STEVE TSHWETE LOCAL MUNICIPALITY

The Proposed Township Development on Portion 341 of the Remainder of Portion 27 of the Farm Middelburg Town & Townsland 387 JS

Updated Wetland Assessment Report

Issue Date: 30th October 2019
Revision No.: 3.0
Project No.: 15034

SPECIALIST REPORT DETAILS

This report has been prepared as per the requirements of Section 13 of Government Notice No. R. 982 dated 4 December 2014 (Environmental Impact Assessment Regulations) under sections 24(5), 24M and 44 of the National Environmental Management Act, 1998 (Act 107 of 1998).

I, **Stephen Burton** declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Economic Development, Tourism, and Environmental Affairs (EDTEA).

Signed: Date: 30/10/2019

Date:	30 October 2019
Document Title:	Updated Wetland Assessment Report for the Proposed Township Development on Portion 341 of the Remainder of Portion 27 of the Farm Middelburg Town and Townsland 387 JS
Authors:	Shaun Taylor & Stephen Burton
Revision Number:	# 3.0
Checked by:	Tarryn Curtis
Approved:	Stephen Burton *Pr.Sci.Nat.*
Signature:	
For:	**STEVE TSHWETE LOCAL MUNICIPALITY**

Confidentiality Statement

STEVE TSHWETE LOCAL MUNICIPALITY

THE PROPOSED TOWNSHIP DEVELOPMENT ON PORTION 341 OF THE REMAINDER OF PORTION 27 OF THE FARM MIDDELBURG TOWN & TOWNSLAND 387 JS

UPDATED WETLAND ASSESSMENT REPORT

Contents Page

List of Tables

List of Figures

List of Plates

STEVE TSHWETE LOCAL MUNICIPALITY

THE PROPOSED TOWNSHIP DEVELOPMENT ON PORTION 341 OF THE REMAINDER OF PORTION 27 OF THE FARM MIDDELBURG TOWN & TOWNSLAND 387 JS

UPDATED WETLAND ASSESSMENT REPORT

1 INTRODUCTION

SiVEST have been appointed by the Steve Tshwete Local Municipality (STLM) to undertake a wetland delineation and impact assessment for the proposed development of a township on the Portion 341 of the remainder of Portion 27 of the Farm Middelburg Town and Townsland 387 JS (hereafter referred to as the “proposed development”). The proposed development is to consist of 624 stands covering the study site of approximately 101 hectares. As part of the broader environmental authorisation process that is to be undertaken, the requirement to undertake a wetlands study has been identified. Accordingly, this study has been conducted to identify all wetlands and potential wetland related impacts and issues in the context of the proposed development. In particular, the study aims to identify potential impacts and issues on the identified wetlands that are specifically related to the construction and operation phases of the proposed development. Detected wetlands that may potentially be impacted on by the proposed development were earmarked as areas of high sensitivity. Recommendations are made with respect to the preferred placement of the proposed development in areas that are anticipated to have the least severe impact on any wetlands identified in the study area.

The original assessments were undertaken in 2011. The amendment report aims to update the *status quo* of the wetlands on site. A review and revision of the site is necessary as the previous study occurred approximately seven years ago, therefore the latest applicable legislation, as well as the condition of the site needs to be updated.

1.1 Wetlands and Hydromorphic Soils

Wetlands are a very important component of the natural environment. Wetlands are typically characterised by high levels of biodiversity and are critical for the sustaining of human livelihoods through the provision of water for drinking and other human uses. Wetlands are sensitive features of the natural environment, and pollution or degradation of surface water can result in a loss of biodiversity, as well as an adverse impact on the human users which depend on the resource to sustain their livelihoods. As such, wetlands are specifically protected under the National Water Act, 1998 (Act No. 36 of 1998) and generally under the National Environmental Management Act, 1998 (Act No. 107 of 1998). This is expanded on in the sections ahead.

Hydric soils, which are soils that are found within wetlands, are defined by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) as being, "soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part". These anaerobic conditions would typically support the growth of hydromorphic vegetation (vegetation adapted to grow in soils that are saturated and starved of oxygen) and are typified by the presence of redoximorphic features (see section 3 for definition). The presence of hydric (wetland) soils on the site of a proposed development is significant, as the alteration or destruction of these areas, or development within a certain radius of these areas would require authorisation in terms of the National Water Act 36 of 1998 (NWA) and in terms of the Environmental Impact Assessment Regulations promulgated under the National Environmental Management Act, 1998 Act No. 107 of 1998 (NEMA).

1.2 Aims of the Study

The primary aims of this study are to:

- identify all wetlands that may potentially be affected by the proposed development and associated infrastructure;
- assess the potential impacts of the proposed development on wetlands along the study site;
- to recommend mitigation and remediation measures that need to be taken where relevant;
- recommend preferred placement of the proposed development, where relevant.

1.3 Legislative Context

The National Water Act, 1998 Act No. 36 of 1998 (NWA) was created in order to ensure the protection and sustainable use of water resources in South Africa. The NWA recognises that the ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users. Bearing these principles in mind, there are a number of stipulations within the NWA that are relevant to the potential impacts on wetlands that may be associated with the proposed development. These stipulations are explored below and are discussed in the context of the proposed development.

Firstly, it is important to discuss the type of surface water resources protected under the NWA. Under the NWA, a 'water resource' includes a watercourse, surface water, estuary, or aquifer. Specifically, a watercourse is defined as (inter alia):

- 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.

In this context, it is important to note that reference to a watercourse includes, where relevant, its bed and banks. Furthermore, it is important to note that water resources, including wetlands, are protected under the NWA. 'Protection' of a water resource, as defined in the NWA entails the:

- Maintenance of the quality and the quality of the water resource to the extent that the water use may be used in a sustainable way;
- Prevention of degradation of the water resource;
- Rehabilitation of the water resource.

In the context of the proposed development and the identification of potential impacts on wetlands in the construction, operation phase of the proposed development, the definition of pollution and pollution prevention contained within the NWA is relevant. 'Pollution', as described by the NWA, is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (inter alia):

- less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

The inclusion of physical properties of a water resource within the definition of pollution entails that any physical alterations to a water body, for example the excavation of a wetland or changes to the morphology of a water body can be considered to be pollution. Activities which cause alteration of the biological properties of a watercourse, i.e. the fauna and flora contained within that watercourse are also considered pollution.

In terms of section 19 of the NWA, owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include measures to (*inter alia*):

- cease, modify, or control any act or process causing the pollution
- comply with any prescribed waste standard or management practice
- contain or prevent the movement of pollutants
- remedy the effects of the pollution; and
- remedy the effects of any disturbance to the bed and banks of a watercourse

Lastly, under section 21 of the NWA, 'water use' is defined *inter alia*, as:
(a) taking water from a water resource;
(c) impeding or diverting the flow of water in a watercourse;
(i) altering the bed, banks, course or characteristics of a watercourse.

If the above activities occur as part of the construction, operation of the proposed development they will need to be licensed in accordance with the NWA.

The National Environmental Management Act 107 of 1998 (NEMA) was created essentially to establish principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of the state to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment. Furthermore, it is stipulated in NEMA *inter alia* that everyone has the right to an environment that is not harmful to his or her health or well-being and everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that; prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Accordingly, several of the principles of NEMA contained in Chapter 1 Section 2, as applicable to wetlands, stipulate that:

- Development must be socially, environmentally and economically sustainable;
- Sustainable development requires the consideration of all relevant factors including the following:
    - That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
    - That pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied.
    - That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.
- The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, *wetlands, and similar systems* require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

In line with the above, Chapter 5 further elaborates on the application of appropriate environmental management tools in order to ensure the integrated environmental management of activities. In other words, this chapter of NEMA addresses the tools that must be utilised for effective environmental management and practice. Under these auspices, the Environmental Impact Regulations were devised in order to give effect to the objectives of NEMA. Subsequently, activities were defined in a series of listing notices for various development activities. Should any of these activities be triggered, an application for environmental authorisation is to be applied for. Fundamentally, applications are to be applied for so that any potential impacts on the environment in terms of the listed activities are considered, investigated, assessed and reported on to the competent authority charged with granting the relevant environmental authorisation. Under Section 24F of the same chapter, NEMA states that no person may commence an activity listed unless the competent authority has granted an environmental authorisation for the activity. Where such activities are undertaken without attaining the necessary authorisation, a person convicted of an offence may be liable to a fine not exceeding R5 million or to imprisonment for a period not exceeding ten years, or to both.

