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Ezakheni Residential Develop Wetland and Riparian Study: In support of the Basic Assessment Study for the proposed Construction of 150 Low income Houses at Alfred Duma Local Municipality, KwaZulu-Natalment Project, KwaZulu Natal

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1. INTRODUCTION

Nkululeko Environmental and Development Agency has been appointed to undertake the necessary environmental services required for the proposed Ezakheni residential development project at the uThukela District Municipality. The proposed housing project is RDP houses which will be built amid existing households. The Environmental Impact Assessment (EIA) report compiled for this project is in accordance with the Environmental Impact Assessment (EIA) Regulations (2014 as amended). The report provides baseline description of the project area and the mitigation measures for impacts identified during assessments. Section 28 of NEMA (National Environmental Management Act, Act 107 of 1998) which pertains to “Duty of care and remediation of Environmental Damage” further strengthens the importance of the EIA report before the project can proceed. As part of the Environmental Impact assessment for the proposed development a Wetland Impact Assessment is being undertaken to asses if the proposed development will have an impact on riparian wetland on site.

Water sources (including wetlands and rivers) are a very important component of the natural environment, as they are typically characterised by high levels of biodiversity, perform critical ecological and hydrological functions and are often vital for sustaining human livelihoods through the provision of water for drinking and other human uses. 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, as amended). It is in this context that the potential impact of the proposed development on water sources features is being assessed.

1.1. Site Location and Description

The development site is located at Ezakheni Section C within the Alfred duma Local Municipality. Ezakheni is an African township that was built in the old KwaZulu homeland about 25km from the town of Ladysmith. The area was established in 1972 and its population at the time was in the region of 50 000. The township was built in two parts, a formal section with rented housing and a site and service section where people could build their own houses. The area was built on Trust Land acquired by the South African Development Trust (SADT) in the early 1960s, after some resistance from the local Farmers Association to the acquisition of more land in the district by the SADT. African families from Ladysmith townships and surrounding ‘black spots’ were moved into Ezakheni in successive batches, and these included landowners. The removals to Ezakheni occurred in 1972, and continued throughout the 1970s. Ezakheni was created to accommodate and control Ladysmith’s labour force and their families within KwaZulu

2. PROJECT TECHNICAL DESCRIPTION

Internal infrastructure

The Underlying project activity is for the construction of 150 houses. The levels of service delivery for the proposed development of the aforementioned houses has been derived from The Guidelines for Human Settlement Planning and Design under the patronage of the Department of Human Settlements and the Services Level Agreements, as well as additional guidelines supplied by Uthukela District Municipality and Alfred Duma Local Municipality. Services associated with the above mentioned development are:

Water

A full pressure piped level of service will be installed within the road reserve area as far as possible in accordance with the requirements and relevant specifications of the Water Services Authority and/or the "Red Book" Guidelines for Human Settlement, Planning and. It will cater for:

Provision of Water for Fire Fighting

Firefighting water will be drawn from the domestic reticulation mains through fire hydrants that will be installed in accordance with the requirements of the relevant Services Authority.

Sanitation

The entire proposed internal sewer reticulation network will be a piped system gravitating towards various collection points.

Roads Storm water Drainage

Roads

All roads will be constructed to the satisfaction of the Alfred Duma Municipality.

The principles and parameters of the storm water management plan, as well as the requirements of the environmental management plan will guide the design of the storm water reticulation system, including the treating of outlet control structures and discharge into the natural drainage courses. All storm water emanating from the roads, as well as run off from properties, where applicable, would be collected by the proposed piped storm water reticulation system and conveyed in a controlled manner to the natural drainage courses.

3. AIMS OF THE STUDY

The aims of the study are to:

- identify all surface water features in the vicinity of the proposed housing development assess the impact of the construction of 150 low cost housing on identified water resources in the vicinity of the development; and recommend suitable mitigation measures, if relevant, to mitigate or extinguish predicted impacts.

Assumptions and Limitations

This study is being undertaken as part of a Basic Assessment Application. At the time of writing, no Water Use Licensing Studies (under Section 21 of the National Water Act) are being undertaken for the proposed project, and thus this study has not included component studies of the state and functionality of surface water resources and wetlands in the wider area that may need to be undertaken as part of a water use application.

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.

The National Water Act

It is important to note that water resources, including wetlands are protected under the National Water Act (Act No. 36 of 1998) (NWA). “Protection” of a water resource, as defined in the Act entails:

> “maintenance of the quality of the water resource to the extent that the water resource may be used in an ecologically sustainable way; prevention of the degradation of the water resource; and the rehabilitation of the water resource;”

In the context of the current study and the identification of potential threats to the surface water features posed by the proposed housing development, 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" "of human beings, to any aquatic or non-aquatic organisms, or to the resource quality."

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

In terms of Section 19 of the Act owners / managers / people occupying land on which any activity or process undertaken that 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."

These general stipulations of the Act have ramifications for the proposed development as impacts on surface water associated with the proposed development would be relevant in terms of the above sections.

4. THE ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE DEVELOPMENT FOOTPRINT

The objective of this section is to provide description of the current environmental conditions of the proposed Ezakheni residential development project area, which has been established through various environmental investigations. The baseline described is the conditions in 2019.

Climate

The project area falls within the subtropical highland climate (Cwb, according to the Köppen climate classification), which is characterised by warm summers and cool, dry winters. It borders on a humid subtropical climate (Cwa) and with most rainfall occurring during summer. Climate data for small towns is always difficult to obtain because stations are not easy to maintain and monitor resulting in them being discontinued. Hence, spectrum maps from National Oceanic and Atmospheric Administration (NOAA) were used for the description of the climate in the project area. Spectrum maps were created for one month in each of the four seasons of the year to study the trends of both rainfall and temperature. The spectrum maps show the average daily temperatures and precipitation rate of the whole country and the red triangle was used to mark the project area.

