E02.JNB.001223

SANRAL – Proposed Construction of P166 Road in Mbombela, Mpumalanga – Wetlands Report

July 2012

A Specialist Report for: SANRAL

SSI A DHV COMPANY
ENGINEERS AND ENVIRONMENTAL CONSULTANTS
Linking People. Promoting Growth.

Tel: +27 (0) 11 798 6000

Email: pauld@ssi.co.za

Building No 5, Country Club Estate, 21 Woodlands Drive, Woodmead, 2191

DOCUMENT DESCRIPTION

Client:
South African National Roads Agency Ltd

Project Name:
Proposed P166 Road in Mbombela, Mpumalanga

SSI Environmental Reference Number:
E02.JNB.001223

Compiled by:
Paul da Cruz

Date:
July 2012

Location:
Johannesburg, South Africa

Approval: Malcolm Roods

____

Signature

TABLE OF CONTENTS

Table of Figures

List of Tables

Appendices

Specialist Declaration

I, Paul da Cruz, declare that I –

- act as an independent specialist consultant in the field of wetland assessment
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006; and

- will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.

PAUL DA CRUZ

1 INTRODUCTION

The South African National Roads Agency Ltd (SANRAL) has appointed SSI Environmental (SSI) to undertake an EIA study for the proposed construction of a road in the Nelspruit (Mbombela) / White River area within the Mbombela Local Municipality in Mpumalanga. One of the most important components of the biophysical environment in the study area are surface water features that would potentially be adversely affected or impacted by the proposed road. Surface water features (including wetlands) are a very important component of the natural environment, as they 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 a wetland 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 surface water resources and 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). It is in this context that the potential impact of the proposed development on surface water features is being assessed.

Accordingly a surface water / wetlands study has been commissioned as part of the EIA studies. This report will input into the Environmental Scoping Report for the EIA, and aims to identify all potential impacts related to the proposed road, as well as identifying all surface water features along the alignment of the proposed road.

1.1 Aim of the Study

The aims of the study are to:

- identify all surface water features along the proposed alignment of the P166 road and to characterise these in terms of their typology (including their respective hydrogeomorphic form, if they are wetlands)
- identify all potential impacts and issues related to the proposed road development and surface water features.
- Outline a terms of reference for the EIA-phase surface water study

1.2 Assumptions and Limitations

Only surface water features along, and within the immediate vicinity of the proposed alignment of the P166 roads, have been assessed as part of this study; the study does not include an assessment of surface water features within a wider area.

As discussed in section 1.3 below, a definition of wetlands that is slightly different to that provided by the National Water Act has been provided in this report. The definition used is based primarily on the presence of hydric soils, rather than on the hydroperiod of the surface water body. It should be noted that certain surface water features that may otherwise be termed as ‘wetlands’ have been excluded in this report. This does not mean however that these surface water features are any less sensitive, or that they are not protected under the Act as discussed below.

Only alignments and not corridors have been provided for assessment. Accordingly the surface water feature within the footprint of the proposed alignment was assessed.

This scoping-phase surface water assessment has been undertaken at a desktop level due to budgetary limitations. A short trip to the study area to verify the findings of the baseline environmental characterisation has been undertaken for this study. A thorough field-based assessment of the surface water features along the alignment of the proposed road will be undertaken in the EIA-phase surface water study.

1.3 Definition of Wetlands and Hydric Soils

The National Water Act defines a wetland as:

"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

This definition alludes to a number of physical characteristics of wetlands, including wetland hydrology, vegetation and soil. The reference to saturated soil is very important, as this is the most important factor by which wetlands are defined.

Another widely used definition of wetlands is the one used under the Ramsar Convention; wetlands are defined as:

"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 the depth of which at low tide does not exceed six metres"

However the definition of a wetland utilised in this report is based on the presence / absence of wetland or 'hydric' soils. Hydric soils 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.

This definition must be viewed in the context of surface water features in the study area; not all surface water features will qualify as wetlands, as hydrological or morphological drivers present within the surface water feature will not necessarily be conducive to the formation of hydric soils.

FIGURE 1 – HYDRIC SOILS EXPOSED BY SAND MINING ACTIVITIES IN A VALLEY BOTTOM WETLAND NEAR DRUM ROCK – NOTE THE ORANGE MOTTLES IN A 'REDUCED MATRIX'

1.4 Legislative Context

The following section briefly examines the legislation that is relevant to the scope of the surface water assessment. The stipulations / contents of the legislation and policy that is relevant to the study are explored.

1.4.1 The National Water Act

It is important to note that water resources, including wetlands are protected under the National Water Act 36 of 1998 (NWA). Wetlands are defined as water resources under the Act. 'Protection' of a water resource, as defined in the Act entails:

- Maintenance of the quality of 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
- The rehabilitation of the water resource

In the context of the current study and the identification of pressures and threats acting on wetlands, the definition of pollution and pollution prevention contained within the Act is relevant. 'Pollution', as described by the Act 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. It should also be noted that stormwater from the road and reserve that carries pollutants and which is discharged / flows into any od the surface water features crossed would be considered pollution.

