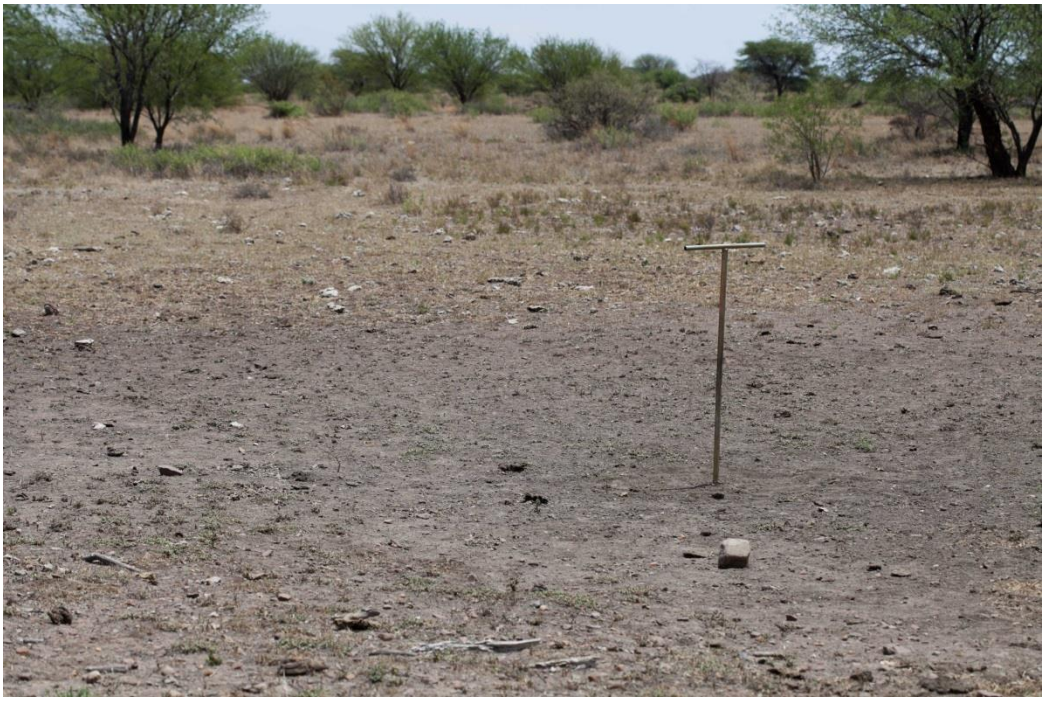
WETLAND ASSESSMENT

Sonbesie, North West Province



View of wetland at the site with soil auger in the seasonal zone of the wetland.
Photo: November 2015, R.F. Terblanche.

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COMPILED BY:

Reinier F. Terblanche

(M.Sc, *Cum Laude*; Pr.Sci.Nat, Reg. No. 400244/05)

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1 INTRODUCTION

A wetland assessment is required for a proposed photo-voltaic development, Sonbesie, 7 km southwest of Vryburg in the North West Province (elsewhere referred to as the site), and if wetlands are present an assessment of these wetlands will take place. Such an assessment would then focus on the hydro-geomorphic setting, an estimate of the properties of the wetlands, an assessment of the functional aspects of wetlands and an impact assessment to wetlands, should the development be approved.

1.1 Wetlands in South Africa

Wetlands are defined by the National Water Act (Act 36 of 1998) as:
"land which is transitional between terrestrial and aquatic ecosystems 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".

According to *A practical field procedure for identification and delineation of wetlands and riparian areas* (DWAF 2005) wetlands must have one or more of the following attributes:

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

Wetlands, according to the definition of DWAF (2005) are at the interface of aquatic systems and the terrestrial environment. As such the characteristics of the surface water or near surface water in space and time at this interface between the terrestrial and aquatic environment are fundamental to understand the functioning of a particular wetland. At the higher elevations of South Africa surface water at wetlands are characterised by considerable contrasts between seasons and periodic precipitation events. Generally accepted definitions of wetlands which focus on the wetland attributes of soil and vegetation are therefore useful because of its consistency despite seasonal fluctuations.

The Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al.*, 2013) includes wetland ecosystems defined by the National Water Act (Act 36 of 1998) as well as those “wetland sytems” defined in the Ramsar Convention. The broader definition of wetlands, according to the Ramsar Convention is that wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water to the depth of which at low tide does not exceed six metres (cited by Ramsar Convention Secretariat 2011). This Ramsar definition of “wetlands” overlaps broadly with the definition of aquatic systems according to the South African system of classifying wetlands and other aquatic ecosystems. In South Africa an aquatic ecosystem is an ecosystem that is permanently or periodically inundated by flowing or standing water, or which has soils that are permanently or periodically saturated within 0.5 m of the soil surface (Ollis *et al*., 2013). Therefore an important consideration of the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*., 2013) is that a wetland (narrow definition according to water act and not Ramsar definition) is taken to be a unique type of aquatic system.

1.2 Importance of wetlands

The importance of wetlands for human well-being and the conservation of biodiversity are recognised world-wide. Ecosystem services which directly or indirectly benefit human well-being are of particular importance when wetlands are considered. Wetlands play a major role to enhance supporting services such as nutrient cycling and primary production, which in turn is the basis for other ecosystem services. Wetlands are very important to regulating services such as maintaining water flow and water quality by processing water and regulating water run-off, provisioning services such as providing freshwater, cultural services such as appreciating the landscape and biodiversity. Overall wetlands play a major role in the sustainability of land use from socio-economic and biodiversity conservation perspectives. The setting and function of wetlands at each site should therefore be evaluated to inform land use management.