Mean monthly temperatures

According to the NOAA spectrum maps, the average daily temperatures in July is 291 Kelvin (17.9 º C), October is 297 Kelvin (23.9 º C), January is 300 Kelvin (26.9 º C) and in April is 296 Kelvin (22.9 º C). The coldest month of the year is July, and the hottest month is January. The area experiences high evapotranspiration rates because of warm temperatures which reduces the surface water. Refer to **Figures 1 – 4.**

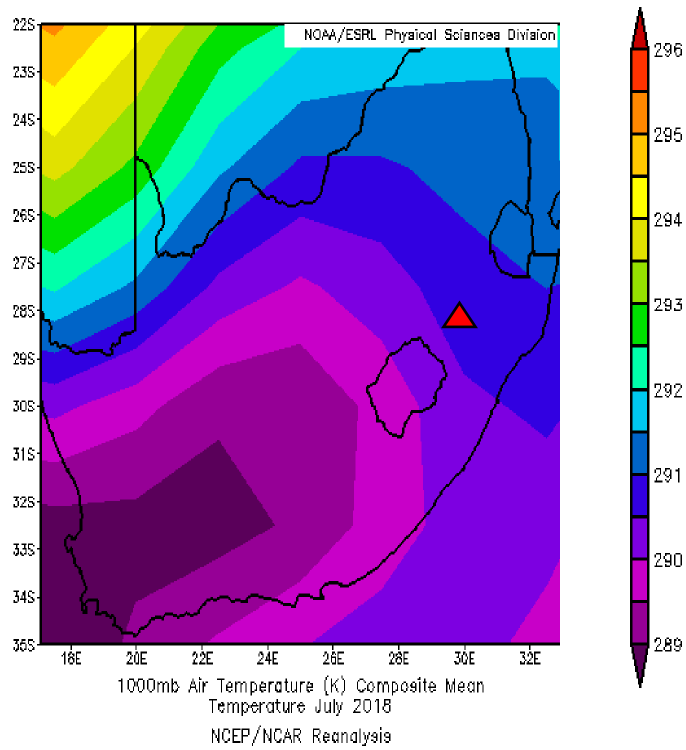

Figure 1: spectrum map representing the temperature of the project area (red triangle) in July 2018

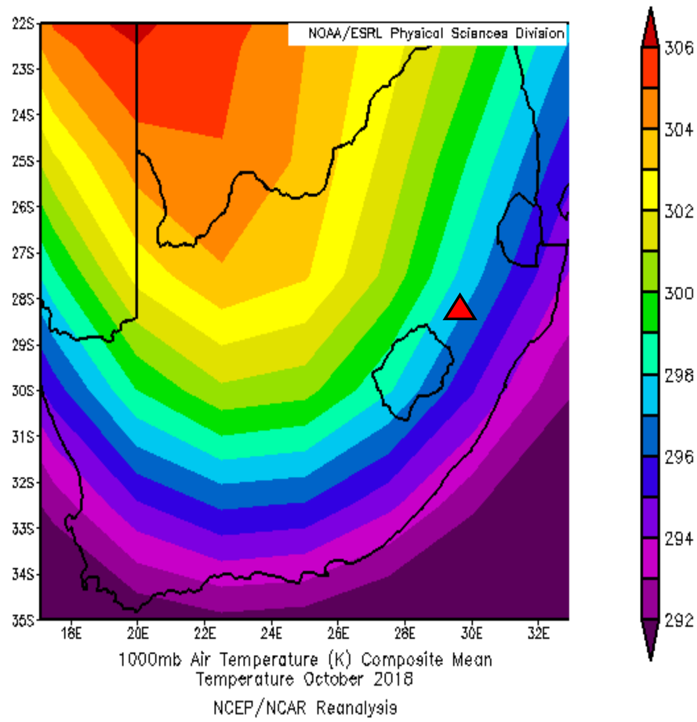

Figure 2: spectrum map representing the temperature of the project area (red triangle) in October 2018

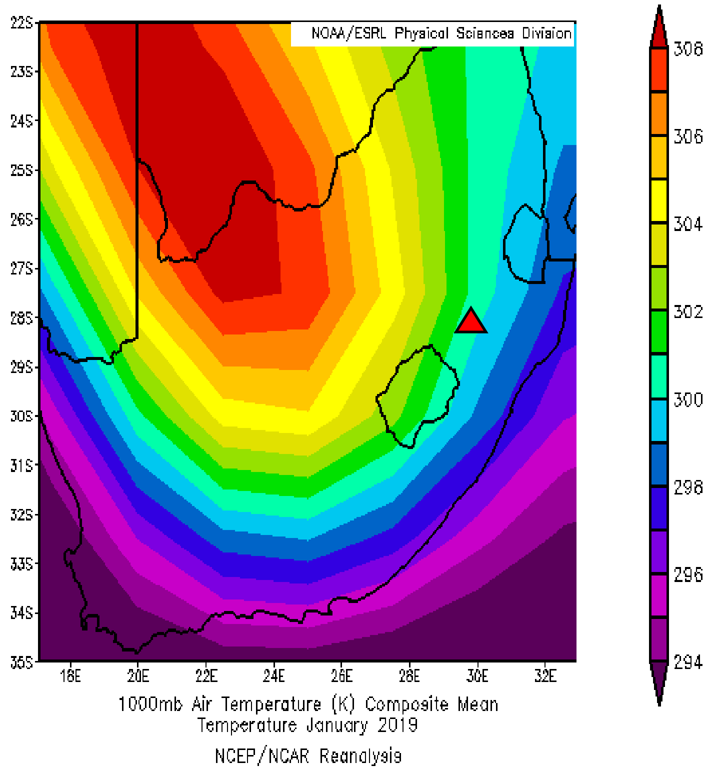

Figure 3: spectrum map representing the temperature of the project area (red triangle) in January 2019

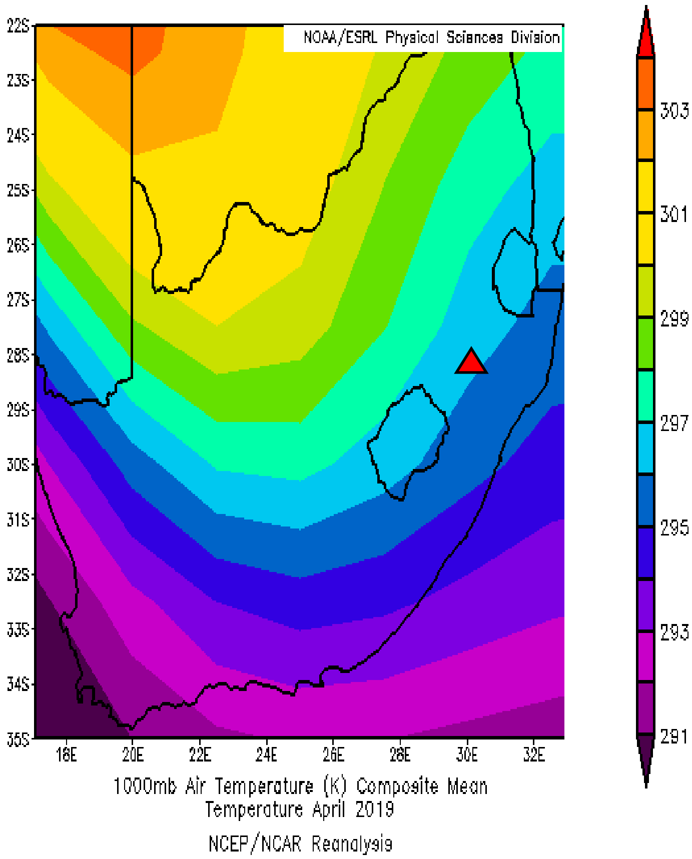

Figure 4: spectrum map representing the temperature of the project area (red triangle) in April 2019