In terms of section 19 of the Act 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

Section 21 of the Act lists the respective water uses as controlled by the Act. Of particular relevance to this project is the water use under Section 21 c) & i):

- c) impeding or diverting the flow of water in a watercourse
- i) altering the bed, banks, course or characteristics of a watercourse

The construction and subsequent operation of the road is highly likely to result in both activities. In the context of activity 21i, is important to note that the banks of a watercourse are taken to include the riparian habitat which under the Act is defined as the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas. The road's physical footprint and reserve will result in the clearing and transformation of a strip of the riparian zone of each watercourse crossed, and this will need to be licensed under the Act, with an accompanying consideration / assessment of the impact of the activity on the water resource.

The above stipulations of the Act have implications for the proposed development; as identified further on in this report the proposed development may be associated with certain direct or indirect impacts on surface water features in the area, some of which may affect the physical characteristics of the wetlands. These impacts are likely to be needed to be licensed under the Act. The National Water Act also stipulates requirements for permitting which would need to be followed.

1.4.2 National Forest Act (Act No 84 of 1998)

This Act provides "for the protection, management and utilisation of forests; the protection of certain plant and animal life; the regulation of trade in forest produce; the prevention and combating of veld, forest and mountain fires; the control and management of a national hiking way system and National Botanic Gardens; and matters connected herewith."

The Act enforces the necessity for a permit to be obtained prior to any clearing of indigenous vegetation. The Act also provides a list of protected tree species. This list was promulgated in 1976 and has since been updated. This act has relevance to the proposed project in relation to surface water features, as many of the protected trees that may be affected by the proposed project occur within the riparian zone and even in the bed of many of the surface water features crossed. If tree / shrub specimens of these species potentially need to felled or cut back, then a permit for this activity will need to be acquired from the Department of Agriculture, Fisheries and Forestry (DAFF).

2 PROJECT DESCRIPTION

2.1 Site Location and Description

The Study Area is located within the area surrounding the city of Mbombela (Nelspruit) and its outlying areas. The southern extent of the proposed road is located in the outlying smallholdings to the south of Mbombela, and the road runs to the west of the city and extending up to the Marathon area and then skirting the northern edge of the town of White River. The area traversed by the proposed lines is mostly rural in character, with the majority of it consisting of rural areas on the edge of the fast-growing city of Mbombela. The area thus consists of a mix of farming land, smallholdings, informal settlements and vacant land on the urban peripheries.

The area traversed by the proposed lines is located within a transitional area between the Mpumalanga Lowveld and the foothills of the escarpment to the west. The study area is underlain by basement granite and thus is characterised by flat to undulating terrain. Due to the sub-tropical nature of the climate in this area, savannah and woodland vegetation naturally occurs, as is explored further below.