Wetland vegetation is of significant importance for wetlands to play a role in valuable ecosystem services. Vegetation plays an important role in natural wetland ecosystems. It holds soil together and slows down the flow of water, reducing the risk of erosion and promoting sediment deposition. Plants are the source of organic material in wetland soils, and form the organic soil in peat wetlands. Vegetation also has an impact on the quality of surface and subsurface water as it (1) provides

organic soil matter required by microbes in order to assimilate nutrients and toxicants (2) provides habitat for the microbes in the soil immediately surrounding the roots, and (3) contributes through direct uptake of nutrients and toxicants and incorporation of these into plant tissues (Sieben *et al.* 2009).

1.3 Aims and objectives of the survey

A survey consisting of three visits to investigate key elements of habitats on the site, relevant to the conservation of wetlands are conducted. The importance and significance of the site with special emphasis on the current status of biodiversity and ecological services of the wetland are evaluated. Literature investigations are integrated with field observations to identify potential ecological impacts that could occur as a result of the development and to make recommendations to reduce or minimise impacts, should the development be approved.

The objectives of the wetland habitat assessment are to provide:

- An indication of the existence of wetlands at the site and if so:
- An identification of major aspects of the hydro-geomorphic setting and terrain unit at which the wetland occur;
- An estimate of the size and roughness of the wetland
- An indication of the hydric soils at the site;
- An indication of erodability;
- An indication of the presence or absence of peat at the site;
- An outline of hydrological drivers that support the existence and character of the wetland;
- An assessment of the possible presence or absence of threatened or localised plant species, vertebrates and invertebrates of the region, at the site;
- A description of the functions provided by the wetland at the site;
- An interpretation of the priority of the wetland for local communities in the area;
- An interpretation of the priority of the wetland to biodiversity at the site;

2 STUDY AREA

The study area is at the proposed Sonbesie Solar Park, 7 km southwest of Vryburg in the North West Province (elsewhere referred to as the site). The site is situated in the Savanna Biome which is represented by Ghaap Plateau Vaalbosveld vegetation type (Mucina & Rutherford, 2006). A brief overview of the Ghaap Plateau Vaalbosveld vegetation type in which the site is located, follows.

Ghaap Plateau Vaalbosveld (SVk 7)

Distribution: In South Africa the Ghaap Plateau Vaalbosveld is found in the Northern Cape and North-West Provinces: Flat plateau from around Campbell in the south, east of Danielskuil through Reivilo to around Vryburg in the north. Altitude at the Ghaap Plateau Vaalbosveld is 1100 – 1500 m.

Vegetation and landscape features: Flat plateau with well-developed shrub layer with *Tarchonanthus camphoratus* and *Acacia karroo.* Open tree layer has *Olea europaea* subsp. *africana*, *Acacia tortilis*, *Ziziphus mucronata* and *Searsia [Rhus] lancea*. *Olea europaea* subsp. *africana* is more important in the southern parts of the unit, while *Acacia tortilis, Acacia hebeclada* and *Acacia mellifera* are more important in the north and part of the west of the unit. Much of the south-central part of this unit has remarkably low cover of *Acacia* species for an arid savanna and is dominated by the nonthorny *Tarchonanthus camphoratus*, *Searsia lancea*, and *Olea europaea* subsp. *africana* (Mucina & Rutherford 2006).

Geology and soils: Surface limestone of Tertiary to Recent age, and dolomite and chert of the the Campbell Group (Griqualand West Supergroup, Vaalian Erathem) support shallow soils (0.1-0.25 m) of Mispah and Hutton soil forms. Land types mainly Fc with some Ae and Ag (Mucina & Rutherford, 2006).

Climate: Climate is characterized by summer and autumn rainfall and very dry winters. Mean annual precipitation from about 300 mm in the southwest to about 500 mm in the northeast. Frost is frequent to very frequent in winter (Mucina & Rutherford 2006).

Important taxa of the Ghaap Plateau Vaalbosveld listed by Mucina & Rutherford (2006): Tall Tree: *Acacia erioloba.* Small Trees: *Acacia mellifera* subsp. *detinens, Searsia lancea, Acacia karroo,*

Acacia tortilis subsp. *heteracantha*, *Boscia albitrunca.* Tall Shrubs: *Olea europaea* subsp. *africana, Rhigozum trichotomum, Tarchonanthus camphoratus, Ziziphus mucronata, Diospyros pallens*, *Ehretia rigida* subsp. *rigida* (this species complex has been revised and the *Ehretia alba* is the species that occurs at the vegetation type, R.F. Terblanche pers. obs.), *Euclea crispa* subsp. *ovata, Grewia flava, Gymnosporia buxifolia, Lessertia frutescens, Searsia tridactyla.* Low Shrubs: *Acacia hebeclada* subsp. *hebeclada, Aptosimum procumbens, Chrysocoma ciliata, Helichrysum zeyheri, Hermannia comosa, Lantana rugosa, Leucas capensis, Melolobium microphyllum, Peliostomum leucorrhizum, Pentzia globosa, Pentzia viridis, Zygophyllum pubescens.* Succulent Shrubs: *Hertia pallens, Lycium cinereum.* Semi-parasitic Shrub: *Thesium hystrix*. Woody Climber: *Asparagus africanus*. Graminoids: *Anthephora pubescens, Cenchrus ciliaris, Digitaria eriantha* subsp. *eriantha, Enneapogon scoparius, Eragrostis lehmanniana, Schmidtia pappophoroides, Themeda triandra, Aristida adscensionis, Aristida congesta, Aristida diffusa, Cymbopogon pospischilii, Enneapogon cenchroides, Enneapogon desvauxii, Eragrostis echinochloidea, Eragrostis obtusa, Eragrostis rigidior, Eragrostis superba, Fingerhuthia africana, Heteropogon contortus, Sporobolus fimbriatus, Stipagrostis uniplumis, Tragus racemosus.* Herbs: *Barleria macrostegia, Geigeria filifolia, Geigeria ornativa, Gisekia africana, Helichrysum cerastoides, Heliotropium ciliatum, Hermbstaedtia odorata, Hibiscus marlothianus, Hibiscus pusillus, Jamesbrittenia aurantiaca, Limeum fenestratum, Lippia scaberrima, Selago densiflora, Vahlia capensis* subsp. *vulgaris.* Succulent herb: *Aloe grandidentata*.