Mean monthly rainfall

According to the rainfall data from NOAA, the mean monthly precipitation in July is 0.2 mm/day, October is 2 mm/day, January is 6.5 mm/day and in April is 5 mm/day. Since the area is characterized by warm summers, 90% of precipitation occurs as showers and thunderstorms from October to March. The winter months are dry with precipitation falling to zero as observed in July. Refer to **Figures 5 - 8.**

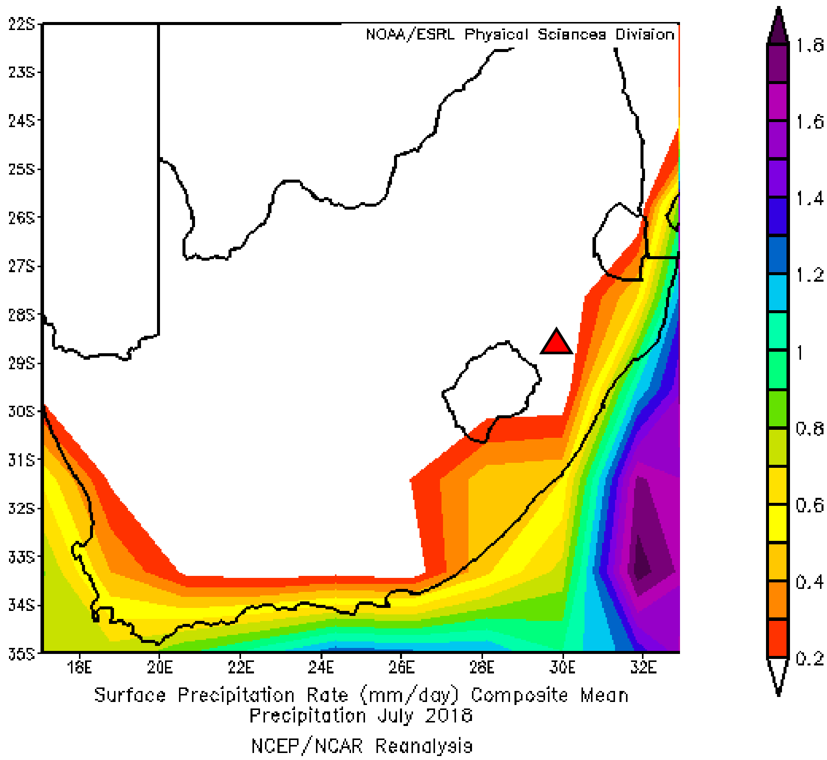

Figure 5: spectrum map representing the precipitation (mm/day) of the project area (red triangle) in July 2018

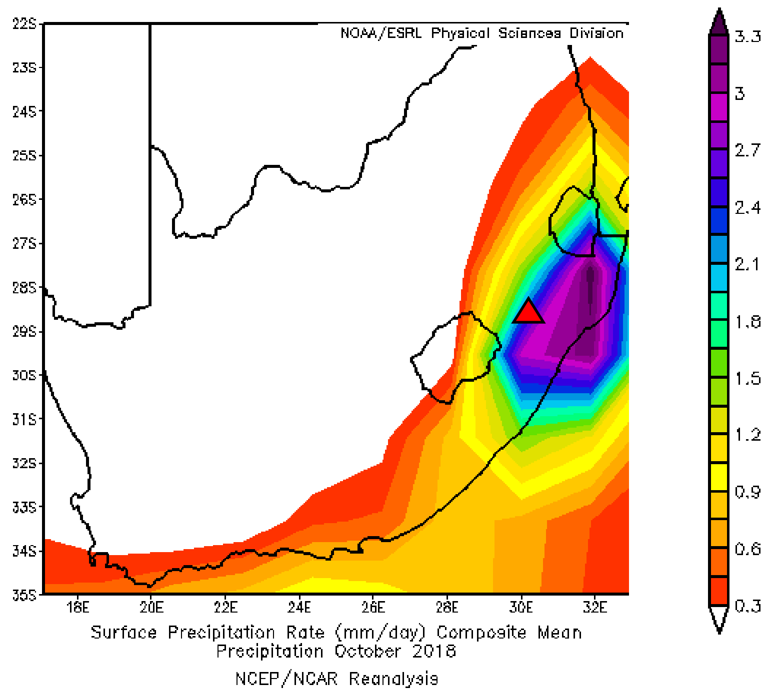

Figure 6: spectrum map representing the precipitation (mm/day) of the project area (red triangle) in October 2018

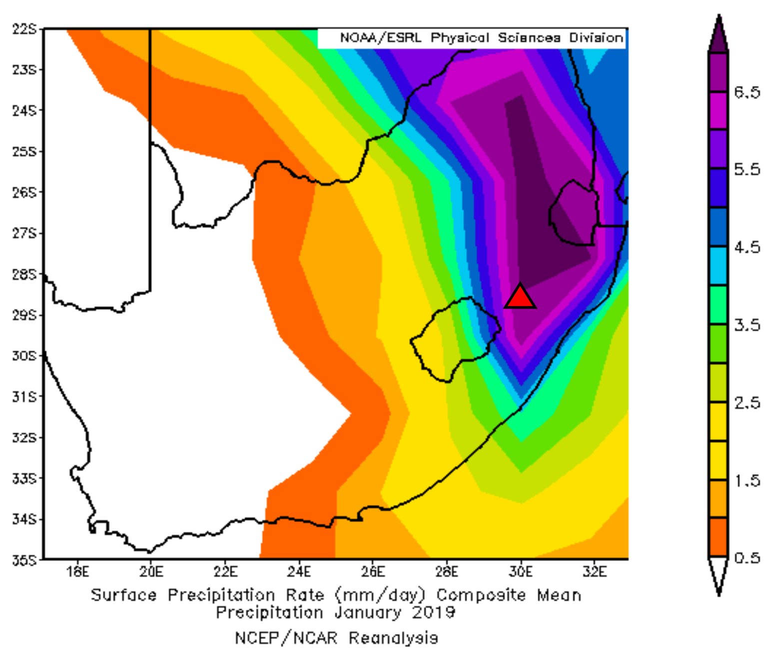

Figure 7: spectrum map representing the precipitation (mm/day) of the project area (red triangle) in January 2019