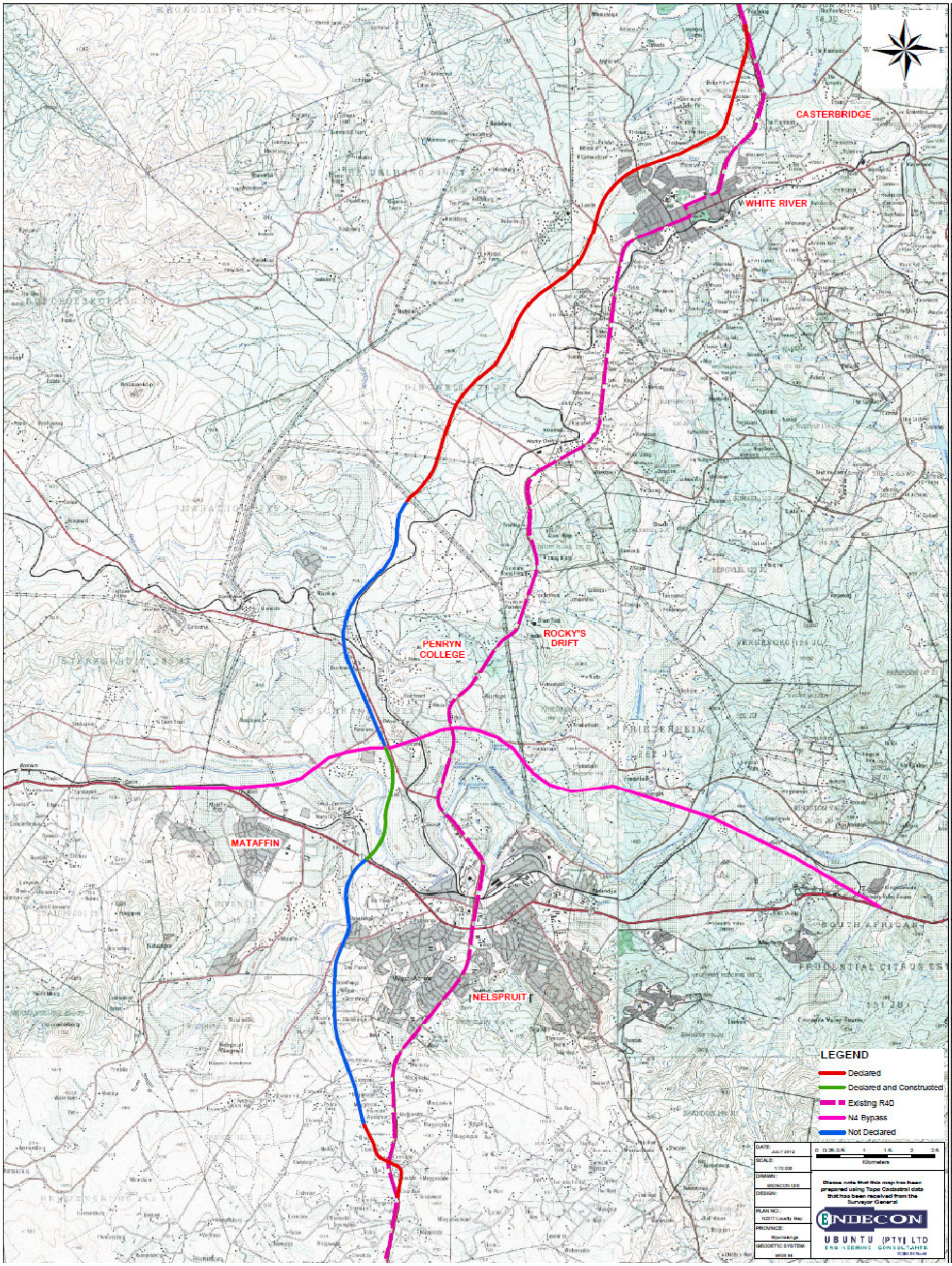

FIGURE 2 – PROJECT STUDY AREA

3 ASSESSMENT METHODOLOGY

The first step of the Scoping Phase wetlands assessment methodology was the identification and delineation of surface water features in the study area along the proposed road alignment. This was undertaken in ArcGIS, using 1:50 000 topo-cadastral maps and aerial photos of the study area to identify surface water features along the alignment. A GIS shapefile was created to represent the surface water feature crossing points. The surface water crossing points are represented in the maps below and in Appendix 1.

Generic potential issues and impacts on surface water features that may be caused by or associated with the life stages of the proposed development (i.e. construction and operation) for all components of the development including associated infrastructure were scoped and identified. These potential impacts will be further assessed in the EIR-phase surface water study.

4 ENVIRONMENTAL BASELINE

4.1 Study Area Biophysical Characteristics and how these relate to / affect surface water features

4.1.1 Climate

The greater study area lies just to the east of the Great Escarpment that separates the high interior plateau of the sub-continent (the Highveld) from the lower-lying areas of Mpumalanga and Limpopo Provinces to the east that are typically referred to the Lowveld. There is a typical rainfall gradient between the escarpment and the lower-lying areas, with rainfall decreasing as one moves away from the escarpment into the Lowveld. The location of parts of the study area within the foothills of the escarpment entail that the study area has a higher rainfall than the surrounding lower-lying areas. The mean annual rainfall figures for the southern part of the study area (to the south of Nelspruit and around the Mbombela stadium and N4 bypass) range between 775 and 795mm/annum (South Africa Rainfall Atlas). As the route climbs into the higher-lying ground to the north, the rainfall gradient increases, with the mean annual rainfall west of Rocky Drift being around 820mm/annum and the area around White River having a mean annual rainfall of 875mm/annum (South Africa Rainfall Atlas).

Rainfall is highly seasonal with rainfall predominantly occurring in the summer months. This high seasonality of precipitation has implications for the hydrology of the area as discussed below. The area typically experiences hot summer temperatures, whilst winters are generally mild with a low incidence of frost (Mucina & Rutherford, 2006). The high seasonality of rainfall is an important driver of the hydrology or rivers and drainage lines within many parts of the study area. The high seasonality of the rainfall entails that river flows are typically much higher in the summer months.

4.1.2 Geology, Macro-geomorphology and Topography

The entire study area is underlain by the basement granites of the Nelspruit suite, which has a bearing on the types of soils derived from the bedrock or parent material. The granites form part of the basement complex, a very old geological formation that consists of Archean granites and gneiss. The granites have been exposed by the very gradual westward-erosion of the younger geological strata associated with the great escarpment to the west.

The wider Lowveld, of which the study area forms part has over aeons developed as the younger overlying sediments have been eroded back, exposing the older granitic geology.

A system to classify the macro-drainage characteristics of South Africa has been developed, in terms of this classification the study area is found within the Lowveld Geomorphic Province; the province is characterised by low, undulating plains. Although in some areas the granite erodes to form exfoliation domes (dome-shaped outcrops of rock) that are typical of much of the study area, the remainder of the landscape is extensively pedimented (Norman & Whitfield, 2006) (i.e. having gentle slopes, occurring below much steeper slopes (the escarpment) and sloping in a low gradient down to river valleys). The topography associated with the granite is thus typically gently undulating, which has had a concomitant effect on the type of drainage present in the area, The undulating terrain is associated with broad, shallow valleys, and the major rivers in the area have very broad cross-sectional profiles (Partridge et al, 2010).

4.1.3 Macro Drainage characteristics

As the proposed route is aligned in a north-south orientation in a context of the overall drainage that is aligned in an east-west orientation (due to rivers flowing down the escarpment towards the Indian Ocean), the lines typically cross a number of rivers and thus catchments. Overall all rivers in the study area drain into the Komati-Crocodile primary catchment. Within this wider context they form part of the Crocodile River sub-catchment. The entire alignment falls within 3 sub-catchments (quarternary catchments) of the Crocodile River catchment - to the north catchment X22H, the lower reaches of the Witspruit or Blinkwaterspruit, X22F containing the lower reaches of the Nels and Sand Rivers, and in the south the catchment X22C which is drained by a stretch of the Crocodile River to the west of Nelspruit and one of its tributaries, the Gladdespruit. All of these rivers are perennial due to the high rainfall within their catchments.