Note: Not all of the above listed plant species for the vegetation type occur at the site in the study area.

3 METHODS

A desktop study comprised not only an initial phase, but also it was used throughout the study to accommodate and integrate all the data that became available during the field observations.

Surveys of a number of study areas in the vicinity of Vryburg, including the site, were conducted from 10 – 16 November 2015 to note key elements of habitats on the site, relevant to the conservation of fauna and flora. Delineation of this wetland took place on 13 November 2015. Notes and experience from earlier surveys at the larger study area of the Taung-Vryburg area by R.F. Terblanche that had taken place in July 2011, November 2011, January 2012, February 2012, August 2013, December 2013, January 2014 and November 2014 were also taken into account where applicable.

Classification of any inland wetland systems that could be present at the site is according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*., 2013). One of the major advantages of the Classification System for South Africa (Ollis *et al*., 2013) is that the functional aspects of wetlands are the focal point of the classification. Wetlands are very dynamic systems and their functionality weighs high against the often rapid changes in their appearance (Terblanche *In prep*). In this document the main guideline for the delineation and identification of wetlands where present is the practical field procedure for identification and delineation of wetlands by DWAF (2005).

The following sections highlight the materials and methods applicable to different aspects that were observed.

3.1 Classification of wetlands (SANBI: Ollis *et al*., 2013)

3.1.1 System, regional setting and landscape unit (Levels 1, 2 and 3)

Three broad types of Inlands Systems are dealt with in the Classification System namely rivers, open waterbodies and wetlands. These Inland Systems are then classified according to a six-tiered structure that includes six levels.

At the systems level (Level 1) of wetland classification, a distinction is made between Marine, Estuarine and Inland ecosystems using the level of connectivity to the open ocean as discriminator of the biophysical character of each (Ollis *et al*., 2013). Inland wetland systems are aquatic ecosystems with no no existing connection to the ocean (i.e. characterised by the complete absence of marine exchange and/ or tidal influence (Ollis *et al*., 2013). In this case if any wetland is present it obviously qualifies as an Inland wetland system.

At Level 2 the regional setting is a spatial framework that is preferred by the investigator to allow for gaining an understanding of the broad ecological context within which an aquatic system occurs (Ollis *et al*., 2013). A regional setting can be identified according to the DWA ecoregion classification of Kleynhans *et al.* (2005).

A distinction is made between four landscape units at Level 3 of the Classification System for Inland Systems on the basis of the landscape setting (i.e. topographical position) (Ollis *et al*., 2013). Four landscape units are recognized: slope, valley floor, plain and bench.

3.1.2 Hydrogeomorphic units (Level 4)

Seven primary hydrogeomorphic (HGM) units are recognised for Inland Systems at Level 4A of the Classification System for Wetlands and other Aquatic Ecosystems in South Africa, on the basis of hydrology and geomorphology (Ollis *et al*., 2013). These are a River, Channeled valley-bottom wetland, Unchannelled valley-bottom wetland, Floodplain wetland, Depression, Seep and Wetland flat.

3.1.3 Hydrological regime (Level 5)

While the hydrogeomorphic unit (HGM) is influenced by the source of water and how it moves into, through and out of an Inland System, the hydrological regime (as catergorised by the Classification System) describes the behaviour fo the water within the system and, for wetlands, in the underlying soil (Ollis *et al.,* 2013). Together with the hydrogeomorphology the hydrological regime are used to describe the wetland as a functional unit (Ollis *et al.*, 2013). In the case of Inland wetlands which are classified as rivers, perenniality is an important characteristic to describe the hydrological regime. For Inland Systems other than rivers, five categories relating to the frequency and duration

of inundation have been provided: Permanently inundated, Seasonally inundated, Intermittently inundated, Never inundated/ rarely inundated and unknown (Ollis *et al*., 2013). Period of saturation within the upper 0.5 m of the soil is a very important discriminator that also links to the wetland delineation system of DWAF (2005). The following categories for saturation of wetland soils are recognised: Permanently saturated, Seasonally saturated, Intermittently saturated and unknown. These categories of period of saturation correspond to the permanent, seasonal and temporary zones of wetlands respectively.

3.1.4 Wetland descriptors (Level 6)

At Level 6 several “descriptors” are included for the structural/ chemical/ biological characterisation of Inland Systems (Ollis *et al.,* 2013). These descriptors are non-hierarchical to one another and can be applied in any order depending on the purpose of a study and the availability of information. Descriptors include natural vs. artificial, salinity, substratum type, pH, geology and vegetation cover (Ollis *et al*., 2013). Various definitions are given for the descriptors which are likely to increase the consistency and use of the system.