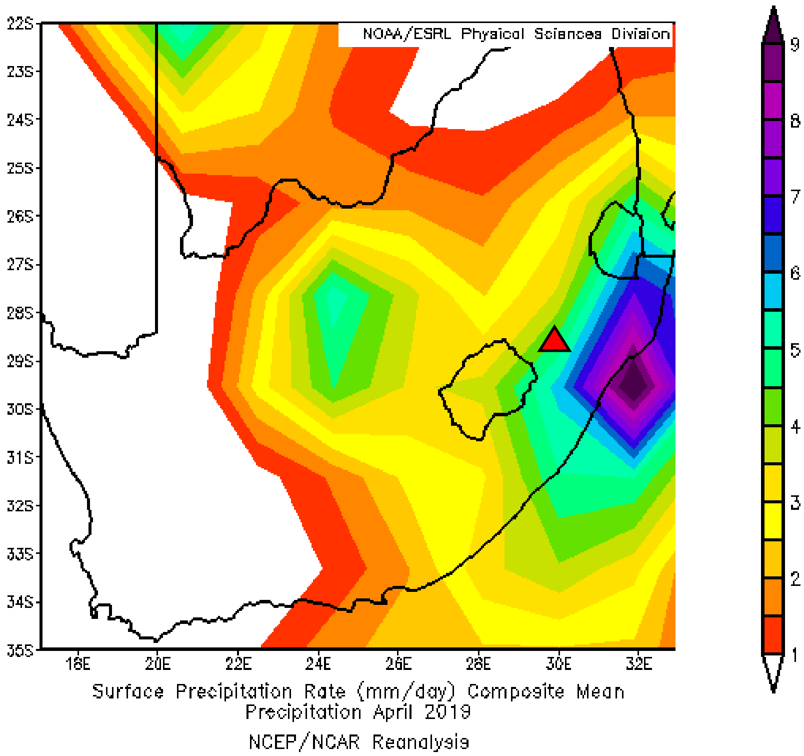

Figure 8: spectrum map representing the precipitation (mm/day) of the project area (red triangle) in April 2019

Surface water

According to the Department of Water and Sanitation, South Africa's average annual rainfall of 500 mm is only 60 per cent of the world average. It is poorly distributed, particularly relative to areas experiencing growth in demand. Only a narrow region along the eastern and southern coastlines is moderately well-watered, while the greater part of the interior and the western part of the country is arid or semi-arid. Sixty-five per cent of the country receives less than 500 mm of rain annually, which is usually regarded as the minimum for successful dry land farming. Twenty-one per cent of the country receives less than 200 mm. As it gets drier towards the west the rainfall becomes more variable. Over most of the country the average annual potential evaporation, which ranges from about 1 100 mm in the east to more than 3 000 mm in the west, is well in excess of the annual rainfall, which reduces the surface runoff greatly.Included in the surface water quantity section below are findings on uThukela catchment area (**Figure 9**), daily average run-off, average dry flow values and flood flows are also presented.

Catchment boundaries

The proposed development project lies on Quntenary catchment V12G which and become one of the tributaries of the Thukela River. The sub-catchment within which the proposed residential development falls is 1654 km2. The station recording flow data in the sub-catchment was however discontinued in 1993 as a result of the insignificant flows, therefore we had to study the sub-catchment south in order to conclude on the reasons for such flows in the Klip River. Refer to figures 9 and 10.

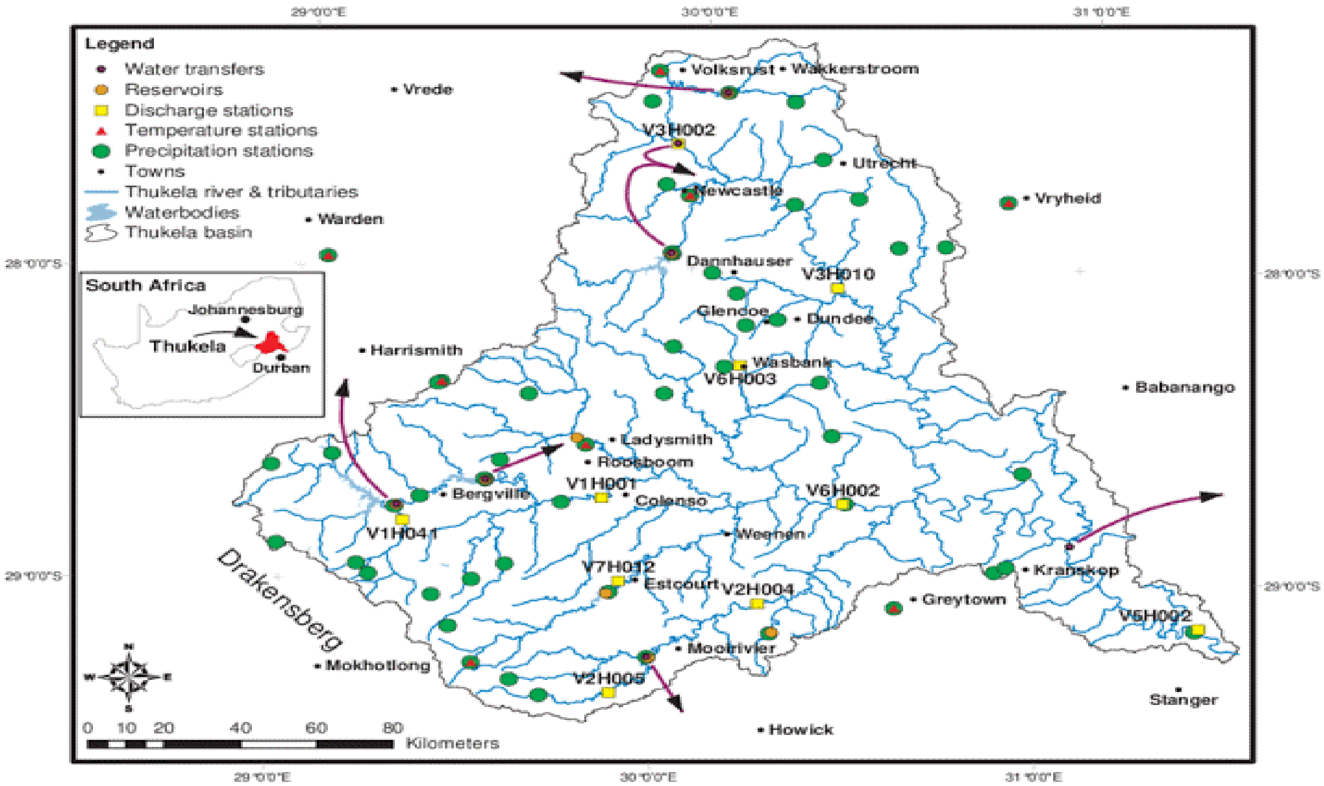

Figure 9: overview of the Thukela River catchment and major stations as well as reservoirs and water transfers (purple arrows) included in the model (Anderson et.al, 2009)