4.1.4 Current Land Cover and Land Use

As stated above, a mix of landuses occurs within the study area. Commercial agriculture predominates, with much of the area in the vicinity of Mbombela and White River being utilised for the commercial production of subtropical fruit, in particularly citrus, as well as sugarcane. In certain areas small compartments of commercial forestry occur. Parts of the area to the north-west of Nelspruit are vacant, and the natural veld has been retained; this includes many parts of the study area where significant outcropping of granite bedrock in the form of large exfoliation domes occur. Other ‘transformed’ parts of the study area in the vicinity of the proposed road include urban areas (residential, retail and light industrial as well as a newly-developed informal settlement component), with a number of transport links in the form of road and rail existing.

4.2 Study Area Surface Water Characteristics

4.2.1 Surface Water Typology (incl. Wetland Hydrogeomorphic Forms)

There are a number of different types of surface water features in the study area, including a number of different wetland hydrogeomorphic forms. It is important to note that not all surface water features found in the study area can be classified as wetlands. There are likely to be certain drainage lines / rivers that occur along the proposed road in which no hydric soils are likely to occur, due mainly to the presence of outcropping / very shallow bedrock at the surface which precludes the occurrence of soils, or where recent alluvial deposits have not developed signs of hydromorphism. Although these areas are not strictly wetlands if hydric soils are not found within them, the areas have been included in the delineation of surface water resources as they are protected under the National Water Act in the same way as wetlands are protected.

Most of the surface water features encountered in the study area contain a distinct riparian zone. Under the National Water Act a riparian zone is defined as the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas. The natural vegetation in the study area consists of savannah-type vegetation – i.e. very open woodland with a grassy understorey. Conversely dense thickets and large trees occur along drainage lines, wetlands and rivers in the study area, with a typical tree and shrub species composition of species that tolerate or thrive in moist or even inundated conditions. Thus riparian zones are wooded. In certain situations, the riparian zone is synonymous with hydric soils Riparain zones are ecologically very important as they contain a high species diversity and provide important food and refuge areas for biota, often forming linear natural habitats in an otherwise transformed context.

FIGURE 3 – HYDRIC SOILS EXPOSED BY ROAD CONSTRUCTION ACTIVITIES. NOTE THE WOODED RIPARIAN ZONE OCCURRING WITHIN THE WETLAND IN THE BACKGROUND

In the context of wetlands that occur in the study area, a classification system exists for different types of wetlands – a hydrogeomorphic-based classification system. The wetland hydrogeomorphic (HGM) approach to wetland classification which uses hydrological and geomorphological characteristics to distinguish primary wetland units has been used to classify wetland types in South Africa (Kotze et al, 2005; SANBI, 2009). This approach has been used, and the classification system has been recently updated as part of the National Wetland Classification System for South Africa (SANBI, 2009). Under this classification system there are a number of different types of terrestrial (as opposed to marine) wetlands, certain of which are likely to occur in the Study Area:

- ☐ Channel
- ☐ Channelled Valley-Bottom Wetland
- ☐ Un-channelled Valley-Bottom Wetland
- ☐ Valleyhead Seep
- ☐ Hillslope Seep

A few HGM forms do not occur within the study area; including pans / depressions, true floodplains, and flats. The primary type of surface water feature occurring across the study area is the valley bottom wetland. Due to the undulating nature of the terrain, most wetlands occur within valley bottoms, and drain into the three major rivers (the Sand, Nels and Crocodile) that drain across the study area. Although valley bottoms are typically not very incised, the valley bottom wetlands are often relatively narrow, and no wide floodplain systems where depositional processes would predominate occur within the study area. The primary reason for the predominance of narrow valley bottom wetlands in the study area is due to the outcropping of granite bedrock in many parts of the study area that precludes the formation of wider depressional systems. In the southern parts of the study area, the Crocodile River has cut a relatively deep, steep-sided valley into the underlying granitic bedrock.

FIGURE 4 – NARROW VALLEY BOTTOM WETLAND WITHIN THE INFORMAL SETTLEMENT TO THE SOUTH OF WHITE RIVER

Where they occur, hillslope seepage and wetlands are hydrologically connected to the drainage network, and typically become valley bottom wetlands in their lower reaches. Hillslope seepage wetlands are found where groundwater discharges to the surface; groundwater outflow is the primary hydrological input to these wetlands. Where hillslope seepage wetlands were encountered in the study area, these were more often than not associated with bedrock outcropping of granite, especially in the form of lower outcrops at surface level. Groundwater in granite bedrock settings typically occurs within fractures within the bedrock. A study for a another project by the author in the same area (da Cruz, 2009) found that in a number of cases hillslope seepage wetlands were located immediately adjacent to, or downslope of these outcrops, suggesting that the granite outcrops are significant determinants of groundwater flow within the granite bedrock matrix, with groundwater discharge to the surface typically occurring at the boundary of these outcrops.