3.2 Delineation of wetland

Together with terrain unit, indirect indicators of prolonged saturation by water: wetland plants (hydrophytes) and wetland (hydromorphic) soils are identified and used to delineate the wetland (DWAF 2005). Three zones, which may not all three be present in all wetlands, namely the permanent zone of wetness, the seasonal zone and the temporary zone are identified. The temporary zone is the outer zone and is saturated for only a short period of the year that is sufficient, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation (DWAF 2005). Hydromorphic soils must display signs of wetness within 50cm of the soil to qualify as wetland soil that can support hydrophytic vegetation. Grid references and altitudes are taken on site with a GPS Garmin E-trex 20 ® instrument. Map information are analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2015).

3.3 Vegetation at and near wetland

Though vegetation is a key component of the wetland definition in the Water Act, using vegetation as a primary indicator requires undisturbed conditions and expert knowledge (DWAF 2005). Modern wetland classification systems in South Africa therefore place more emphasis on the soil wetness indicators. It remains however, that plant assemblages undergo distinct changes in species composition from the centre of a wetland to the edge, and into adjacent terrestrial areas (DWAF 2005). This change in species composition of vegetation provides valuable clues for determining the wetland boundary and wetness zones (DWAF 2005).

Apart from botanical aspects which are integrated into the description of a wetland it is imperative to note the existence or not of threatened plant species or other plant species of conservation concern, such as near-threatened, data deficient or declining species at a wetland. Floristic composition is therefore also considered during the wetland assessment. Voucher specimens of plant species are only taken where the taxonomy is in doubt or where the plant specimens are of significant relevance for invertebrate conservation. Field guides such as those by Germishuizen (2003), Manning (2003), Manning (2009), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Malan (1998) and Van Wyk & Van Wyk (1997) were used to confirm the taxonomy of the species. Works on specific plant groups (often genera) such as those by Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), McMurtry, Grobler, Grobler & Burns (2008), Smit (2008), Van Jaarsveld (2006) and Van Wyk & Smith (2003) were also consulted to confirm the identification of species. An important source of identifications of plant species for the wetland survey is Van Ginkel, Glen, Gordon-Gray, Cilliers, Muasya & Van Deventer (2011). In this case no plant specimens were needed to be collected as voucher specimens or to be send to a herbarium for identification. For the most recent treatise of scientific plant names and broad distributions, Germishuizen, Meyer & Steenkamp (2006) or Raimondo *et al*. (2009) or updated lists on SANBI websites are followed to compile the lists of species.

3.4 Fauna at and near wetland

Species composition of fauna is not used in wetland characterization and assessments. However, it is important to note species that favour wetlands and especially whether threatened animal species are present at a wetland or not.

Mammals are noted as sight records by day. For the identification of species and observation of diagnostic characteristics Smithers (1986), Skinner & Chimimba (2005), Cillié, Oberprieler and Joubert (2004) and Apps (2000) are consulted. Sites are been walked, covering as many habitats as possible. Signs of the presence of mammal species, such as calls of animals, animal tracks (spoor), burrows, runways, nests and faeces are recorded. Walker (1996), Stuart & Stuart (2000) and Liebenberg (1990) are consulted for additional information and for the identification of spoor and signs. Trapping is only done if necessary. Habitat characteristics are also surveyed to note potential occurrences of mammals. Many mammals can be identified from field sightings but, with a few exceptions bats, rodents and shrews can only be reliably identified in the hand, and even then some species needs examination of skulls, or even chromosomes (Apps, 2000).

Birds are noted as sight records, mainly with the aid of binoculars (10x30). Nearby bird calls of which the observer was sure of the identity were also recorded. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Ryan (2001) is followed. For information on identification, biogeography and ecology Barnes (2000), Hockey, Dean & Ryan, P.G. (2005), Cillié, Oberprieler & Joubert (2004), Tarboton & Erasmus (1998) and Chittenden (2007) are consulted. Ringing of birds falls beyond the scope of this survey. Sites are walked, covering as many habitats as possible. Signs of the presence of bird species such as spoor and nests are additionally been recorded. Habitat characteristics are surveyed to note potential occurrences of birds.

Reptiles are noted as sight records in the field. Binoculars (10x30) can also be used for identifying reptiles of which some are wary. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques, Branch (1998), Marais (2004), Alexander & Marais (2007) and Cillié, Oberprieler and Joubert (2004) are followed. Sites are walked, covering as many habitats as possible. Smaller reptiles are sometimes collected for identification, but this practice was not necessary in the case of this study. Habitat characteristics are surveyed to note potential occurrences of reptiles.

Frogs and toads are noted as sight records in the field or by their calls. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Carruthers (2001), Du Preez (1996), Conradie, Du Preez, Smith & Weldon (2006) and the recent complete guide by Du Preez & Carruthers (2009) are consulted. CD's with frog calls by Carruthers (2001) and Du Preez & Carruthers (2009) are used to identify species by their calls when applicable. Sites are walked, covering as many habitats as possible. Smaller frogs are often collected by pitfall traps put out for epigeal invertebrates (on the soil), but this practice falls beyond the scope of this survey. Habitat characteristics are also surveyed to note potential occurrences of amphibians.

