of 2014). The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table 1.1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014)

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:	**Relevant section in report**
Details of the specialist who prepared the report	Prof Marion Bamford
The expertise of that person to compile a specialist report including a curriculum vitae	Palaeontologist (PhD Wits 1990) CV attached
A declaration that the person is independent in a form as may be specified by the competent authority	Page 2
An indication of the scope of, and the purpose for which, the report was prepared	Section 1
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	n/a Seasons make no difference to buried coals
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	See table 2
An identification of any areas to be avoided, including buffers	n/a
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be	n/a

avoided, including buffers;	
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 6
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	n/a
Any mitigation measures for inclusion in the EMPr	Section 8
Any conditions for inclusion in the environmental authorisation	Section 8
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and	Section 7
If the opinion is that the proposed activity 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 7
A description of any consultation process that was undertaken during the course of carrying out the study	n/a
A summary and copies if any comments that were received during any consultation process	n/a
Any other information requested by the competent authority.	n/a

2. Methods and Terms of Reference

1. In order to determine the likelihood of fossils occurring in the affected area geological maps, literature, palaeontological databases and published and unpublished records must be consulted.

2. If fossils are likely to occur then a site visit must be made by a qualified palaeontologist to locate and assess the fossils and their importance.

Figure 1.1: Locality of proposed stormwater drainage project in Witfield, Gauteng Province. Map provided by Delta.

3. Unique or rare fossils should either be collected (with the relevant South African Heritage Resources Agency (SAHRA) permit) and removed to a suitable storage and curation facility, for example a Museum or University palaeontology department or protected on site.

4. Common fossils can be sacrificed if they are of minimal or no scientific importance but a representative collection could be made if deemed necessary.

The published geological and palaeontological literature, unpublished records of fossil sites, catalogues and reports housed in the Evolutionary Studies Institute, University of the Witwatersrand, and SAHRA databases were consulted to determine if there are any records of fossils from the sites and the likelihood of any fossils occurring there.

3. Consultation Process

No consultations were carried out during the desktop study. Apart from reviewing interested and/or affected party (IAP) comments received by the EIA consultant during the EIA process, no other consultation took place as part of the paleontological study.

4. Geology and Palaeontology

<u>Project location and geological setting</u>

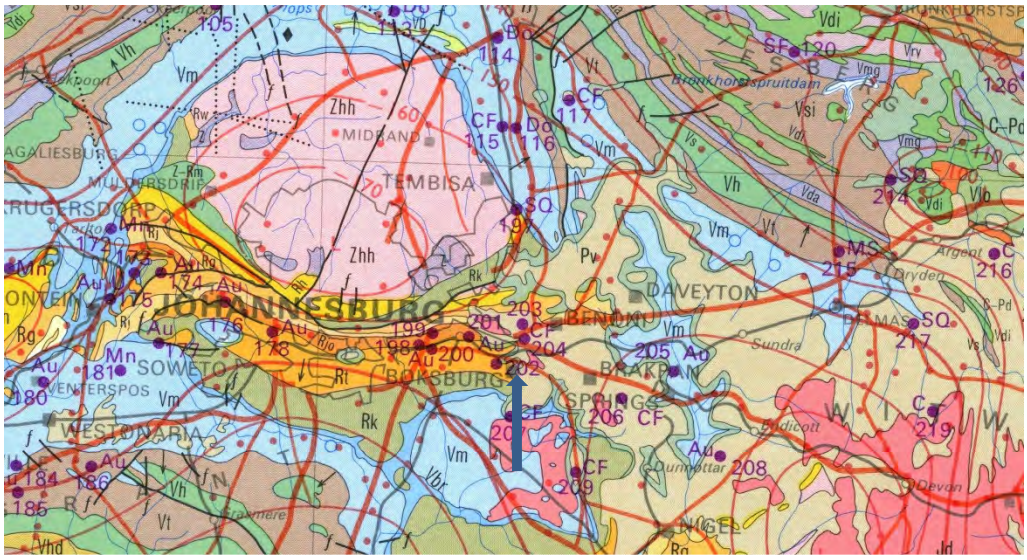

Figure 1.2 Geological map of the area around the proposed stormwater management project, Witfield.. The approximate location of the proposed project is indicated with the