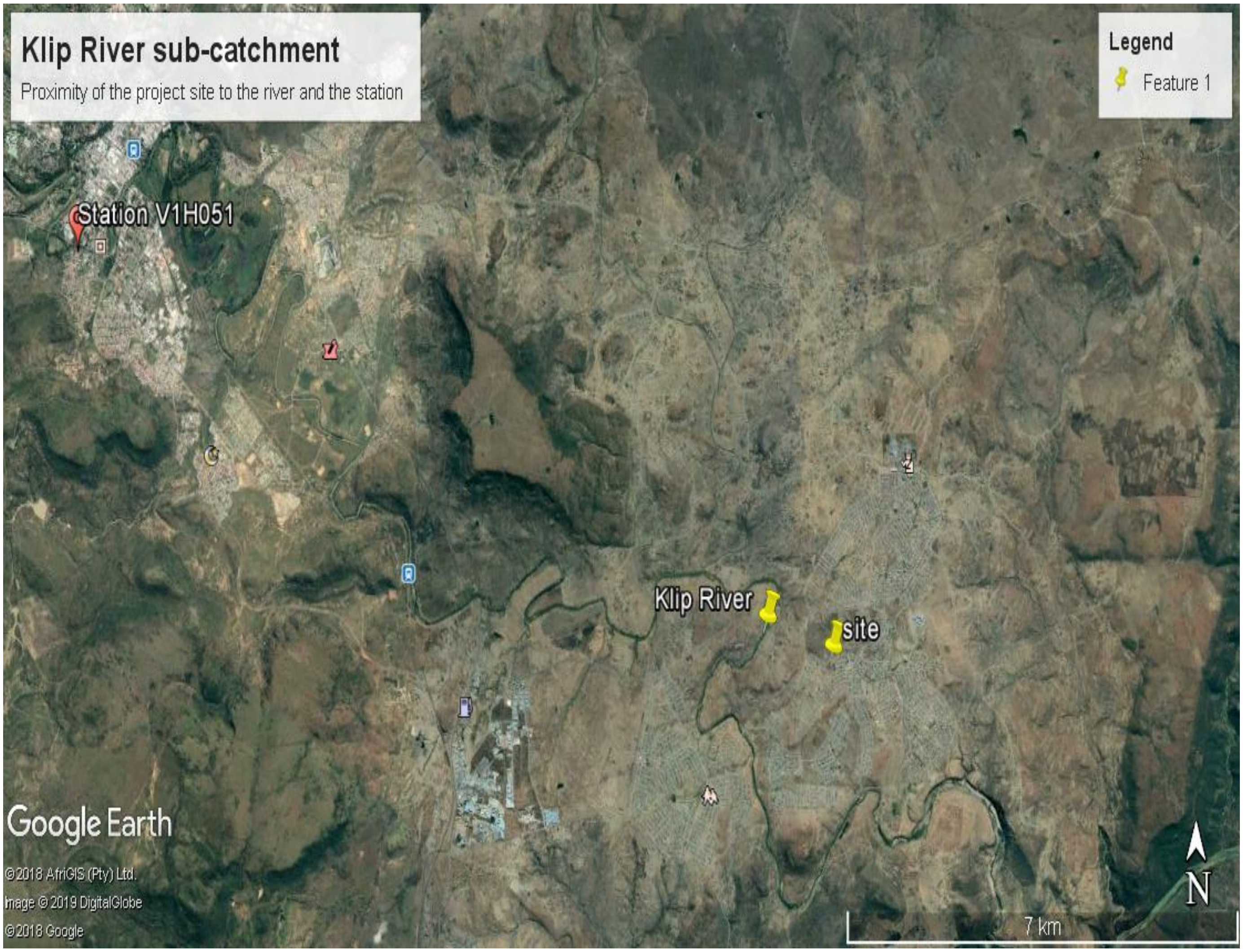

Figure 10: the google earth image demonstrates the proximity of the site to the river and the station

Daily average runoff

The flow data at Station V1H051 was recorded from 1987 to 1993 the year that the station was discontinued. The highest peak was recorded in 1988 (350 m^3/s) but throughout the years the flow was below 100 m^3/s and mostly insignificant (0 m^3/s). When compared to Station V1H001, it suggests that the peak in 1988 was a result of the flood that hit KZN in September 1987. And also small peaks are in summer due to high rainfall suggesting that the Klip River is a seasonal river. Refer to figures 11 and 12.