The above stipulations of the NWA and NEMA have implications for the proposed development in the context of wetlands. Accordingly, the potential impacts of the proposed development on wetlands have been scoped and identified in this report.

2 STUDY AREA DESCRIPTION

The study site is located within the town of Middelburg, which is situated in the Mpumalanga province of South Africa. The site can generally be accessed from the N4 highway, along the R35 leading onto Dr. Mandela Drive (formerly known as Tafelberg Drive). The greater study area lies to the west of the Mpumalanga province situated predominantly on the highveld. The Grassland biome covers much of the Mpumalanga province. More specifically, however, the study area fits into the Eastern Highveld Grassland, which subsequently falls within the Mesic Highveld Grassland bioregion (Mucina & Rutherford, 2006). The particular vegetation unit for this area is described as containing short dense grassland dominated by the usual Highveld grass composition and small scattered rocky outcrops with wiry sour grasses and some woody species (Mucina & Rutherford, 2006). The climate generally exhibits strongly seasonal summer rainfall (Mean Annual Precipitation of 650-900mm – overall average of 726mm), with very dry winters (Mucina & Rutherford, 2006).

The topography of the specific study site is characterised by an undulating plain. The terrain generally slopes towards the west and the plain descends somewhat gently into a shallow valley bottom. Here, a non-perennial stream can be observed. The altitudinal range is approximately between 1515-1545metres above sea level (m.a.s.l.). As described above, grassland covers much of the site. Virtually no trees (barring several exotics in the north eastern corner) can be found. Ferricrete extrusions are prominent to the east of the study area, located in the higher areas of the plains as well as near the valley bottom stream in the northern western most corner of the site (Photo 1).

Photo 1: Typical ferricrete extrusion on the study site.

2.1 Drainage Context

The proposed development site is situated next to a small non-perennial stream which runs to the north. This stream is a tributary of the Klein-Olifants River. The stream eventually meets with the Klein-Olifants River some 6km to the north. Several man-made impoundments obstruct the course of the tributary leading to the Klein-Ollifants River. The study site is contained within the Olifants (North) primary catchment, which ultimately drains to the east of South Africa. More specifically, it can be found in the Quarternary Catchment B12D. The soil of the broader study area generally expresses red to yellow sandy soils found on shales and sandstone of the Madzaringwe Formation (Mucina & Rutherford, 2006). Figure 1 illustrates the locality and general drainage characteristics of the greater study area.

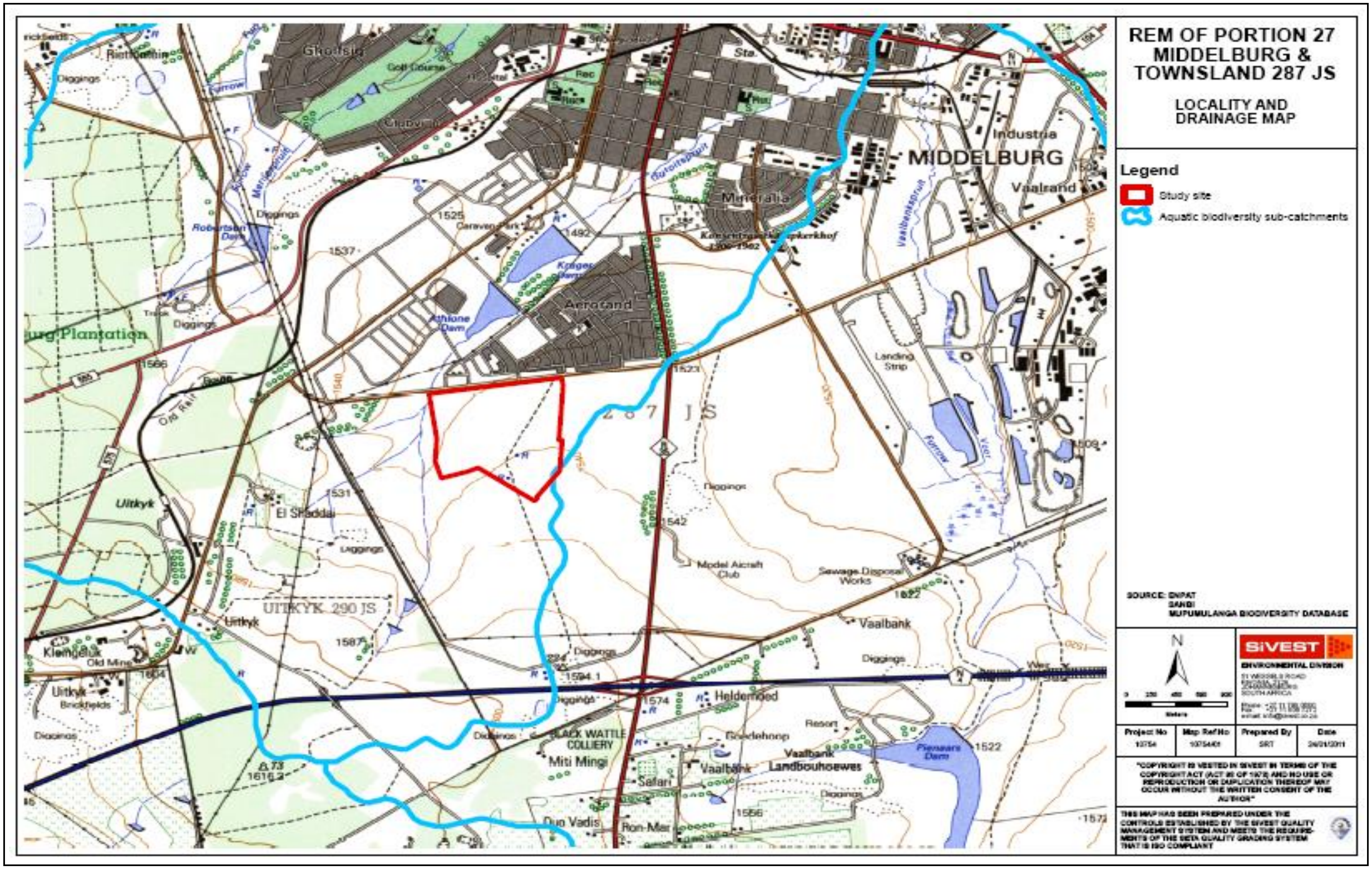

Figure 1: Locality map and drainage characteristics of the study site and the broader study area.

3 METHODOLOGY

3.1 Desktop Delineation of Wetlands

The first step in the wetland assessment and delineation process was to identify at a desktop level any potential wetland areas using various information sources. This was undertaken using Geographic Information Software (GIS). The collection of data source information included the ENPAT (Biobase Mpumulanga), Mpumalanga Biodiversity Plan and the SANBI (RSA Wetlands 2010) databases. The use of Google Earth™ imagery and aerial photography (dated 2004) supplemented these data sources.

Utilising these resources, wetlands identified according to the databases were mapped and highlighted for the in-field phase of the assessment. The supplementary use of aerial photography and satellite imagery allowed other potentially overlooked wetland areas, not contained within the above mentioned databases, to be identified and verified in the field work phase. On aerial photography, wetland vegetation appears as a different hue (often being darker in colour) than the grassy vegetation in the surrounding terrestrial areas, thus allowing wetland vegetation to be demarcated. The occurrence of wetland vegetation as apparent on the images was initially used to mark the boundaries of the wetlands.

On colour (Google Earth™) satellite imagery, soil colour is able to be used as a further means of delineating wetland boundaries through remote sensing, especially where agricultural activities have transformed the natural vegetation within the wetlands and within the surrounding wetland catchment. For example, wetland soil colours are often ‘greyer’ in hue, reflecting the gleyed soils that typically occur within wetlands. These can be differentiated from the orange / brown / yellow more oxidised non-wetland soils that exist outside of the wetland.

3.2 Field-based Wetland Delineation and Assessment Techniques

Wetland delineations are based primarily on soil wetness indicators. For an area to be considered a wetland, redoximorphic features must be present within 50cm of the surface soil profile (Collins, 2005). Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils alternate between aerobic (oxygenated) and anaerobic (oxygenless) conditions. Only once soils within 50cm of the surface display these redoximorphic features, can the soils be considered ‘hydric soils’. Redoximorphic features typically occur in three types (Collins, 2005):

- A reduced matrix – i.e. an in situ low chroma (soil colour), resulting from the absence of Fe^{3+} ions which are characterised by “grey” colours of the soil matrix.
- Redox depletions - the “grey” (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur.