arrow. Abbreviations of the rock types are explained in Table 1. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Symbol	Group/Formation	Lithology	Approximate Age
Pv	Vryheid Formation	Shales, sandstone, coal	Lower Permian, Middle Ecca
C-Pd	Dwyka Group	Tillite, sandstone, mudstone, shale	Upper Carboniferous to Lower Permian
Vm	Malmani subgroup, Chuniespoort Group	Dolomite, chert	2640 – 2500 Ma
Vbr	Black Reef Formation	Quartzite, conglomerate, shale, basalt	Ca 2650 Ma
Rk	Klipriviersberg Group, Ventersdorp Supergroup	Andesite, tuff	2714 Ma
Rt	Turffontein subgroup, Central Rand Group	Conglomerate, quartzite	
Rjo	Johannesburg subgroup, Central Rand Group, Witwatersrand Basin	Quartzite, conglomerate, shale	3074 Ma
Rj	Jeppestown subgroup, Central Rand Group	Shale, quartzite, shale, lava	>3074 Ma

Table 1: Explanation of symbols for the geological map and approximate ages (McCarthy, 2006; Johnson et al., 2006; Snyman, 1998).

Geology

Most of the rocks in the area are very old, ranging from those of the Central Rand Group (Witwatersrand Basin), i.e. the Jeppestown, Johannesburg and Turffontein Subgroups, which are more than 3000 million years old and too old for invertebrate, vertebrate or plant fossils. Algae and bacteria were present at this stage but these rocks have been metamorphosed and do not preserve fossils. The slightly younger rocks of the Ventersdorp and Chuniespoort Groups are too old for fossils. Some marginal outcrops of the Main Karoo Basin occur to the east, the Dwyka Group and Vryheid Formation which are young enough to contain fossil plants of the Glossopteris flora but too old for vertebrate fossils.

Palaeontology

Fossil plants are very rarely preserved in the shales of the Dwyka Group and can be common in the shales of the Vryheid Formation, however they can be very sporadic. The previous development in this urban area would have destroyed any surface fossils. Furthermore, the periodic flooding would have destroyed any surface or below surface fossils.

The SAHRIS palaeosensitivity map for the site indicates red (very sensitive and very high probability of fossils occurring there), orange (high probability), green (moderate) and grey (insignificant to zero). There are, however, no records of fossils plants from this area. There is no record of coal or clays where fossils may be preserved (Snyman, 1998; Bredell, 1979).

5. Impact assessment

The surface activities would not impact on the fossil heritage as any fossils would have been destroyed when the area was first developed and by the flooding. The impact is nil.

Once excavation for the drainage infrastructure start there would be minor deterioration of the site and no impact on people. Therefore the SEVERITY/NATURE of the environmental impact would be L (according to the scheme in Table 2.

DURATION of the impact would be permanent: L.

Since only the possible fossils within the stormwater drainage will be affected the SPATIAL SCALE will be localised within the site boundary: L.

There is a very small chance of finding fossils on the surface or below the surface. However, the PROBABILITY of affecting any fossils is unlikely or seldom: L

TABLE 2: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

6. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the shales are typical of other deposits in the Karoo Basin, so no fossil animals will occur there. Coal is made from fossil plants but compressed and altered to such an extent that the original plant material is unrecognizable. Fossil plants may be associated with the adjacent shales and shale lenses but are assumed to be the same as other coal deposits and therefore very common. Until the coal seams and shales are exposed and examined this remains an uncertainty, but a minor one. The same applies for any shales or clay deposits.

7. Recommendation

While it is possible that plant fossils occur in the proposed stormwater drainage or infrastructure area they will not be detected until excavations begin. A site visit is therefore not feasible until such stage.

If fossil plant material is discovered during the excavations, then it is strongly recommended that a professional palaeontologist, preferably a palaeobotanist, be called to assess the importance and to rescue them if necessary (with the relevant SAHRA permit).

If the fossil material is deemed to be of scientific interest then further visits by a professional palaeontologist would be required to collect more material.

As far as the palaeontology is concerned the proposed development can go ahead. Any further palaeontological assessment would only be required after excavations have commenced and if fossils are found by the engineer or environmental personnel.

1. References

Bredell, J.H., 1979. The nature and distribution of the Karoo Sequence on the East and West Rand with special reference to refractory clay deposits. Geokongress 77: geological Society of Southern Africa Special Publications 6, 151-160.

Erikssen, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. pp 237-260.

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Snyman, C.P., 1998. Coal. In: Wilson, M.G.C., and Anhaeusser, C.P., (Eds). The Mineral Resources of South Africa: Handbook, Council for Geosciences 16, 136-205.

MKB – 07 June 2016