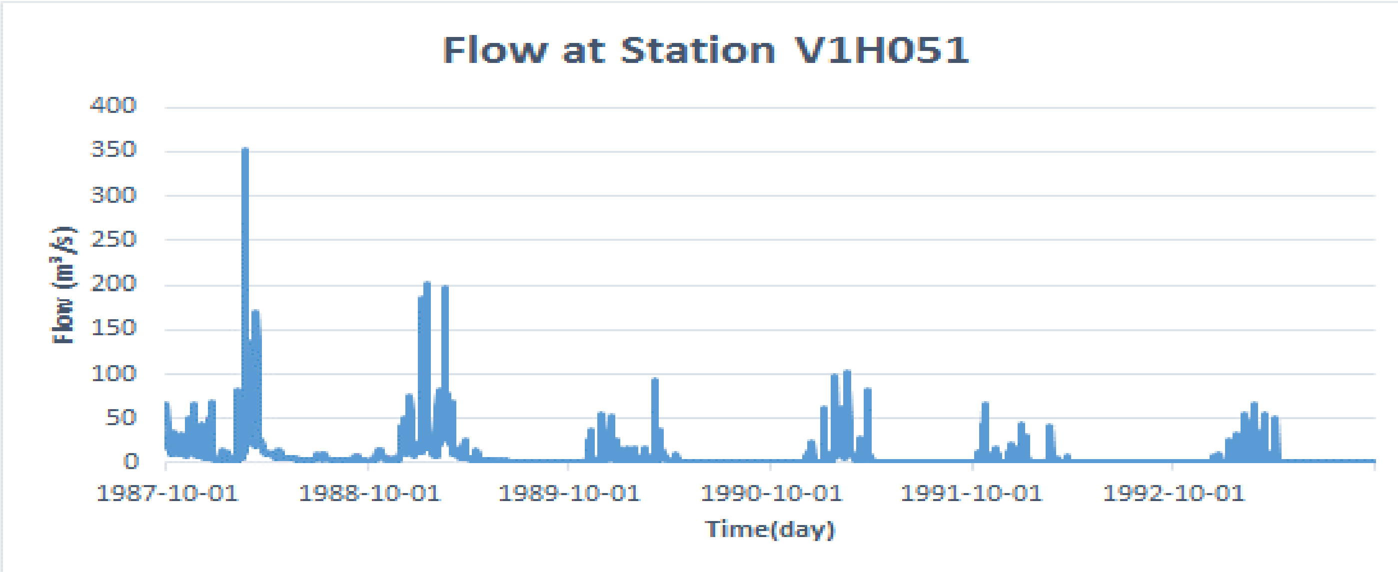

Figure 11: flow graph representing flow data at station V1H051 (Klip River) from 1987 to 1993

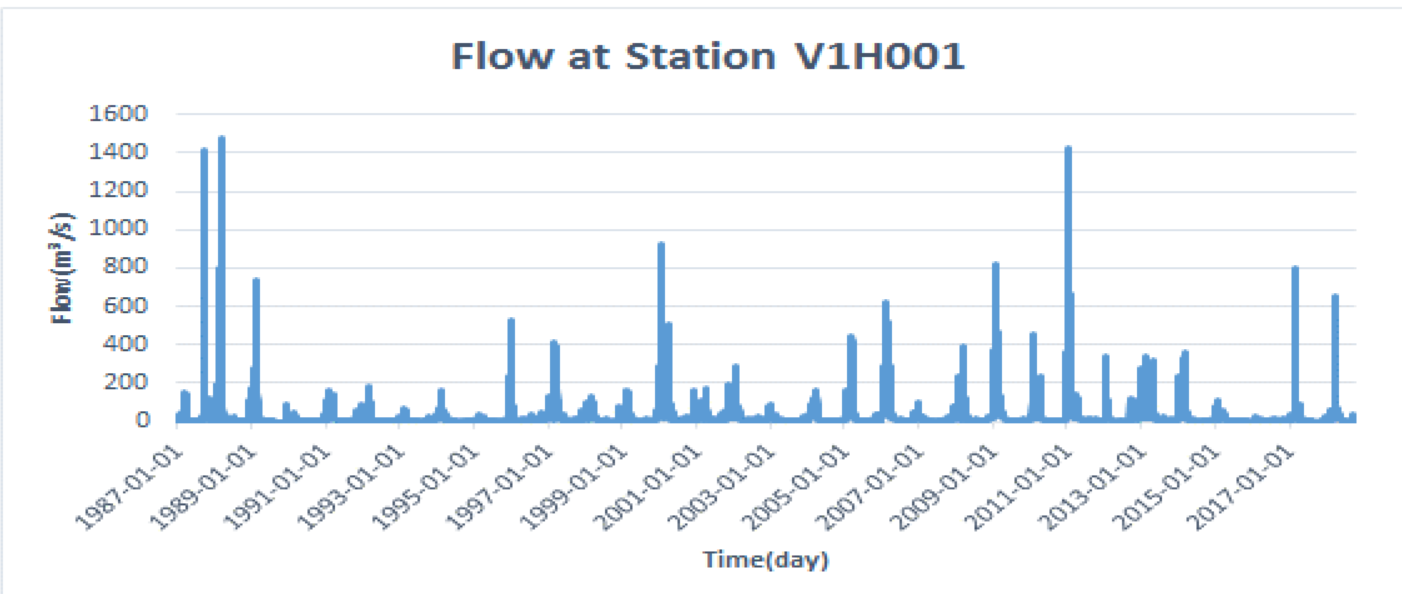

Figure 12: flow graph representing flow data at station V1H001 (Thukela River) from 1987 to 2018

Normal dry volume weather flow

The flow of the river than runs through Ezakheni has remained the same (insignificant) for more than 10 years as it can be seen the figures 13 an 14 below. During the dry seasons, the normal flow at the Klip river sub-catchment is below 50 m^3/s.

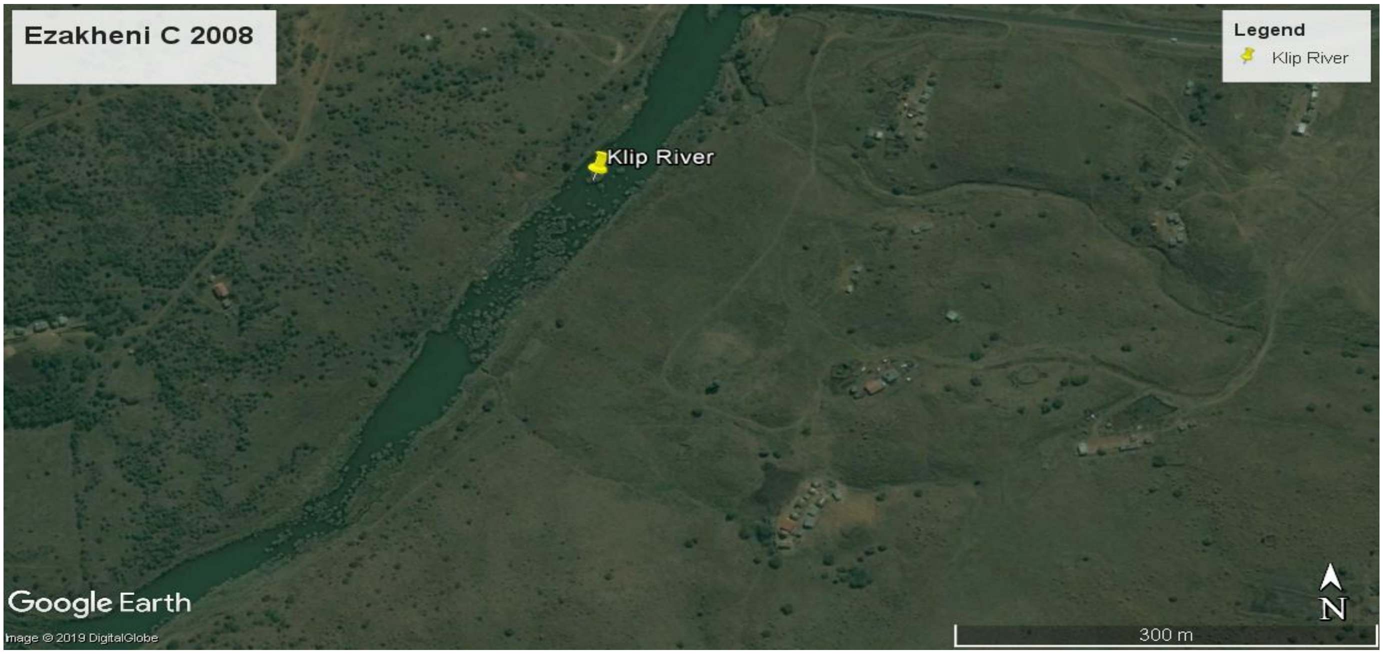

Figure 13: the google earth image demonstrates the state of the Klip River in 2008