- Redox concentrations - Accumulation of iron and manganese oxides (also called mottles). These can occur as:

i) Concretions - harder, regular shaped bodies

ii) Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours

iii) Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

The potential occurrence / non-occurrence of wetlands and wetland (hydric) soils on the study site have been assessed according to the DWAF (2005) guidelines, “A practical field procedure for the identification and delineation of wetlands and riparian areas”. According to the DWAF guidelines, soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence. This is mainly due to the fact that soil wetness indicators remain in wetland soils, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 50cm of the soil profile alone is sufficient to identify the soil as being hydric or non-hydric (non-wetland soil) (Collins, 2005). Three other indicators (vegetation, soil form and terrain unit) are used in combination with soil wetness indicators to supplement findings. Where soil wetness and/or soil form could not be identified, information and personal professional judgment was exercised using the other indicators to determine what area would represent the outer edge of the wetland.

Importantly, it must be recognised that there are normally three zones to every wetland including the permanent zone, seasonal zone and the temporary zone. Each zone is based on the degree that each zone reflects the duration of inundation in the soils. The permanent zone usually reflects soils that indicate inundation cycles that last more or less throughout the year, whilst the seasonal zone may only reflect soils that indicate inundation cycles for a significant period during the rainy season. Lastly, the temporary zone reflects soils that indicate the shortest period(s) of inundation that are long enough, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation (DWAF, 2005).

The actual delineation process entailed drawing soil samples, using a soil augur, at depths between 0.5 to 1.5metres in the soil profile. This was done in order to determine the location of the outer edge of the temporary zone. The outer edge of the temporary zone will usually constitute the full extent of the wetland, thereby encompassing any other inner lying zones that are saturated for longer periods. The appropriate soil form was also of interest and determined for each zone of the wetland. Points are then recorded at these locations for an approximate length of 10metres depending on the topography along the length of the wetland for each identified wetland zone. A conventional handheld Global Positioning System (GPS) was used to record the points taken in the field. The GPS points were then imported into a GIS system to map the identified zones. The GPS is expected to be accurate up to 5 metres. A GIS shapefile was created to represent the boundaries of the delineated wetlands.

Depending on the type of land use or development proposed, an appropriate buffer zone to protect the wetland should also be delineated (DWAF, 2005). Buffer zones are typically required to ensure that the ecotones between aquatic and terrestrial landscapes are protected. Ecotones are ecologically significant, especially for species that utilise these contrasting habitats for different stages of their lifecycle (for example, Bull Frogs). Hence, buffer zones are necessary where developments involve the transformation of land from the prevailing natural condition. At present, however, there are no official requirements for buffer zones in the Mpumalanga province. However, there are guidelines for the Gauteng province which necessitate the implementation of buffer zones (GDACE, 2009). In the case of the proposed development, considering the nature and footprint of the proposed development as well as the types of issues and impacts anticipated (assessed in later sections of the study), a buffer zone of 30metres is applied.

4 FINDINGS OF ASSESSMENT

4.1 Desktop Delineated Wetlands

Figure 2 depicts the occurrence of wetlands for the greater study area as per information drawn from the various databases. According to the databases, the RSA wetlands database (2010) only identifies two wetland areas around the study area. This includes the Athlone Dam, which is viewed as a channeled valley bottom wetland, and an area of wetland located southwards along the non-perennial stream, which is viewed as a hillslope seepage wetland. The two wetlands are hydrologically connected by a non-perennial stream. Importantly, the study site is situated within an area classified as ‘irreplaceable’ in terms of aquatic biodiversity sub-catchments.

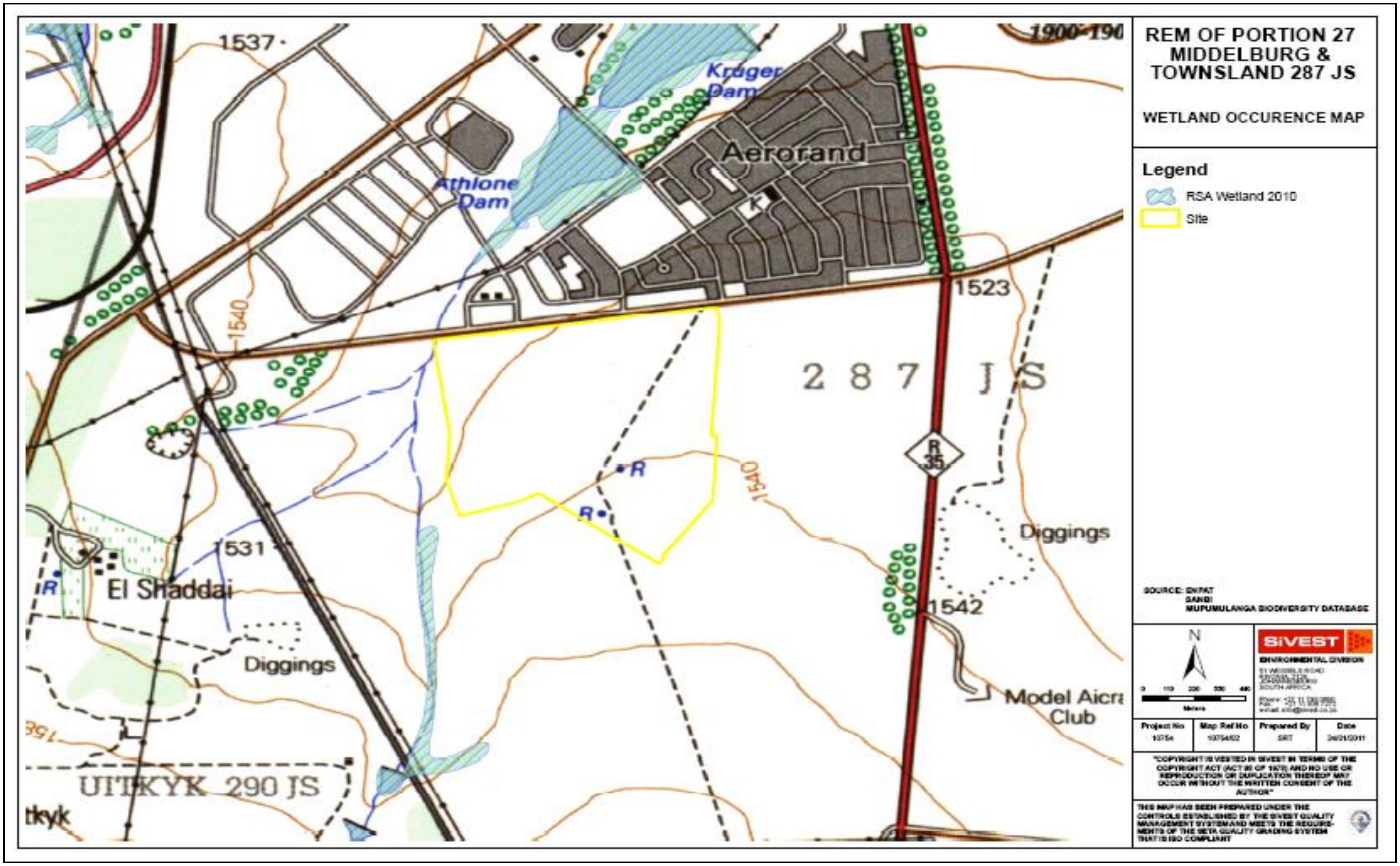

Figure 2: Wetland occurrence as per desktop information on the study site.

Figure 3 illustrates the delineation of the potential wetland areas on the study site using a Google image overlay. Using remote sensing techniques, several potential wetland areas were apparent and accordingly delineated. This, of course, was conducted in conjunction with the information drawn from the databases as well. As such, the desktop delineation exercise revealed three different potential wetland areas. The larger of the desktop delineated wetlands is located along the length of the non-perennial stream in the valley, to the west of the site. The two other potential wetland areas are located higher in the landscape and seem to represent depression wetlands but do not appear to be directly hydrologically connected.