4.2.2 Wetland Vegetative Characteristics

As described above, most wetlands in the study area are valley bottom systems, many of which are narrow features. The most commonly occurring vegetative form in these wetlands is *Phragmites mautitianus* reedbeds. The reeds occur across the channel or bed of the wetland, often with a very narrow vegetative transitional area to the surrounding non-wetland area. As described above, many of the wetlands display a wooded riparian component to their vegetative structure, with a dense cover of trees and shrubs occurring on the channel banks, or even in the wetland itself. In some wetlands, particularly those in the higher-lying northern parts of the study area near white river, wetland vegetation was noted to consist of grasses rather than reedbeds.

FIGURE 5 – *PHRAGMITES MAURITIANUS* REEDBEDS THAT COMMONLY OCCUR IN MANY OF THE WETLANDS IN THE STUDY AREA

FIGURE 6 – A VALLEY BOTTOM WETLAND ON THE PERIPHERY OF WHITE RIVER. NOTE THE GRASSY PERIPHERIES OF THE WETLAND AND THE WOODED RIPARIAN COMPONENTS

4.2.3 Crossing Points

The table below lists all of the potential crossing points along the alignment (including the proposed road reserve area) of the P166 road. The table lists the wetland or river type (in the context of wetlands the hydrogeomorphic wetland type is listed), as well as the name of the river, where applicable. The crossing name has been based on the quaternary catchment in which the crossing point is located. As can be seen, the vast majority of crossing points are valley bottom wetlands that are channelled. In addition to a number of larger perennial rivers crossed, the other wetland type crossed is the un-channelled valley bottom wetland. These wetlands are characterised by diffuse flow within the wetland area, which is important in the context of potential impacts on the hydrology of the wetland, as explored below.

It should be noted that certain rivers / wetlands are crossed in more than one location, or by linkages to the main servitude road; in this case all potential crossing points have been listed. It should also be noted that where the proposed road and its reserve falls within the riparian zone of a river only (not crossing the river itself), this has also been listed as a crossing point. A number of other points which could be wetlands have been marked for further investigation to determine whether they are surface water features. These points have not been listed below but may be added to this list at a later point. At the present time 30 crossing points have been identified along the length of the proposed road (and within its reserve).

TABLE 1 – CROSSING POINTS ALONG THE PROPOSED ALIGNMENT

Crossing Number	Wetland / River Type	Name
X22C_1	Channel / Seasonal Drainage line	
X22C_2	Valley Bottom Wetland - channelled	
X22C_3	Channel / Seasonal Drainage line	
X22C_4	Valley Bottom Wetland - channelled	Brinkspruit
X22C_5	Channel / Seasonal Drainage line	
X22C_6	Valley Bottom Wetland - channelled	BrinkSpruit
X22C_7	Channel / Seasonal Drainage line	
X22C_8	Channel / Seasonal Drainage line	
X22C_9	Perennial River	Gladdespruit
X22C_10	Perennial River - riparian only	Gladdespruit
X22C_11	Perennial River	Crocodile
X22J_1	Channel / Seasonal Drainage line	
X22J_2	Channel / Seasonal Drainage line	
X22F_1	Valley Bottom Wetland - unchannelled	
X22F_2	Perennial River	Sand
X22F_3	Valley Bottom Wetland - channelled	
X22F_4	Valley Bottom Wetland - channelled	
X22F_5	Valley Bottom Wetland - channelled	
X22F_6	Valley Bottom Wetland - unchannelled	
X22F_7	Valley Bottom Wetland - channelled	
X22F_8	Valley Bottom Wetland - channelled	
X22F_9	Valley Bottom Wetland - channelled	
X22F_10	Valley Bottom Wetland - channelled	
X22F_11	Valleyhead Seepage Wetland	
X22H_1	Valley Bottom Wetland - channelled	
X22H_2	Valley Bottom Wetland - unchannelled	
X22H_3	Valley Bottom Wetland - channelled	
X22H_4	Valley Bottom Wetland - channelled	
X22H_5	Valley Bottom Wetland - channelled	Blinkwaterspruit
X22H_6	Valley Bottom Wetland - channelled	De Beersspruit

5 NATURE OF THE POTENTIAL IMPACTS ON SURFACE WATER FEATURES ASSOCIATED WITH THE PROPOSED DEVELOPMENT

5.1 How are wetlands impacted by roads?

The most important aspect of the impact of any development on a wetland (and other surface water features) is in terms of the wetland's ***functionality*** and ***state***. In general a structure such as a road can have a physical effect on a wetland or watercourse, transforming or causing loss of wetland habitat that importantly can result in an impact on wetland state and functionality. Wetland functionality can be divided up into a number of components including ecological value, hydrological functioning, water quality enhancement and socio-economic functionality, amongst others; all of which can be included in a set of ecosystem goods and services typically offered by wetlands. All of these functions are intrinsically related to, and are dependent upon the physical components of the wetland, including the soils and vegetation contained within the wetland as well as other biotic components that are adapted to life within wetlands. The presence of these biotic components is in turn closely related to the nature of the hydrology of the wetland, which in the hydro-geomorphic forms found in the study area is characterised by the retention of, and diffuse flow of water through the wetland in the case of valley bottom wetlands, or the interface with groundwater (discharge) in the case of hillslope seepage wetlands. The combination of the hydrology, hydromorpholgy and biota (especially vegetation) within the wetland allows certain chemical and ecological processes to occur that provide much of the wetland's functionality. If the physical characteristics of the wetland are transformed, or destroyed, the hydrology, hydromorphology and ecological assemblages within the wetland will typically be altered. The resulting impact is the loss / destruction of functionality and value of the wetland, as well as a degradation of the wetland state.