Figure 14: the google earth image demonstrates the state of the Klip River in 2019

Wetlands

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. However, the presence / absence of hydric soils is the primary determining factor used to define a surface water feature as a wetland. This determining factor has been utilised in this assessment.

Wetland soils can be termed hydric or hydromorphic 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. The presence of hydric (wetland) soils on the site of a proposed development is significant, as the alteration or destruction of these areas, or development within a certain radius of these areas would require authorization in terms of the National Water Act (36 of 1998) and in terms of the Environmental Impact Assessment Regulations promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998).

It has been estimated that the demand for water in South Africa is likely to meet the economically exploitable supply for the country as a whole by about the year 2030. Without sufficient water we cannot grow enough crops, support the growth of industry and mining, or develop a growing tourism industry. Our economy is therefore totally dependent on a continual supply of water of sufficient quality and quantity. (Department of Water Affairs and Forestry 2015). Wetlands act like giant sponges, they hold back water during floods and release it during dry periods. In a dry country like South Africa, this is crucial. By regulating water flows during floods, wetlands reduce flood damage and help prevent soil erosion. Wetlands recharge ground water sources, and also remove pollutants from the water. According to the wetland definition used in the National Water Act, vegetation is the primary indicator, which must be present under normal circumstances. However, in practice the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role. The reason is that vegetation responds relatively quickly to changes in soil moisture regime or management and may be transformed; whereas the morphological indicators in the soil are far more permanent and will hold the signs of frequent saturation long after a wetland has been drained (perhaps for several centuries). (Department of Water Affairs and Forestry 2015)

Typically the presence of wetlands is determined through wetland delineation. The accepted procedure for wetland delineation in South Africa is based upon the DWA(F) guidelines “A practical field procedure for the identification and delineation of wetlands and riparian areas' (DWAF, 2005),” which stipulates that consideration be given to four specific wetland indicators to determine the boundary of a wetland.

The four wetland indicators are:

- terrain unit - helps to identify those parts of the landscape where wetlands are more likely to occur.
- soil form - identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- soil wetness - identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation.
- vegetation - identifies hydrophilic vegetation associated with frequently saturated soils.

The guidelines do mention hydrology, although it is not listed as being one of the four indicators above. However, the guidelines state that the delineation procedure is substantially facilitated by an understanding of the broad hydrological processes that drive the frequency of saturation (DWAF, 2005). Under most circumstances the most important indicator of the presence of hydric soils is the soil wetness indicator, i.e., examination of redoximorphic features within the soil. The reason for this is that vegetation, the primary factor as defined under the National Water Act, can easily respond to changes in hydrology, e.g., the draining of a wetland, while the soil morphological signatures remain even if the wetland hydrology is altered. In terms of the soil form indicator, the guidelines list a number of soil forms that are associated with the permanent zone of the wetland and the seasonal / temporary zones. For an area to be considered a wetland, redoximorphic features must be present within the upper 500 mm of the soil profile (Collins, 2005). Redoximorphic features are the result of the reduction, translocation and oxidation, i.e., precipitation of Fe (iron) and Mn (manganese) oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic. Only once soils within 500 mm of the surface display these redoximorphic features can the soils be considered to be hydric (wetland) soils. Redoximorphic features typically occur in three types (Collins, 2005):

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

  These can occur as:
    - Concretions - harder, regular shaped bodies.
    - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours.
    - Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

Under most circumstances the presence or absence of redoximorphic features within the upper 500 mm of the soil profile alone is sufficient to identify the soil as being hydric, i.e., a wetland soil, or non-hydric, i.e., a non- wetland soil (Collins, 2005; DWAF, 2005).

Vegetation in an untransformed state is a very useful way to support the delineation of a wetland, due to plant community transition from the middle of the wetland to the adjacent terrestrial area. The guidelines specify that when using vegetation indicators, that focus be placed on the plant communities, rather than individual indicator species. The dominant species in the area being assessed (hydrophytes or not) must be assessed to determine the presence of a wetland. The DWA guidelines make reference to vegetation types typically found within the classical zones of a wetland (permanent, seasonal, temporary), but also make reference to the classification methodology developed by Kotze and Marneweck (1999) as part of the Resource Directed Measures for Protection of Water Resources for Wetland Ecosystems which is based on the identification of obligate and facultative wetland species, and the relative coverage of these species in terms of whether the area being assessed is likely to display hydric conditions, possibly display hydric conditions, or not at all.

Lastly, the hydrological framework for wetlands is covered in an appendix of the guidelines. This is based on the longitudinal classification of river channels into three different zones based on their hydrological activation:

- A Section – baseflow never occurs, and the water table never occurs at the surface (typically headward channels).
- B Section – channels within the zone of a fluctuating water table, only being characterised by baseflow when the saturated zone is in contact with the channel bed.
- C Section – channels that are always in contact with the zone of saturation, and thus always experiencing baseflow (i.e., being perennial in nature).

Typically, wetland habitat will never occur in the A section due to the insufficient period of saturation, while Section B and C channels will contain wetland habitat due to a sufficient period of saturation. In terms of the classical zonation of a wetland, the permanent wetland zone will typically only be found in the C Section, while the B section is only
characterised by the presence of seasonal and temporary zones.