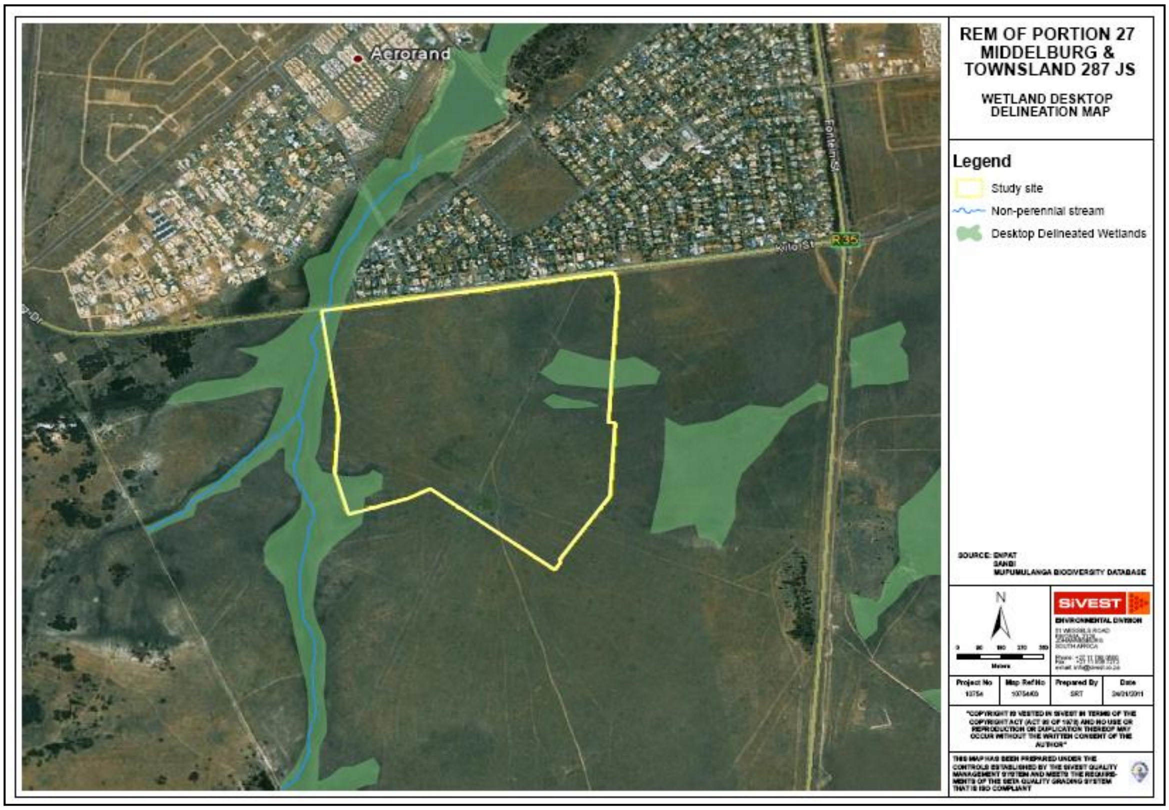

Figure 3: Desktop wetland delineation using Google image of the study site.

4.2 Field-assessed Wetlands

4.2.1 Wetland Terrain and Soils

In accordance with the DWAF (2005) methodology, detailed wetland delineations were conducted taking into account all indicators. Figure 4 provides a conceptual illustration of the sub-surface soil profile for the study site. The illustration depicts an undulating plain descending into a shallow valley bottom representing the essential terrain and topography of the study site. The subsoils of the terrain are dominated by a hard layer of ferricrete (hard plinthic horizon) near the crest of the undulating plain. The ferricrete then subsides along the length of the mid-slopes and protrudes once again at the valley bottom near the non-perennial stream. Overlying the ferricrete, a layer of hillwash gravel can be found underneath another layer of sandy loam sub-soil. The ferricrete abruptly ends in the valley bottom which is then dominated by a sandy clay substrate. The water table at the time, the field assessment was undertaken, was relatively high. This is indicated in the illustration below. The non-perennial stream is located at the valley bottom.

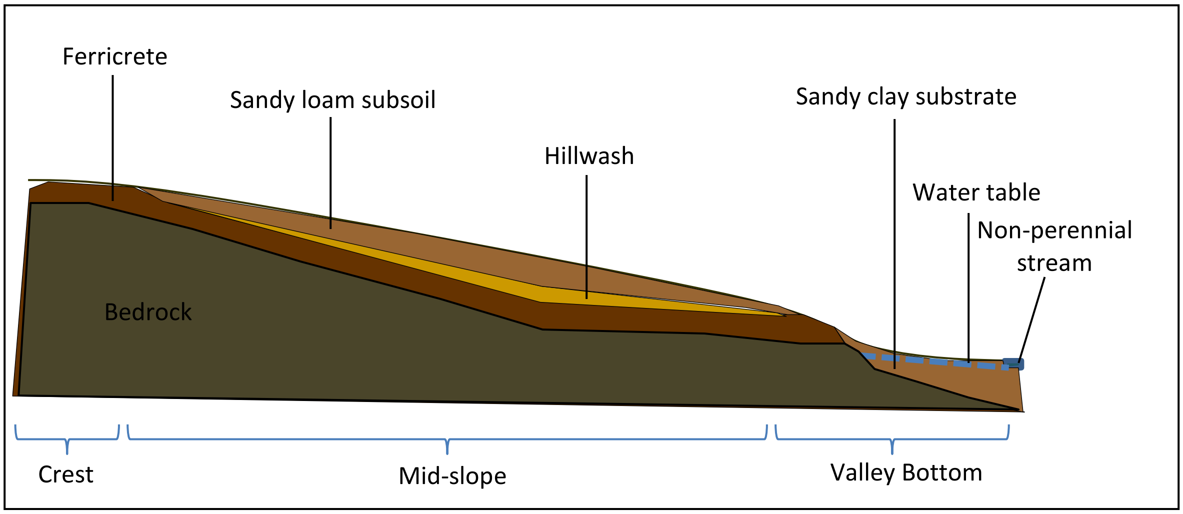

Figure 4: Conceptual illustration of sub-surface profile of the study area

Overall, a total of five wetlands were identified on the study site. These wetlands can be classed into three different wetland types based on the position in the landscape. At the crest of the undulating plain, two grassland *depression wetlands* were identified. In the mid-slope, linking into the valley bottom, *two grassland/marsh hillslope seepage wetlands* were identified. Finally, a predominantly *un-channelled grassland/marsh valley bottom wetland* was identified at the foot of the plain. Each wetland, as delineated with the associated buffers, are illustrated in Figure 6 below. The types of soil horizons encountered for each wetland varies based on the location of the wetland in the landscape.