Invertebrates of which enough information is available to be integrated into an assessment, such as butterflies, are recorded as sight records, photographic records or voucher specimens. Voucher specimens are mostly taken of those species of which the taxa warrant collecting due to taxonomic difficulties or in the cases where species can look similar in the veldt. Many butterflies use only one species or a limited number of plant species as host plants for their larvae. Myrmecophilous (ant-loving) butterflies such as the *Aloeides*, *Chrysoritis*, *Erikssonia, Lepidochrysops* and *Orachrysops* species (Lepidoptera: Lycaenidae), which live in association with a specific ant species, require a unique ecosystem for their survival (Deutschländer & Bredenkamp, 1999; Terblanche, Morghental & Cilliers, 2003; Edge, Cilliers & Terblanche, 2008; Gardiner & Terblanche, 2010). Known food plants of butterflies are therefore also recorded. Other invertebrate groups such as fruit chafer beetles and mygalomorph spiders are also investigated where relevant.

3.5 Present Ecological Status

Ecological status of wetlands are based on models such as the modified Habitat Integrity approach developed by Kleynhans (1996, 1999). Present ecological status PES methodology is then largely based on criteria for assessing the habitat integrity of floodplain wetlands and notes for allocating a score to attributes and rating the confidence level associated with each score (DWAF 1999). Such criteria are selected on the assumption that anthropogenic modification can generally be regarded as the primary causes of degradation of the ecological integrity of a wetland (see DWAF 1999). This is done by using Table W4-1 given by DWAF (1999):

- Score each attribute according to the guidelines provided in the footnote.
- Calculate a mean score for Table W4-1 using the individual scores for all attributes.

- Provide a confidence rating for each score according to the guidelines provided in the footnote to indicate the areas of uncertainty in the determination.

Table W4-2 provides guidelines for the determination of the Present Ecological Status Class (PESC), based on the mean score determined for Table W4-1. If any of the attributes scores < 2 (i.e., it is considered to be seriously or critically modified) this score and not the mean should be taken into consideration. This approach is based on the assumption that extensive degradation of any of the wetland attributes may determine the Present Ecological Status Category (PESC). In any case, the mean on which the assessment of the PESC is based should be regarded as a guideline and should also be tested against the opinion of local experts (DWAF 1999).

Biological integrity is not directly estimated through this approach though in some systems or parts of systems, information on biological integrity is available. In such cases, the information on biological integrity can be used as a check of the PES Category determination. The mean is used to relate the ecological state of the wetland to a particular PES Category (Table W4-2) (DWAF 1999).

3.6 Ecological Importance and Sensitivity

The assessment of the ecological importance and sensitivity is according to DWAF (1999) which in turn is adapted from Kleynhans (1996) and Kelynhans (1999). "Ecological importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The Ecological Importance and sensitivity (EIS) provides a guideline for determination of the Ecological Management Class (EMC) DWAF (1999).

In the method outlined here, a series of determinants for EIS according to Table W5-1 of DWAF (1999) are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The method is used as a guideline for the professional judgement of individuals familiar with an area and its wetlands. The assessors must substantiate and document their judgement as far as possible for future reference and revision (DWAF 1999).

3.7 Limitations

Wetlands are very dynamic systems and owing to time constraints a snapshot of conditions at wetlands are taken, even though the hydrogeomorphological setting, soil wetness characteristics and established vegetation constitute some longer term features of a wetland. For each site visited, it should then be emphasized that surveys can by no means result in an exhaustive list of wetland plants and animals present on the site, because of the time constraint. Surveys of a number of study areas in the vicinity of Vryburg, including the site, were conducted from 10 – 16 November 2015 to note key elements of habitats on the site, relevant to the conservation of fauna and flora. Delineation of this wetland took place on 13 November 2015. Notes and experience from earlier surveys at the larger study area of the Taung-Vryburg area by R.F. Terblanche that had taken place in July 2011, November 2011, January 2012, February 2012, August 2013, December 2013, January 2014 and November 2014 were also taken into account where applicable. Survey covers a good time of the year to to note key elements of habitats on the site, relevant to the conservation of fauna and flora. Weather conditions during the surveys were favourable for recording fauna and flora. The focus of the survey remains a habitat survey that concentrates on the hydrogeomorphological, hydrological and additional descriptors to classify and assess the wetland.

4 RESULTS AND DISCUSSION

4.1 Assessment and classification of wetland at the site

A distinct small wetland (Figure 2) of approximately 0.12 ha (longest diameter, 48 m) is found at the northern (NNW) part of the proposed footprint. Therefore relatively this wetland, a depression, is very small. Vegetation at the restricted wetland area is represented by hydrophytic plant species such as a *Persicaria* species but any concentrations of sedges reeds or other obligate wetland plant species are absent. Wetland is a small depression on a plain with no clear inlet or outlet. As such the small depression approaches endorheic conditions where the water that flows in during rainfall events mostly leaves through evapotranspiration and infiltration in a low rainfall area (Mean Annual Precipitation < 500 mm).

The wetland patch will, if only for shorter periods during some years, be visited by water birds when standing water prevails or soil is very wet.

A concentration of trees is found around the small pan. These trees include the indigenous *Acacia karroo* (Sweet Thorn) but there is also an exotic alien invasive species, *Prosopis glandulosa* (Honey Mesquite) present. It is very important that *Prosopis glandulosa* should be eradicated around the pan area in particular.

Present ecological status (PES) of the wetland at the site is CATEGORY B which means the wetland is largely natural with few modifications, but with some loss of natural habitats (Table 4.2 and Table 4.3), largely atributed to possible grazing pressure but more so owing to presence of alien invasive *Prosopis glandulosa* (Honey Mesquite). Ecological importance and sensitivity (EIS) of the wetland is Moderate which means the wetland is considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains or wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers (Table 4.4 and Table 4.5).