In the context of the of the physical transformation of a stretch of a wetland by a development such as a road, it is important to note that the impact is likely to not only be limited to the wetland crossing and the footprint of the crossing itself, but to a much wider area, especially downstream of the crossing. This is discussed below, particularly in the context of the alteration that a road crossing can have on hydrology of the wetland and the concomitant impact on wetland functionality and state. Thus a reach of a river or wetland much wider than just the area affected by the crossing can be affected and experience impacts in terms of its functioning and state.

5.2 Generic impacts related to roads

Roads can have a significant impact on surface water features, as depending on the design of the road crossing the surface water feature may be physically affected as the footprint of the road will affect the hydrology and habitat of the surface water feature to varying degrees. The degree of impact depends to a large degree on the type of the road crossing. Spanning a water feature by building a bridge or similar structure typically has much less of an impact than if the road structure is constructed into the wetland – i.e. the substrate of the road is constructed into and across the surface water feature and culvert structures are used to allow flow to underpass the road. A bridge structure typically has a much lesser physical footprint in the bed of the river or wetland, thus resulting in a lower loss of vegetation and disturbance of physical habitat. Conversely roads will tend to have a much greater physical footprint within a surface water feature in the latter case as foreign substrate will need to be laid and imported into the bed and banks of the feature.

FIGURE 7 – EXAMPLE OF ROAD CONSTRUCTION ACTIVITIES THAT HAVE IMPACTED A WETLAND IN THE STUDY AREA NEAR THE EMNOTWENI CASINO COMPLEX

The two most important types of impacts that would relate to new roads constructed into and across surface water features relates to the destruction of riparian / wetland habitat and vegetation and the alteration of the hydrological regime. Depending on the nature of the design roads constructed into a surface water feature could involve the placing of imported substrate into the bed of the watercourse or wetland. This would cause a certain area of vegetation on the banks and in the channel to be lost. The presence of the raised road and its substrate typically acts as hydrological barrier to flow in the system. This would typically alter the hydrology of the surface water feature by effectively 'damming' water on the upstream side of the road (making this wetter than the pre-construction situation) and by allowing water to bypass or underpass the road to the downstream section of the wetland more slowly or in lesser volumes. The impounding effect can also have an important effect on the morphology of the watercourse as sediment that is transported down the watercourse during flow periods would be trapped behind the structure. This can alter the natural sediment balance of the downstream watercourse, and by depriving the downstream stretches of sediment, can induce erosion in these stretches as the natural sediment balance is re-established.

Culverts are often constructed under road crossings of watercourses. The number and size of the culverts is an important factor in determining the degree and nature of the impact on the hydromorphological regime of the feature; too few culverts can exacerbate the impounding function of the road, also concentrating flow downstream of the crossing which can result in channelisation of a wetland. This is very important in the context of wetlands, where diffuse flow would naturally occur within the bed of the valley bottom; the reduction in diffuse flow and channelisation of the downstream part of the wetland can have an important impact on the resource quality in the wetland and could negatively affect its level of functionality. In this context the alteration of the hydrology of a surface water feature can alter the vegetative composition of a wetland, by allowing pioneer non-wetland plant species to establish themselves in an area where the wetland has been channelised and the water table has been lowered, thus desiccating the wetland.

Roads can also form hard barriers which can hamper the movement of terrestrial biota along the riparian corridor, and even other flying invertebrates such as butterflies. In this regard bridge crossings which have a much lesser footprint in the channel and adjacent banks have a much lesser restrictive factor and have a lower impact in this regard.

Roads can also be associated with stormwater inputs into surface water features, especially if the road has an impermeable surface. Stormwater input can be associated with a number of impacts; firstly it can artificially increase the flow within the surface water feature during rainfall events, resulting in potential knock-on effects on the downstream wetland such as scour and erosion of the downstream watercourse. Stormwater may also pick up pollutants that are spilt onto the road surface, especially fuel, oil and other hydrocarbons that could pollute the downstream surface water feature. Lastly, but just as importantly, stormwater may also feed silt from the catchment or road surface itself into a watercourse, thus altering the habitat integrity of the feature, in particular of wetlands.

5.3 Ecological Impacts in the context of Surface Water Features

Surface water features are ecologically very important for a number of reasons due to presence of aquatic and riparian habitat and the associated biota that occur within these habitats. Surface water features are typically linear in nature, and in many cases provide a last remnant of natural habitat in an otherwise transformed landscape. For these two primary reasons, surface water features often act as important movement corridors and ecological linkages. The development of a road through a surface water feature such as a wetland can be associated with a number of impacts on the movement of biota through this feature. Road crossings typically create a 'hard barrier' across the surface water feature in the context of its bed and banks. The creation of this barrier is a very strong hindrance to both aquatic and terrestrial biota using the wetland or watercourse as a movement corridor. Animals moving across a road may be prone to greater mortalities and increased predation as they move across the cleared area of the road surface and reserve. Road crossing structures not designed to accommodate low water flows through the crossing may similarly be a significant hindrance to the movement of aquatic biota.