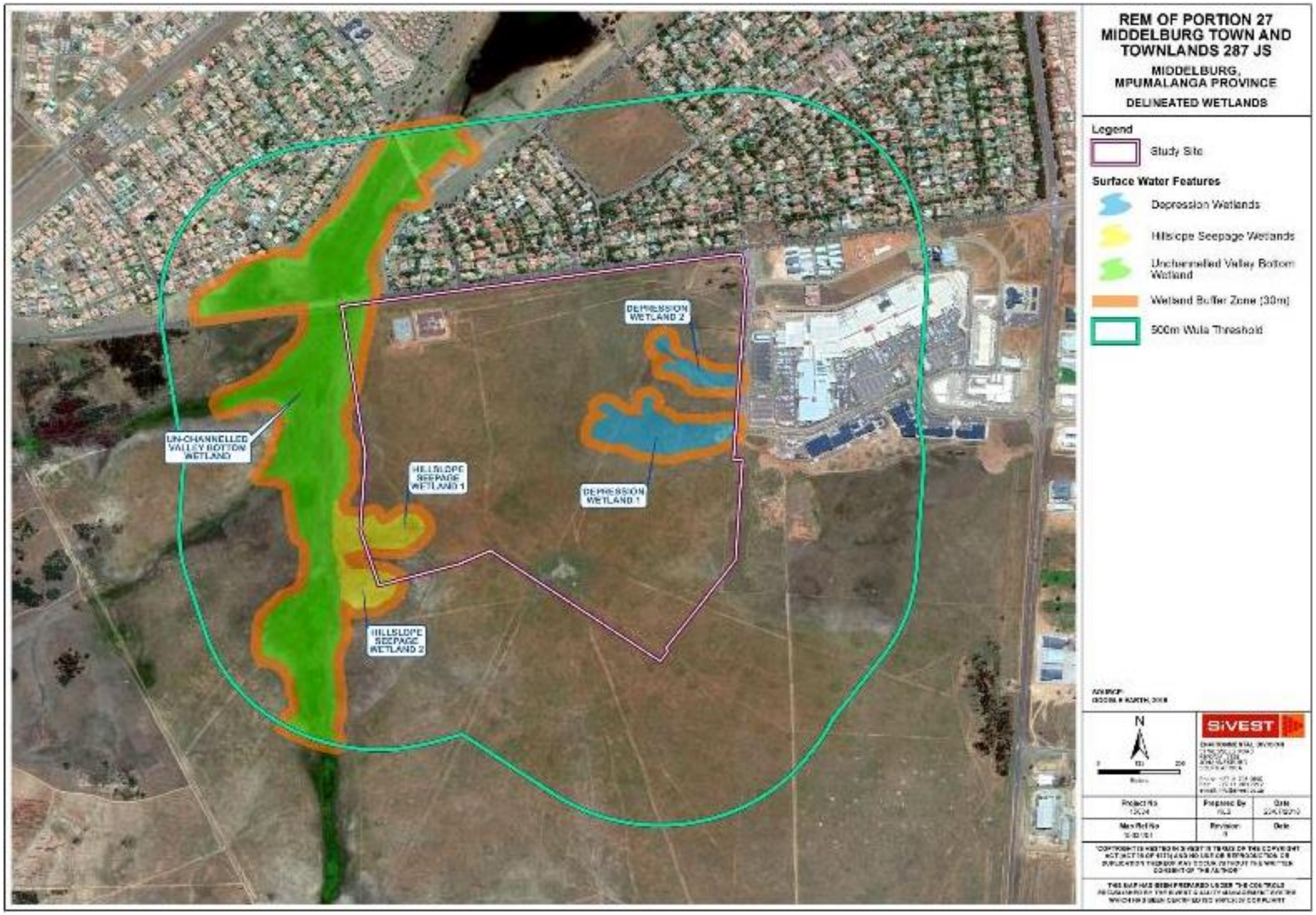

Figure 5: Wetland delineation of the study site with associated buffer zones.

The soil profile of the two depression wetlands identified at the crest of the study site typically consist of a thin (approximately 50cm) yellow-brown apedal B horizon or a soft plinthic B horizon (Photo 2) beneath a very thin (roughly between 5-10cm) orthic A horizon. Where the yellow-brown apedal B is found, it is directly underlain by the soft plinthic B horizon. The soft plinthic B horizon essentially represents the temporary and seasonal zones of the wetlands. Mottling is present in this layer of soil. Accordingly, the B horizon is underlain by a hard plinthic horizon for an indeterminable depth. The soil augur is not able to penetrate the hard plnthic horizon which therefore, meant a specific depth could not be established. However, it is assumed that this hard layer is in turn underlain by bedrock.

Over areas of the depression wetlands, outcrops of ferricrete were not uncommon (Photo 4). This also meant that water in the subsoil was often forced to the surface in areas of the wetlands (Photo 5). Importantly, it is not evident that the two depression wetlands are hydrologically interconnected despite being in close proximity. Connectivity may only be established during times of heavy precipitation. However, it must be stated that both wetlands continued off-site and may well be linked by the same hydrological source beyond the site boundary.

Based on the soil samples drawn and the consequent arrangement of the horizons, the soil form can be determined. The soft plinthic B horizon underlying the orthic A horizon suggests that the Westleigh soil form (Soil Classification Working Group, 1991) dominates the depression wetlands. However, where a yellow-brown apedal B horizon overlies the soft plinthic horizon suggests that the Avalon soil form prevails. Finally, the various areas of the wetlands where the orthic A horizon directly overlies the hard plinthic B horizon suggests that the Dresden soil form (Soil Classification Working Group, 1991) exists. Plate 1 contains photographic evidence of the sub-surface soils and other mentioned features of the depression wetlands encountered.

Photo 2: Yellow-brown apedal B horizon beneath the orthic A.

Photo 3: Distinct red chroma mottling in the soft plinthic B horizon of the depression wetlands.

Photo 4: Ferricrete or 'hard plinthic' horizon extruding from the depression wetland.	Photo 5: Water forced to the surface over the ferricrete. Note the "oily nature" of the water which is actually oxidised soluble iron seeping out the subsoils.
Plate 1: Photos of the sub-surface soil profile for the depression wetlands	

With respect to both the temporary and seasonal zones, the soils of the two hillslope seepage wetlands located in the mid-slopes as well as the un-channelled valley bottom wetland could be likened to the other two depression wetlands of the study site. These soils, however, could be associated more with the Westleigh soil form (Soil Classification Working Group, 1991), whereby an orthic A horizon overlies a soft plinthic B. The mottling pattern likewise showed similar results to the depression wetlands, although with a higher clay rather than sand content (Photo 6).

Importantly, it must be noted that the hillslope seepage wetlands are hydrologically linked to the un-channelled valley bottom wetland (Photo 7). Interestingly, despite indications that the valley bottom contained a stream from remote sensing data, upon observation the un-channelled valley bottom wetland did not appear to have a distinct channel. Rather, concentrated overland flow through the marsh/grassland vegetation of the wetland can explain the seasonal flow or indication of a stream. Flow through the predominantly un-channelled valley bottom wetland is expected to mainly be a result of sub-surface flows like many other structurally pristine wetlands. Plate 2 contains photographic evidence of the sub-surface soils and other mentioned features of the hillslope seepage and the un-channelled valley bottom wetlands encountered.

	
Photo 6: Representative mottling pattern of the seasonal zones of the hillslope seepage wetlands and the un-channelled valley bottom wetland.	Photo 7: Hillslope seepage wetland leading into the un-channelled valley bottom wetland of the undulating plain constituting the study site.

Plate 2: Photos of the sub-surface soil profile for the hillslope seepage wetlands and the un-channelled valley bottom wetland

4.2.2 Wetland Vegetation

All the wetlands types showed a degree of similarity in terms of overall vegetation composition. The permanent zones (predominantly of the valley bottom wetland) were generally dominated by *Typha capensis*, (Photo 8) followed by a relatively sharp transition to the seasonal zone by dense communities of sedge species (Photo 9-11). However, smaller communities of *T. capensis* could also be found in some of the seasonal zones of the wetlands. The vegetation of the seasonal zones (i.e. sedges) thereafter gradually decreased away into the temporary zone where grasses became more prominent before finally changing to terrestrial grassland species beyond the wetland zones of saturation. The temporary zones of the wetlands comprised mainly of *Trachypogon spicatus*, *Setaria sphacelata* var. *sphacelata*, *Tristachya leucothrix*, *Eragrostis racemosa*, *Eragrostis capensis* and *Agrostis lachnantha* which are all common, or at least associated, with wetland areas (Van Oudtshourn, 1999). Plate 3 contains photographic evidence of the vegetation of the depression, the hillslope seepage and the un-channelled valley bottom wetlands.

Plate 3: Photos of the vegetation identified within the wetlands of the study site

	
Photo 8: Community of *T. capensis* in hillslope seepage wetland 1.	Photo 9: Common sedge in the temporary/seasonal zone of the valley bottom wetland.
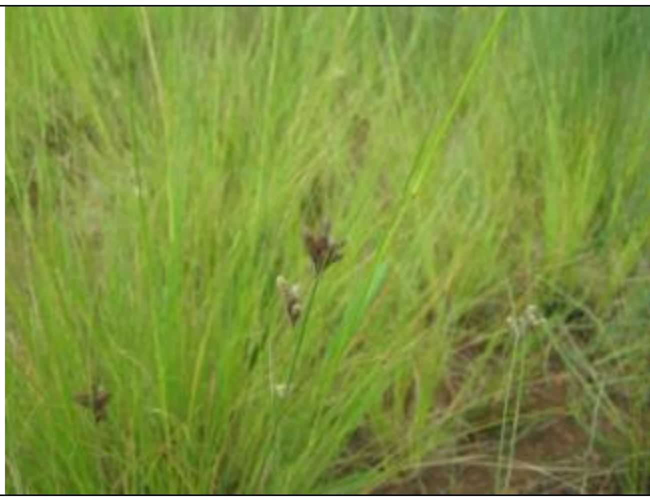	
Photo 10: Dominant sedge species of the seasonal/permanent zone found in all wetlands.	Photo 11: Less common sedge species. Only found in small communities in the temporary/seasonal zone.