It is anticipated that the proposed development would not have a major influence on the hydrological regime of the depression at the site as long as the wetland is conserved as a no-go area for developments with some buffer zone. There appears to be no distinct reason (such as would have been the case for gatherings of large rare water birds; associated unique wetland vegetation;

extensive edge effects of impacts; sensitive extensive wetlands) why the buffer zone should be large.

No threatened plant or animal species are suspected to be present at the site. Given the present restricted nature of the wetland at the site, as well as the lack of threatened species, it is recommended that proposed developments, if approved, focus on maintaining the integrity and functioning of a small depression in a low rainfall area (below 500 mm per annum). The type of development proposed, if approved, does not have the same impact as for example a plantation or buildings in terms of shade effects on the flora and fauna, and more importantly, on buffer zones or corridors. A buffer zone of 32 m, given the type of development and the restricted nature of the wetland system, is thought to be adequate to maintain the functioning of the wetland system at the site.

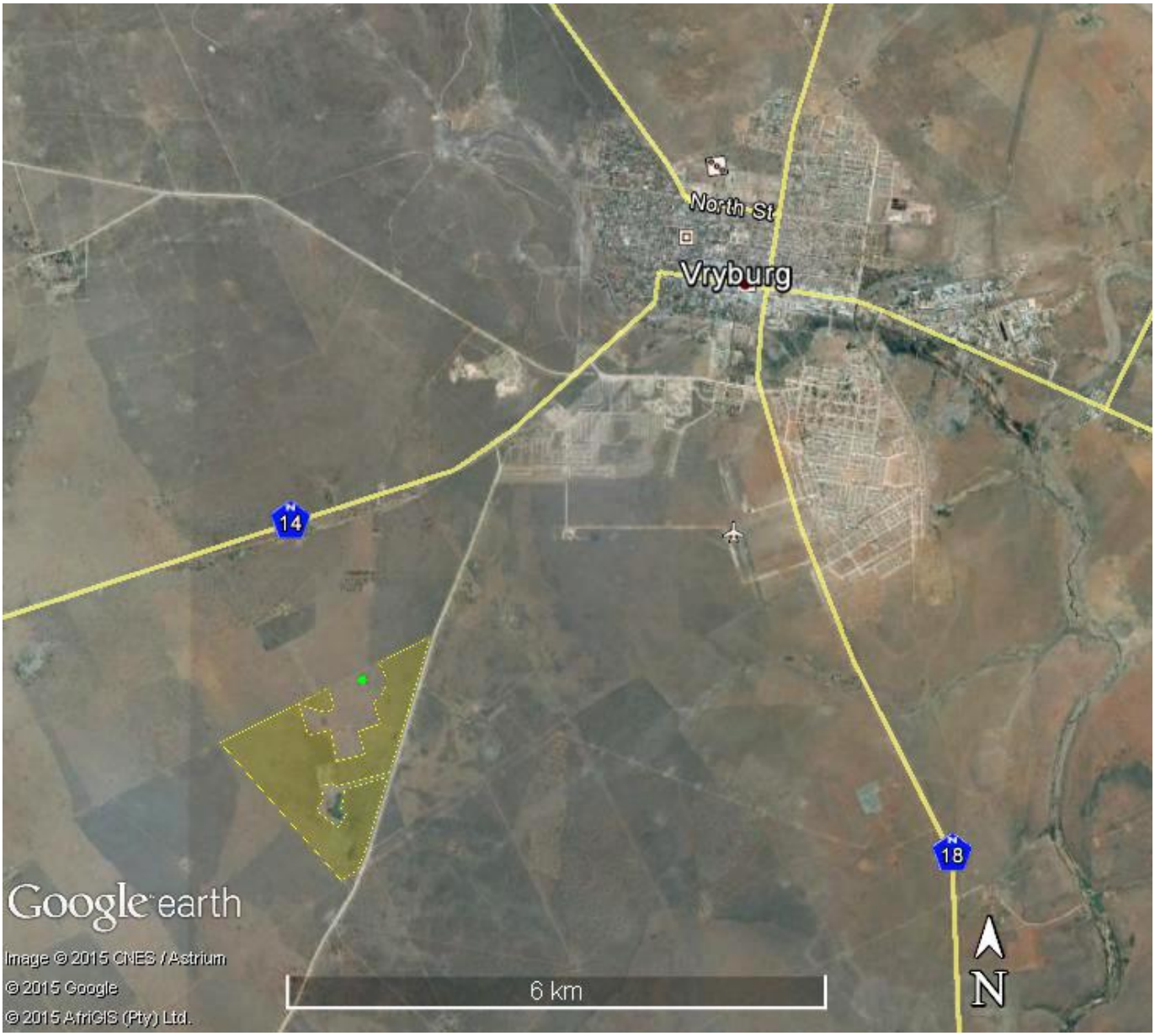

Figure 1 Location of the site in larger area and at the proposed footprint. Wetland is indicated by green dot.

Grid references and altitudes were taken at site with a GPS Garmin E-trex 20 ® instrument.
Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2015, licenced software bought by the author).

Table 4.1 Classification and outline of characteristics of wetland at the site according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al.*, 2013).