As most of the surface water features in the area are associated with a riparian zone, the road crossings of surface water features will have an impact on these riparian areas. Riparian vegetation will be cleared within the road and road reserve footprint, and thus will have an impact on the structural integrity of the riparian zone. Importantly it introduces the edge effect which can have an important effect on biota within the riparian zone, and create a very convenient 'entry point' into the riparian zone and wider riverine corridor for alien invasive vegetation. Certain of the tree / shrubs occurring within the riparian zones of rivers and watercourses in the study area are protected species, and these would be felled if they are located within the reserve. Although many of the larger trees are not subject to protection under the National Forestry Act, these larger trees are locally very important as they provide an important seasonal source of food for many animals, including many avian frugivores (fruit-eating bird species).

5.4 Other Construction-related impacts

A number of construction activities can cause impacts in surface water features. Accordingly the following impacts on surface water can result from construction activities along the road servitude:

- The uncontrolled interaction of construction workers with watercourses that could lead to the pollution of the water in these drainage systems. Examples of this may be the washing of equipment in water within the watercourse, dumping of construction material into the drainage system etc.
- The lack of provision of adequate sanitary facilities and ablutions on the servitude may lead to the direct of indirect faecal pollution of surface water resources.
- Leakage of hazardous materials, including chemicals and hydrocarbons such as fuel, and oil, which could potentially enter nearby surface water resources through stormwater flows. This may arise from their incorrect use or incorrect storage.
- The incorrect mixing (batching) of cement could lead to siltation and contamination of watercourses.
- Inadequate stormwater management and soil stabilisation measures in cleared areas could lead to erosion that may lead to siltation of nearby watercourses.
- The creation of new access roads for construction traffic across watercourses may lead to the erosion of banks and disturbance of riparian vegetation that may trigger the further development of gulley (donga) erosion.
- Construction of accesses across watercourses may impede the natural flow of water (especially if access is required across running water). This would alter the hydrology of the watercourse and potentially act as a barrier to the movement of aquatic biota. Uncontrolled access of vehicles through wetlands can cause a significant adverse impact on the hydrology and soil structure of these areas through rutting (which can act as flow conduits) and through the compaction of soils.
- Construction vehicles and machinery that move along the alignment of a road during construction would typically to cross rivers and drainage lines. Construction accesses across these surface water resources may need to be constructed should existing accesses for vehicles not exist

5.5 Implications for Development

These impacts could have a significant localised effect on the surface water features crossed by causing transformation of wetland, aquatic and riparian habitat. The impact could be wider reaching, as impacts could be experienced in downstream reaches of the affected watercourse. Although localised in extent, cumulatively the impacts could be significant in a catchment scale, as all surface water crossing exist within the context of the Crocodile River catchment. The river is internationally important, as it is a tributary of the Inkomati (Komati) River which flows into Mozambique.

As discussed above, most of the river crossings are valley bottom wetlands. Although these are typically the most resilient types of wetlands to disturbance, this does not diminish in any way the importance of potential impacts of the road on these wetlands. Although they would contain a channel, much of the above-ground flow within these types of wetlands is diffuse in nature. Along with the handful of un-channelled valley bottom wetlands that are proposed to be crossed, the alteration of this diffuse flow through the channelisation of the wetland through one or more culverts can have very significant impacts on the downstream reach of the wetland as described above.

A licensing process under the National Water Act exists to manage activities such as the proposed road construction which could potentially adversely affect water resources, as described above. As mentioned in the introductory sections above, the road construction and operation would fall under Section 21 c) & i) activities that are specified by the Act, and as such would need to be licensed as part of an integrated Water Use Licence for the proposed development.

It is important to note that most of these impacts can be effectively mitigated through a number of design and construction and operational practice measures that can be implemented. A full set of mitigation measures will be drawn up as part of the EIR-phase surface water study.

6 CONCLUSIONS

The proposed P166 road would cross and thus would potentially affect a number of surface water features along its length. The predominant surface water feature in the study area is the channelled valley bottom wetland, with a number of perennial rivers and some un-channelled valley bottom wetlands also crossed. A typical feature of the vast majority of surface features in the study area is the presence of a vegetative riparian zone that is distinct from the surrounding woodland vegetation in terms of its structure and species composition. These riparian zones are ecologically very important, and play an important role in terms of the morphological state of the watercourse.

The road could result in a number of potential impacts on the identified surface water features in the area, which have been detailed above. The most important impacts relate to the potential transformation of wetland habitat, as well as the localised and downstream changes to wetland functioning and state which would result from alteration to the hydrology and vegetative composition of the surface water feature downstream of the crossing point.

This scoping-phase surface water study has been conducted as a desktop study. The findings of this study in terms of the nature of surface water features in the study area and the identified issues and impacts will be further assessed in the EIR-phase study. The terms of reference for this study are detailed below.

6.1 Terms of reference for the EIR-phase surface water study

The EIR-phase surface water study will assess in more detail the nature of the surface water features crossed by the proposed P166 road. All surface water features will be visited in the field to validate the findings of the scoping phase study in terms of their (hydrogeomorphic) classification. Where wetlands (i.e. containing hydric soils) are found to occur, the extent of the crossing will be delineated in the field utilising the Department of Water Affairs' guideline for the delineation of wetland areas (DWAF, 2005). This guideline will also form the basis for the delineation of the edge of the riparian zone of the surface water features where a riparian zone is present. A wetland and riparian zone shapefile will be created. The field visit will also be used to identify all other surface water features not identified during the desktop assessment, or where uncertainty existed as to whether the area constituted a wetland or other surface water feature.