4.3 Functionality of Wetlands Assessed (PES/EIS)

In order to predict the potential impacts that a particular activity will have on a wetland system, it is important to first obtain a clear understanding of the current baseline health of the affected wetland.

Thereafter, the effect of potential impacts i.e. the degree of change in a system, can be more scientifically and pragmatically assessed. A summary of the Present Ecological Status (PES) based on results from the WET-Health Tool is provided in Table 1 below.

Table 1: WET-Health Score

	MODULE				
Unit	**Hydrology Impact Score and Class**	**Geomorphology Impact Score and Class**	**Vegetation Impact Score and Class**	**Combined Impact Score**	**PES Category**
Valley Bottom Wetland	2.1 (C)	2.7 (C)	3.1 (C)	2.56	C (Moderately Modified)
Hillslope Seepage Wetland 1	3.1 (C)	2.5 (C)	3.4 (C)	3.01	C (Moderately Modified)
Hillslope Seepage Wetland 2	2.8 (C)	2.4(C)	3.2 (C)	2.80	C (Moderately Modified)
Depression Wetland 1	5.6 (D)	5.2 (D)	3.7 (C)	4.94	D (Largely Modified)
Depression Wetland 2	5.8 (D)	5.9 (D)	3.8 (C)	5.26	D (Largely Modified)

Several activities were noted to have been taking place in and around the study site. These encompass pastoral activities on the study site, as well as neighbouring development activities to the east. Other external influences affecting the study area include dumping of waste on the premises. Each has a relative individual effect and cumulative impact, when analysed in conjunction with other activities, on the state and functionality of the wetlands assessed.

An important current land use impact on the wetlands of the study site is the use of the property for cattle grazing (Photo 12). Typical impacts associated with cattle grazing can include over-grazing of the vegetation and physical degradation caused by trampling. Other indirect effects can include the onset of soil erosion caused by trampling resulting in the exposure of bare soil. Overall, however, the grazing and trampling impacts were not particularly severe at the time and have not resulted in major impacts.

Additional surrounding impacts that were observed to have affected the wetlands on site include excavations for various purposes by the neighbouring mall development to the east. More specifically, a stormwater outlet trench has been dug that has caused the formation of depression wetland 1 (Photo 13). Lastly, a cattle kraal (Photo 14) and a recently constructed substation (Photo 15) have been constructed on the study site with associated dirt access roads. Several traversing pipelines (Photo 16) and storm water outlets (Photo 17) can also be found. Plate 4 shows photographic evidence of the impacts affecting the wetlands and the study site in general. All listed impacts above are note particularly severe.

During the site visit, minimal faunal activity was noted, and the possibility of wetland faunal and avi-faunal species being present at different times of the day and season is probably limited. The confidence levels for the assessment were generally moderate. The EIS score, based on the **DWAF** (**1999**) scoring method, are summarised in **Table 2**, below.

Table 2: EIS Scores for the assessed wetland units

	HGM UNIT		**HGM UNIT**		**HGM UNIT**		**HGM UNIT**		**HGM UNIT**	
	Valley Bottom Wetland		Hillslope Seepage Wetland 1		Hillslope Seepage Wetland 2		Depression Wetland 1		Depression Wetland 2	
	Score	**Confidence**	**Score**	**Confidence**	**Score**	**Confidence**	**Score**	**Confidence**	**Score**	**Confidence**
PRIMARY DETERMINANTS										
1. Rare & Endangered Species	0	2	0	2	0	2	0	2	0	2
2. Populations of Unique Species	3	2	3	2	3	2	2	2	2	2
3. Species/taxon Richness	2	3	2	3	2	3	2	3	2	3
4. Diversity of Habitat Types or Features	2	3	2	3	2	3	2	3	2	3
5. Migration route/breeding and feeding site for wetland species	3	3	3	3	3	3	1	3	1	3
6. Sensitivity to Changes in the Natural Hydrological Regime	3	3	3	3	3	3	3	3	3	3
7. Sensitivity to Water Quality Changes	3	3	3	3	3	3	3	3	3	3
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	2	3	2	3	2	3	1	3	1	3
MODIFYING DETERMINANTS										
9. Protected Status	3	4	3	4	3	4	0	4	0	4
10. Ecological Integrity	**2**	**3**	**2**	**3**	**2**	**3**	1	3	1	3
TOTAL	**23**	**29**	**23**	**29**	**23**	**29**	**15**	**29**	**15**	**29**
MEDIAN	2.5	3	2.5	3	2.5	3	**1.5**	**3**	**1.5**	**3**
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**B**		**B**		**B**		**C**		**C**	

Plate 4: Photos of the impacts of the identified wetlands as well as the general study site

		
Photo 12: Grazed vegetation.	Photo 13: Stormwater trench that has caused depression wetland 1.	Photo 14: Cattle kraal located within the study site (south).
		
Photo 15: Substation on site.	Photo 16: Installed pipelines.	Photo 17: Storm water outlet.

5 POTENTIAL IMPACT OF PROPOSED DEVELOPMENT ON WETLANDS

5.1 Potential Impacts of the Construction and Operation of Development on Wetlands

The proposed development is intended to cover the entire study site as per the lay-out plans provided to SiVEST by the STLM (Figure 6). Essentially the proposed development will chiefly entail the construction of residential properties (57.1%) with varying densities (Residential 1, 2, 3). The 'residential 1' properties make up the bulk of the building structures. Other structures that are to be developed include a municipal and institutional building as well as associated internal access roads and a public open space. Because the proposed development is intended to cover the entire study site, potential impacts on the wetlands are high. ***Significantly, no development is to take place in the wetlands and the associated buffer zones as delineated by this assessment***. However, because the proposed development is likely to take place up to the boundaries of the buffer zones, there are many potential impacts that are likely to occur mainly during the construction phase. Several potential impacts may also occur during the operational phase of the proposed development. Since the proposed development is expected to be a long term development (lasting over 40 years or more), no decommissioning phase is expected and has therefore, not been assessed. The potential impacts of the construction and operational phases, on the other hand, are assessed.

5.1.1 Construction Related Impacts

In light of the extent of the study site that is to be covered by the proposed development as well as the types of structures being considered, there is an array of potential impacts that are likely to occur if appropriate practices and mitigation measures are not adhered to. Each of these potential impacts are highlighted along with proposed mitigation measures.

Vehicle impacts: During the construction phase, there will be a considerable amount of vehicle activity throughout the study site. Given this, there is the potential that vehicles will transgress into the wetlands areas. This could result in destruction of wetland habitat, disruption of wetland soils, compaction of soils and subsequent disruption of the hydrology of the wetlands. Hence, during the construction phase it is ***critical*** that the wetlands and the associated buffer zones are fenced off (preferably palisade fencing). This will prevent entry into the wetlands. If wire fencing is used, it must be monitored for damage and repaired immediately throughout the construction phase.

Figure 6: Proposed development layout plans.

Another potential impact that could affect the wetlands as a result of vehicle activity is the spillage or leakage of oils and fuels from hydraulic and/or small to heavy vehicles into the soils of the wetland. Leakage or spillage of oils and/or fuels can contaminate the wetlands soils making the substrate sterile for vegetation and potentially lethal for faunal organisms. It is therefore important that all vehicles are checked and maintained before entering the construction site. If leakage or spillage is detected and it is not extensive, repairs must be made to the vehicles and the contaminated soil are to be physically removed and dumped at an appropriate dumping site. Where spillage is extensive, more drastic and specific mitigation measures will need to be adopted. More importantly, however, vehicle activity is to be kept as far as possible away from the wetlands to prevent contamination altogether.

Soil and Groundwater Contamination Impacts: The storage of fuels and oils may be necessary on site. The impact of fuels and oils percolating into the soil and even groundwater can have potentially severe contamination effects. The effects are similar to those mentioned above for the leakage and spillage of fuels and oils from vehicles. Fuel and oil storage tanks as well as fuelling stations must therefore be strategically positioned away from all water sources at an appropriate distance accompanied by all the necessary and associated safety precautions. Furthermore, these areas must be contained in bunded areas or situated over drip trays with sufficient capacity to accommodate potential spills. Cement spillage and cement run-off into the wetlands may be an additional source for soil contamination. Cement mixing sites must therefore be located away from the wetlands. The cement mixing sites should also be surrounded by berms to prevent run-off from the sites entering the wetlands.