CHARACTERISTIC TYPE WETLAND DISCRIMINATORS AND DESCRIPTORS	**DESCRIPTION**
System (level 1)	Inland wetland
Regional setting (level 2)	Southern Kalahari Ecoregion (Kleynhans *et al.* 2005)
Landscape unit (level 3)	Plain
Hydrogeomorphic unit (level 4)	Depression
Hydrological regime (Level 5)	Wetland occurs at plain on gentle slopes. No conpsicuous inlet or outlet could be found. This depression is probably endoreic, so that water that flows in during rainfall events probably leaves mostly through evaporation and infiltration.
Additional descriptors (Levels 5,6)	Shallow brown-greyish soils are present in at the wetland. No permanent zone appears to be present at the small wetland and also no megagraminoids or sedges are present despite this area being a farmland with natural indigenous vegetation. A patch with a *Persicaria* plant species is found at the core of the wetland.

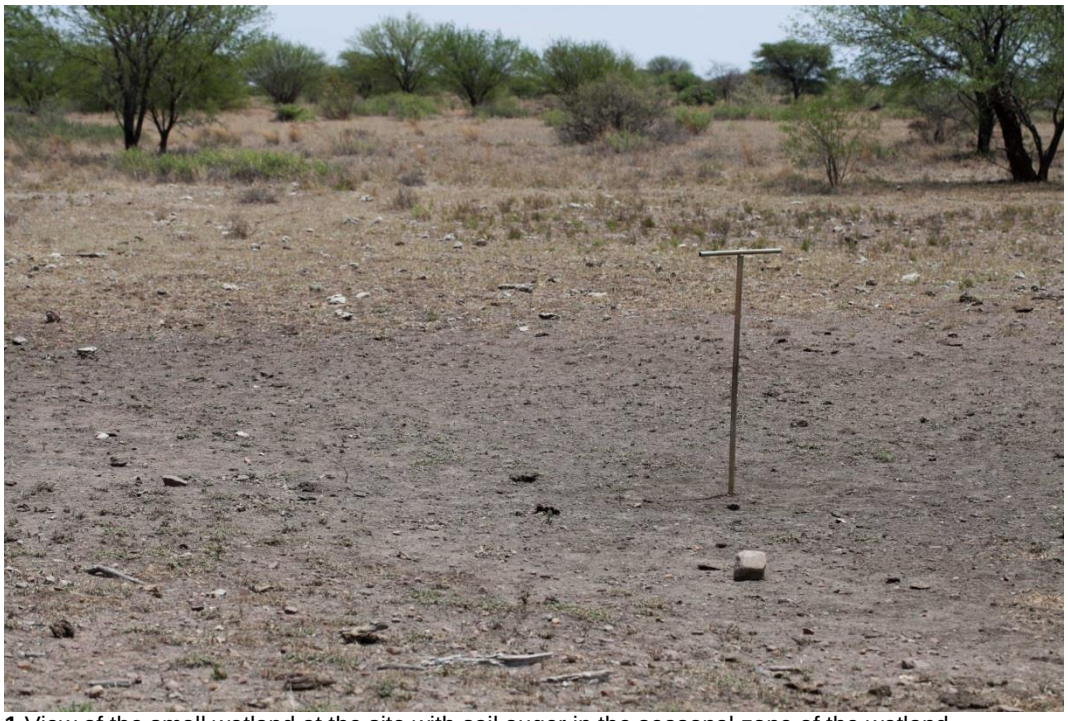

Photo 1 View of the small wetland at the site with soil auger in the seasonal zone of the wetland.
Photo: November 2015, R.F. Terblanche.

Photo 2 *Persicaria* species at the core of the small depression at the site. These will grow much taller once enough water accumilates in the small pan.
Photo: November 2015, R.F. Terblanche.

Photo 3 Mottled soil from the seasonal zone at the small restricted depression at the site.
Photo: November 2015, R.F. Terblanche.

Photo 4 Terrestrial soil nearby the wetland at the site is a light reddish-brown sandy soil.
Photo: November 2015, R.F. Terblanche.

Figure 2 Delineated seasonal and temporary zones of wetland at the site.

Green Outline: Outer limits of the temporary zone.
Light Blue Outline: Outer limits of the seasonal zone of the wetland.

Grid references and altitudes were taken at site with a GPS Garmin E-trex 20 ® instrument.
Map information was analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2015).

Table 4.2 Scoresheet with criteria for assessing habitat integrity of the wetland at the site to DWAF (1999) such as adapted from Kleynhans (1996).

Criteria and attributes	**Relevance**	**Score**	**Confidence**
Hydrologic			
Flow modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.	4	4
Permanent inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.	4	4
Water Quality			
Water quality modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.	3	3
Sediment load modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.	4	3
Hydraulic/Geomorphic			
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.	3	4
Topographic alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities which reduce or change wetland habitat directly or through changes in inundation patterns.	4	4
Biota			
Terrestrial encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.	3	4
Indigenous vegetation removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.	2	4
Invasive plant encroachment	Affect habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).	3	4
Alien fauna	Presence of alien fauna affecting faunal community structure.	4	4
Overutilisation of biota	Overgrazing, over-fishing etc.	3	4
TOTAL **MEAN**		**37** **x=3.4**	**42** **x=3.8**

Scoring guidelines per attribute:
natural, unmodified = 5; Largely natural = 4, Moderately modified = 3; largely modified = 2;
seriously modified = 1; Critically modified = 0.
Relative confidence of score:
Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1.