The impacts of the proposed road and river crossing structures will be assessed in detail in the EIR-phase surface water study. This will include the assessment of the likely impacts associated with the relevant design of the crossing structure (if available) at the level of each crossing point. A high level assessment of the Present Ecological Status of each crossing will be undertaken in order to inform the assessment of impacts.

Based on the identification of impacts, a list of mitigation or remediation measures will be specified.

Lastly the impacts of the proposed project on surface water features will be rated in terms of the EIA rating matrix.

7 REFERENCES

- Collins, N.B., 2005, Wetlands: The basics and some more. Free State Department of Tourism, Environmental and Economic Affairs.
- Da Cruz, P.R. 2009, Wetlands Assessment Report for the proposed Marathon-Delta power line, unpublished EIA specialist report
- Department of Water Affairs and Forestry, 2005, A Practical field procedure for identification and delineation of wetlands and riparian areas, Final Draft
- Dollar, E.S.J., 2000, The Determination of Geomorphologically effective flows in selected eastern sea-board rivers in South Africa. Unpublished PHD Thesis, Rhodes University
- Norman, N. & Whitfield, G. 2006. Geological Journeys: A traveller's guide to South Africa's rocks and landforms. Struik Publishers. Cape Town
- Partridge, T. C., Dollar, E. S. J., Moolman, J. and Dollar, L. H.:2010. The geomorphic provinces of South Africa, Lesotho and Swaziland: A physiographic subdivision for earth and environmental scientists', Transactions of the Royal Society of South Africa, 65: 1, 1 — 47
- 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).

APPENDIX A:
Maps

APPENDIX B:

Description of Wetland Hydrogeomorphic (HGM) Forms (extracted from SANBI, 2009)

- **Channel (river, including the banks):** an open conduit with clearly defined margins that (i) continuously or periodically contains flowing water, or (ii) forms a connecting link between two water bodies. Dominant water sources include concentrated surface flow from upstream channels and tributaries, diffuse surface flow or interflow, and/or groundwater flow. Water moves through the system as concentrated flow and usually exits as such but can exit as diffuse surface flow because of a sudden change in gradient. Unidirectional channel-contained horizontal flow characterises the hydrodynamic nature of these units. Note that, for purposes of the classification system, channels generally refer to rivers or streams (including those that have been canalised) that are subject to concentrated flow on a continuous basis or periodically during flooding, as opposed to being characterised by diffuse flow (see un-channelled valley-bottom wetland). As a result of the erosive forces associated with concentrated flow, channels characteristically have relatively obvious active channel banks.
- **Channelled valley-bottom wetland:** a mostly flat valley-bottom wetland dissected by and typically elevated above a channel (see channel). Dominant water inputs to these areas are typically from the channel, either as surface flow resulting from overtopping of the channel bank/s or as interflow, or from adjacent valley-side slopes (as overland flow or interflow). Water generally moves through the wetland as diffuse surface flow, although occasional, short-lived concentrated flows are possible during flooding events. Small depressional areas within a channelled valley-bottom wetland can result in the temporary containment and storage of water within the wetland. Water generally exits in the form of diffuse surface flow and interflow, with the infiltration and evaporation of water from these wetlands also being potentially significant (particularly from depressional areas). The hydrodynamic nature of channelled valley-bottom wetlands is characterised by bidirectional horizontal flow, with limited vertical fluctuations in depressional areas.
- **Un-channelled valley-bottom wetland**: a mostly flat valley-bottom wetland area without a major channel running through it, characterised by an absence of distinct channel banks and the prevalence of diffuse flows, even during and after high rainfall events. Water inputs are typically from an upstream channel, as the flow becomes dispersed, and from adjacent slopes (if present) or groundwater. Water generally moves through the wetland in the form of diffuse surface flow and/or interflow (with some temporary containment of water in depressional areas), but the outflow can be in the form of diffuse or concentrated surface flow. Infiltration and evaporation from unchannelled valley-bottom wetlands can be significant, particularly if there are a number of small depressions within the wetland area. Horizontal, unidirectional diffuse surface-flow tends to dominate in terms of the hydrodynamics.
- **Valley head seep:** a gently-sloping, typically concave wetland area located on a valley floor at the head of a drainage line15, with water inputs mainly from subsurface flow (although there is usually also a convergence of diffuse overland water flow in these areas during and after rainfall events). Horizontal, unidirectional (down-slope) movement of water in the form of interflow and diffuse surface flow dominates within a valleyhead seep, while water exits at the downstream end as concentrated surface flow where the valleyhead seep becomes a channel.
- **Hillslope seep**: a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Water inputs are primarily from groundwater or precipitation that that enters the wetland from an up-slope direction in the form of subsurface flow. Water movement through the wetland is mainly in the form of interflow, with diffuse overland flow (‘sheetwash’) often being significant during and after rainfall events. Water leaves a ‘hillslope seep with channelled outflow’ mostly by means of concentrated surface flow, whereas water leaves a ‘hillslope seep without channelled outflow’ by means of a combination of diffuse surface flow, interflow, evaporation and infiltration