Clearing Impacts: The clearing of vegetation (vegetation that can be acceptably lost, not including sensitive and protected landscapes) is a standard procedure in the construction phase. The clearing of wetland vegetation could potentially take place. This can result in the loss of biodiversity in the landscape as well as a general loss of habitat. Indirect impacts as a consequence of vegetation clearing on the site in general, and not specifically to the wetlands, can influence erosion effects in conjunction to increased sediment run-off and siltation. Additionally, the clearing of landscapes consisting of established vegetation affords an opportunity to pioneer species and exotics to take over and/or encroach on pristine grasslands and wetlands. In order to avoid these impacts, storm water run-off during the construction phase needs to be strictly managed and allowed to seep away gradually into the wetland. Energy dissipaters in the form of grass blocks and silt netting or other suitable structures can be used to slow the rate of run-off in lowland areas. Such structures can also prevent sediment run-off and prevent the built up of silt in the wetlands.

Human Impacts: Human transgression into wetland areas can lead to a number of impacts. Transgression can result in the physical destruction of the wetlands but, more commonly, the removal of fauna and flora could potentially take place. Abstraction of water from the wetlands for the use of building and other purposes moreover, can affect the hydrology of the wetlands especially the smaller isolated systems. Wetlands may potentially also be used for sanitation purposes and human waste disposal during the construction phase. Lastly, burning practices may impact on the wetlands. In order to prevent many of the above mentioned impacts, fencing off of the wetlands areas will prevent entry and unauthorised use of wetlands for the construction of the proposed development. Burning on the entire study site during the construction phase should be strictly prohibited and needs to be stipulated in the environmental management plan for the proposed development.

Building Construction Impacts: Foundations will need to be constructed for the building structures. The laying of foundations can potentially severely impact on the wetlands if the proposed development extends into the wetlands. Impacts can include the complete and partial transformation of the wetlands. Wetland soils are likely to be lost and disrupted affecting the basic functionality of the systems (such as nutrient cycling). Given the presence of ferricrete, blasting is also highly likely to take place. Blasting over the areas of the wetlands where ferricrete extrudes will irreversibly destroy the wetland. It is therefore crucial that these activities do not take place in or near the wetlands and the associated buffer zones.

Water will be required for the construction of the proposed development. Water is often used for cement mixing, watering of access roads to prevent dust generation and so on. The use of water from wetlands is illegal without attaining a water use license for this purpose. Hence, to avoid impacting on the hydrology of the wetlands, water should be sourced elsewhere for construction purposes.

Dumping of building materials and litter accumulation in the wetlands could potentially take place. Residual materials and building packaging often builds on construction sites or is dumped directly in the wetlands. Fencing off of the wetlands will prevent dumping in the wetlands. Additionally, during the construction phase it is important that regular cleaning up and monitoring of the wetlands take place to remove any litter or waste materials.

During the construction phase, if the wetlands are not fenced off to construction activities, excavation of the wetlands could potentially take place. Excavations and/or trenches are often constructed as a means of diverting excess run-off from the site. The impacts associated with excavations and trenches include physically changing the structure, hydrology and therefore the natural functioning of wetlands as a whole. In short, these activities lead to the degradation of a wetland. With the aim of eliminating such impacts, access to wetlands on the study site need to be restricted. Creating a physical boundary around the buffer zones of the wetlands will adequately meet this in objective.

Stormwater Run-off Impacts: During the construction phase, excessive run-off can be generated where areas have been cleared of natural vegetation, which normally act as natural dissipaters for increased water energy. An increased flow rate of run-off (as a result) can contribute to accelerated erosion of susceptible surfaces. Additionally, increased sediment loads can accumulate in the lower lying areas of the landscape, which are often also wetland areas. Siltation and sedimentation effects can affect the physical structure of wetlands. Where flows are channelled into wetlands, the higher volume can cause un-channelled wetlands to become channelled wetlands by scouring out sediments. The banks along wetlands moreover are also likely to be affected by erosion. To prevent such impacts from occurring, certain measures can be adopted to dissipate the energy of increased run-off. Ideally, measures can include the introduction of structures that would result in no change or a decrease in the volume and rate of discharge of storm water generated by construction activities. Such structures can include the use of semi pervious blocks or gravels between the construction area and the wetland buffer zones, energy dissipaters at storm water outlets and routing storm water over vegetated land or in shallow broad grass lined or stone pitched drainage ways. Finally, a berm can also be constructed upland of the buffer zone.

5.1.2 Operational Impacts

Transgress into Wetlands: It is crucial that the wetland area is restricted as sensitive areas for the operation phase. Any transgression into the wetland areas are highly likely to result in physical impact to the system. Access to the wetland areas should therefore be strongly discouraged. The buffer zones, on the other hand can serve as an open space area. Therefore, during the operation phase, it is recommended that the wetland is fenced off by palisade fencing to prevent transgression.

Stormwater Run-off Impacts: A well planned storm water management system incorporating energy dissipater structures throughout the development is off paramount importance. The proposed development is highly likely to develop extensive impervious surfaces throughout the study site, which can lead to the same effects of increased discharge and run-off of storm water created during the construction phase. This will therefore, also cause similar impacts on the wetlands as during the construction phase. This impact is of critical concern due to the intended long term existence of the proposed development, which means that any impacts will last for an extended period resulting in a potentially more severe impact with time.

5.2 Impact Risk Assessment

As prescribed by the Department of Water and Sanitation (DWS, 2015), the assessment of potential impacts has been undertaken using the Risk Assessment Matrix (RAM) provided by the Department. Please note that the RAM assumes the construction over the wetlands on site (worst case scenario).

Table 3: Summary of Risk Assessment Results

No.	Phases	Activity	Aspect	Impact	Significance Risk Rating	Risk Rating	Control Measures	Borderline LOW MODERATE Rating Classes	PES and EIS of Watercourse
1	**Construction Phase**	Construction of road or platform	Negative impacts during construction	Physical destruction and/or damage to the wetland areas by road or platform	**220**	**H**	Mitigation through offset	Not applicable	Ecological Condition C (Moderately Modified) / EISC Class B (High)
				Pollution of wetland areas near the proposed construction as a result of contaminated runoff.	**55**	**L**	Careful control of all hazardous substances and appropriate drip trays	Not applicable	Ecological Condition C (Moderately Modified) / EISC Class B (High)
				Contamination of soil and sub-surface water through infiltration of construction related pollutants.	**50**	**L**	Careful control of all hazardous substances and appropriate drip trays	Not applicable	Ecological Condition C (Moderately Modified) / EISC Class B (High)
				Increased disturbance to aquatic and semi-aquatic fauna.	**38.25**	**L**	Appropriate toolbox talks regarding interactions with fauna for all staff.	Not applicable	Ecological Condition C (Moderately Modified) / EISC Class B (High)

2		Construction of stormwater management facility	Negative impacts during construction	Physical destruction and/or damage to the wetland areas by stormwater management facilities.	**220**	**H**	Mitigation through offset	Not applicable	Ecological Condition C (Moderately Modified) / EISC Class B (High)
				Pollution of wetland areas near the proposed construction as a result of contaminated runoff.	**55**	**L**	Careful control of all hazardous substances and appropriate drip trays	Not applicable	Ecological Condition C (Moderately Modified) / EISC Class B (High)
				Contamination of soil and sub-surface water through infiltration of construction related pollutants.	**50**	**L**	Careful control of all hazardous substances and appropriate drip trays	Not applicable.	Ecological Condition C (Moderately Modified) / EISC Class B (High)
				Increased disturbance to aquatic and semi-aquatic fauna.	**38.25**	**L**	Appropriate toolbox talks regarding interactions with fauna for all staff.	Not applicable.	Ecological Condition C (Moderately Modified) / EISC Class B (High)

3	**Operation Phase**	Activities associated with the ongoing operation of the road, platform or stormwater facility.	Potential runoff	Pollution of wetland areas near the road or platform as a result of contaminated runoff.	**40.5**	**L**	Appropriate toolbox talks with staff undertaking maintenance, to ensure detection of leaks.	No applicable.	Ecological Condition C (Moderately Modified) / EISC Class B (High)
			Increased hydrological inputs	Increased hard surfaces leading to increased hydrological inputs for the wetland areas off site	**40.5**	**L**	Appropriate toolbox talks with staff undertaking maintenance, to ensure detection of erosion.	Not applicable	Ecological Condition C (Moderately Modified) / EISC Class B (High)
			Potential erosion	Outflow from stormwater management facilities could cause erosion	**42.75**	**L**	Appropriate toolbox talks with staff undertaking maintenance, to ensure detection of erosion nick points.	No applicable.	Ecological Condition C (Moderately Modified) / EISC Class B (High)

6 CONCLUSION AND RECOMMENDATIONS

A wetland delineation and impact assessment is contained within this report. Findings based on a methodology using soil wetness, soil type, terrain and vegetation indicators reveal that five wetlands were identified on the study site. These wetlands fall into three categories of wetlands. Firstly, two isolated grassland depression wetlands were identified at the crest of the undulating plains of the study site. Secondly, two grassland/marsh hillslope seepage wetlands were identified in the mid-slopes of plains of the study site that link into and are hydrologically connected to the lower lying grassland/marsh un-channelled valley bottom wetland. The wetlands were accordingly delineated and an adequate buffer zone of 30 metres was applied. These wetlands are to be regarded as areas of ***high sensitivity***.