Table 4.3 Interpretation of scores for determining present ecological status **(PES)** of the wetland at the site according to DWAF (1999) such as adapted from Kleynhans (1999). Present ecological status of the wetland (indicated in blue font) is Category B.

Interpretation of Mean* of Scores for all Attributes: Rating of Present Ecological Status Category (PES Category)
WITHIN GENERALLY ACCEPTABLE RANGE
CATEGORY A >4; Unmodified, or approximates natural condition.
CATEGORY B **>3 and <=4; Largely natural with few modifications, but with some loss of natural habitats.**
CATEGORY C >2 and <=3; moderately modified, but with some loss of natural habitats.
CATEGORY D =2; largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
OUTSIDE GENERAL ACCEPTABLE RANGE
CATEGORY E >0 and <2; seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
CATEGORY F 0; critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

* If any of the attributes are rated <2, then the lowest rating for the attribute should be taken as indicative of the PES category and not the mean.

Table 4.4 Score sheet for determining ecological importance and sensitivity for floodplains (DWAF 1999, adapted from Kleynhans 1996, 1999).

Determinant	Score	Confidence
PRIMARY DETERMINANTS		
1. Rare & Endangered Species	0	3
2. Populations of Unique Species	0	3
3. Species/taxon Richness	2	3
4. Diversity of Habitat Types or Features	2	3
5. Migration route/breeding and feeding site for wetland species	1	3
6. Sensitivity to Changes in the Natural Hydrological Regime	3	3
7. Sensitivity to Water Quality Changes	3	3
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	3	3
MODIFYING DETERMINANTS		
9. Protected Status	0	4
10. Ecological Integrity	3	4
TOTAL	**17**	**32**
MEAN	**1.7**	**3.2**

Score guideline Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0
Confidence rating Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1

Table 4.5 Ecological importance and sensitivity categories. Interpretation of median scores for biotic and habitat determinants (DWAF 1999, adapted from Kleynhans 1996, 1999). Wetland at the site is of moderate ecological importance and sensitivity such as indicated in blue font.

Ecological Importance and Sensitivity Category (EIS)	**Range of Median**	**Recommended Ecological Management Class**
Very high Floodplains that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these floodplains is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4	A
High Floodplains that are considered to be ecologically important and sensitive. The biodiversity of these floodplains may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3	B
Moderate **Floodplains that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.**	**>1 and <=2**	**C**
Low/marginal Floodplains which are not ecologically important and sensitive at any scale. The biodiversity of these floodplains is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1	D

5 CONCLUSION

A distinct but small wetland of approximately 0.12 ha (longest diameter, 48 m) is found at the northern part of the site. Relatively this wetland, a depression, is very small. Vegetation at the restricted wetland area is represented by hydrophytic plant species such as a *Persicaria* species but any concentrations of sedges reeds or other obligate wetland plant species are absent. Wetland is a small depression on a plain with no clear inlet or outlet. Therefore the small depression approaches endorheic conditions where the water that flows in during rainfall events mostly leaves through evapotranspiration and infiltration in a low rainfall area (Mean Annual Precipitation < 500 mm).

Site is part of the Lower Vaal Water Management Area (WMA 10). The site is not part of a Freshwater Ecosystem Priority Area (FEPA) or wetland cluster (Nel, Driver, Strydom, Maherry, Petersen, Hill, Roux, Nienaber, Van Deventer, Swartz, & Smith-Adao, 2011; Nel, Murray, Maherry, Petersen, Roux, Driver, Hill, Van Deventer, Funke, Swartz, Smith-Adao, Mbona, Downsborough & Nienaber, 2011). By no means could the small depression at the site be classified or regarded as anything similar in scale to Southern Kalahari Salt Pans or Southern Kalahari Mekgacha (see Mucina & Rutherford, 2006).

The wetland patch will, if only for shorter periods during some years, be visited by water birds.

Present ecological status (PES) of the wetland at the site is CATEGORY B which means the wetland is largely natural with few modifications, but with some loss of natural habitats (Table 4.2 and Table 4.3). Ecological importance and sensitivity (EIS) of the wetland is Moderate which means the wetland is considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers (Table 4.4 and Table 4.5).

The small wetland could be managed in particular to fulfill its role in providing ecosystem services such as:

- Nutrient cycling and primary production, which are basic prerequisites of other ecosystem services of wetlands,
- Conservation of some wetland biodiversity,
- Counter erosion which remains important even though slopes in the area are not steep.

It is anticipated that the proposed development would not have a major influence on the hydrological regime of the depression at the site. There appears to be no distinct reason (such as would have been the case for gatherings of large rare water birds; associated unique wetland vegetation; extensive edge effects of impacts; sensitive extensive wetlands) why the buffer zone should be large.

No threatened plant or animal species are suspected to be present at the site. Given the present restricted nature of the wetland at the site, as well as the lack of threatened species, it is recommended that proposed developments, if approved, focus on maintaining the integrity and functioning of a small depression in a low rainfall area (below 500 mm per annum). The type of development proposed, if approved, does not have the same impact as for example a plantation or buildings in terms of shade effects on the flora and fauna, and more importantly, on buffer zones or corridors. A buffer zone of 32 m, given the type of development and the restricted nature of the wetland system, is thought to be adequate to maintain the functioning of the small wetland at the site.

A concentration of trees is found around the small pan. These trees include the indigenous *Acacia karroo* (Sweet Thorn) but there is also an exotic alien invasive species, *Prosopis glandulosa* (Honey Mesquite) present in numbers. It is very important that *Prosopis glandulosa* should be eradicated around the pan area in particular.

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