The two depression wetlands seem to have been formed through the creation of stormwater outlets (as noted in the layout for the mall in Figure 7 below) when the shopping mall was built, and thus the planned formalisation of the stormwater drains (originally approved) exiting the existing mall will likely lead to the drying out of these wetlands.

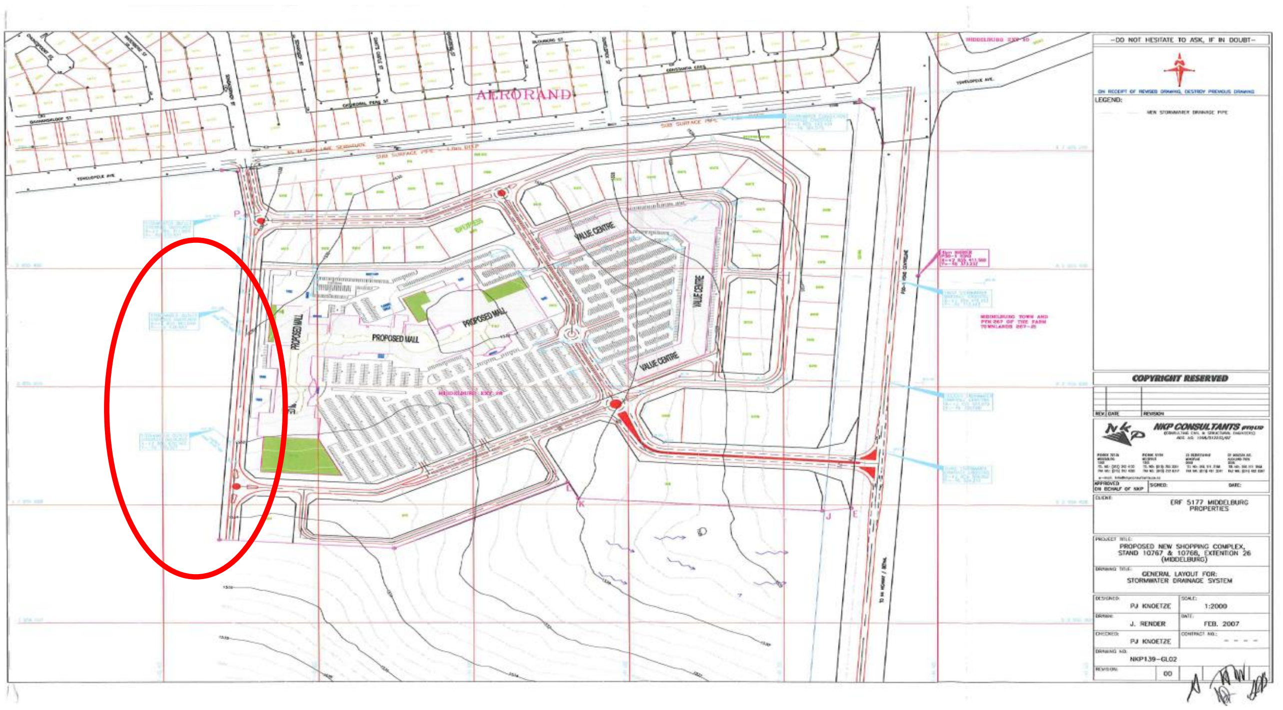

Figure 7: Layout plan of the mall showing the position of the stormwater outlets, and thus the position of the depression wetlands that have formed.

These wetlands cover a proportion of the study site where the proposed development intends to cover the full extent of the property. The risk assessment matrix for the wetlands shows high risks associated with the proposed wetland losses. **Overall, the proposed development lay-out must be redesigned to accommodate the wetlands as areas of high sensitivity and therefore**

zones of exclusions. The placement of structures can take place around the wetlands and the associated buffer zones. The buffer zones can be used as public open space areas during the operation phase of proposed development. However, this area must be maintained as a natural area and no landscaping or re-vegetation should take place.

The applicability of the above statement must be tested with the Department of Water and Sanitation with regards to the two depression wetlands that have formed as a result of the stormwater outlets on the site. Specifically, how the formalisation of the stormwater outlets will affect the wetlands, and the drying out process that is likely to occur.

It is strongly recommended that the proposed appropriate practices and mitigation measures raised in this report are to be followed. The most important preventative measure specifically relates to the palisading off of the wetland and buffer zones, which will prevent most of the potential impacts from occurring.

Should the development proceed with the proposed layout the loss of wetlands on site would require a biodiversity offset for the wetland loss. An appropriate study will need to be undertaken in order to determine appropriate areas for offset. It must be noted that the component wetlands form constituent parts of the irreplaceable aquatic biodiversity sub-catchments of the Mpumalanga Province.

Any development of this nature within 500m of a wetland requires a water use license from the Department of Water and Sanitation, and it is recommended that a meeting be sought to discuss the project with the Department of Water and Sanitation to determine any license requirements relating to the project.

7 REFERENCES

Coetzee, M. A. S. 1995. Water Pollution in South Africa: It's Impacts on Wetland Biota; In Cowan, G. I. (ed). *Wetlands of South Africa*. Department of Environmental Affairs and Tourism (DEAT), Pretoria.

Collins, N. B. 2005. Wetlands: The basics and some more. Free State Department of Tourism, Environmental and Economic Affairs.

DWAF. 2005. A practical field procedure for the identification and delineation of wetlands and riparian areas.

DWAF.1999. Resource Directed Measures for Protection of Water Resources. Volume 4: Wetland Ecosystems Version 1.0, Pretoria.

Kotze, D., Marneweck, G., Batchelor, A., Lindley, D. and Collins, N. 2009. WET-EcoServices: A technique for rapidly assessing ecosystem services provided by wetlands. *Wetland Management Series*. Water Research Commission Report TT 339/09.

Macfarlane, D., Kotze, D., Ellery, W., Walters, D., Koopman, V., Goodman, P. and Goge, M. 2009. WET-Health: A technique for rapidly assessing wetland health. *Wetland Management Series*. Water Research Commission Report TT 340/09.

Macfarlane, D.M., Bredin, I.P., Adams, J.B., Zungu, M.M., Bate, G.C. and Dickens, C.W.S. 2014. Preliminary guideline for the determination of buffer zones for rivers, wetlands and estuaries. Final Consolidated Report. WRC Report No TT 610/14, Water Research Commission, Pretoria.

Mucina, L. and Rutherford, M. C. (eds) 2006. The Vegetation of South Africa, Lesotho and Swaziland. *Strelitzia 19*. South African National Biodiversity Institute, Pretoria.

Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. *SANBI Biodiversity Series* 22. South African National Biodiversity Institute, Pretoria.

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

SiVEST Environmental Division
Northview Building, Bush Shrike Close, Victoria Country Club Office Estate, 170 Peter Brown Drive
Montrose, Pietermaritzburg 3201. South Africa
PO Box707, Msunduzi.3231. South Africa

Tel + 27 33 347 1600
Fax +27 33 347 5762
Email info@sivest.co.za
www.sivest.co.za

Contact Person: Stephen Burton
Tel No.: 033 347 1600
Email: stephenb@sivest.co.za