SITE SPECIFIC CONDITIONS

A site visit was conducted on 30th of May 2019. The primary aim of the site assessment was to determine the presence of hydric soils, i.e., wetland habitat, in the vicinity of the proposed housing Development. Investigation of Presence or Absence of Hydric Soils in areas adjacent to the sewer upgrading route

Wetland area to the north of the proposed site

A small wet perch exists on the North Eastern section of the portion of the site. The soil is very clay-rich and is hard when dry. It is assumed to be alluvial in origin. The origin of the water which sustains them is not apparent. There are no signs of perennial surface water visible on site, and tall wetland plants are generally absent. It does not exhibit a variety of wetland life form since only one plant species was observed on site. Although the cyperus species observed on site belong to emergent plant species it is classified as terrestrial weed. It is not a hydrophyte. It is thus worth noting that it is common to find greener vegetation in the furrows left by the old cultivation and in some cases, these may be drawing water from the wet patches but most are probably just localized reservoirs of pooled rainwater and are not linked to ground water in any way. Thus, the presence of scattered individuals of an upland plant species in a community dominated by hydrophilic species is not sufficient to conclude that the area is not a wetland. Likewise, the presence of a few individuals of a hydrophilic species in a community dominated by upland species is not a sufficient basis for concluding that the area is a wetland (Department of Water Affairs and Forestry 2015)

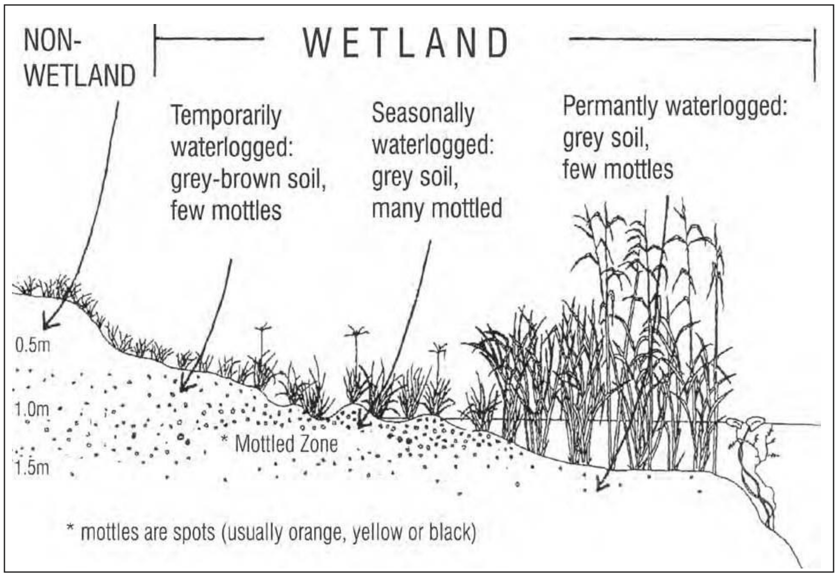

Figure 15: different types of wetland

The entire area has been cultivated in the past, but is currently not, although it is still connected to the ongoing subsistence agricultural activities carried out by the local community along the Eastern section of the proposed site. A larger portion of the site is used as a sport field and the site is consistently buttered by scraping and grabbing that is intermittently carried out as sport field maintenance practice. large deposit of topsoil scraped from the surface is deposited on saturated zone. In addition, domestic waste is also dumped around. The area is heavily grazed by livestock which consists primarily of cattle.

The identified hydric zone was delineated according to the Department of Water Affairs wetland delineation manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005). Land cover data, contour data and the latest aerial imagery were examined in a thorough desktop analysis of the site.

This provided important background information to the specialists' understanding of the broader context of the landscape (e.g. baseline vegetation, geology and climate) an on-site delineation was undertaken.

5. RESULTS OF INVESTIGATION

Soils investigated on to the wetland revealed the presence of hydromorphy, primarily in the form of soft plinthic soil characteristics and as well as iron and manganese mottling and redox depletions within a grey matrix towards the edge of the saturated area. The wet patch is considered to be unchanneled floodplain hygrophilous grassland and it is apparent form the soil leach, the degree of wetness is seasonal or ephemeral.

The wetter part of the wetland consisted of one specimen of *Cyperus polystychos*. This plant species is obligate hydrophytes, which is often associated with wetland soils (Marnewecke & Kotze, 1999). The vegetation which now covers much of the area surrounding this wetland towards the North Eastern section of the site and towards the rocky outcrop is a species-poor medium-to-tall grassland community. Thatch grass (Hyparrhenia hirta) and Turpentine grass (Cymbopogon sp.) predominate, but short species such as Kweek (Cynodon dactylon) and Buffalo grass (Paspalum sp.) are also widespread. There were no visible forbes during the site visit.

Turpentine grass (Cymbopogon sp.), Kweek (Cynodon dactylon), grass that is declared as invasive species predominate the hydric soil. Buffalo grass (Paspalum sp.) with other grass species were also noted including Hyparrhenia filipendula, Paspalum urvillei facultative wetland species well-known weed of agricultural fields and disturbed areas (Randall, 2012), That has been widely introduced as a forage grass to ecosystems outside South America (Hitchcock, 1936; PIER, 2012; Bowen & Hollinger, 2002). It is now widely naturalized and is able to invade grass land including the wetlands and displaced the indigenous vegetation and altering the lower strata (Western Australian Herbarium, 2012). It is listed as invasive in Portugal, Réunion, and the United State), Bothriochloa bladhii (grows on riverbanks, in vleis, other wet places & often in road reserves where water collects) and Cyperus Polystychyos, Pycreus polystachyos, Imperata cylindrica, are hydrophyte species typically associated with wetland habitat, in particular the margins of wetland habitat. This vegetation assemblage and transition is typical of wetland margins and is generally reflective of an increasing degree of inundation of the soils from the area outside of the wetland into the wetland itself

Soils in this area were noted to be highly clayey in character, showing expansive (swelling and shrinking) properties in certain locations (as indicated by surface cracking). Certain soil samples along this patch showed no signs of hydromorphy. The presence of soft plinthic soils indicated that under natural conditions a degree of soil saturation sufficient for the development of anaerobic conditions and thus hydric soils would have been present in this area, but no evidence of a current perched water table was noted on the site. Within the soft plinthic matrix a number of redoximorphic characteristics were present, in particular large iron (bright orange and red) and manganese (black) oxides (mottles), as well as adjacent areas of clay and redox depletions (greyer areas within the matrix). The location of oxides and depletions in an alternating pattern within the matrix.

From a terrain perspective, this wetland is occurring on an intervening area between an outcrop and an existing human settlement. The location of hydromorphic soils on a slightly higher gradient could possibly suggest the historical (natural) presence of a seepage wetland in this location, but may also reflect a natural extension of the valley bottom wetland with an associated degree of inundation. However due to the physical transformation of this area, the origin of these areas of hydric soils is very difficult to determine.

Implications for Development

The above analysis has shown that the area has been extensively physically modified by alternating land uses of the site cultivation, grazing, sport field as well as illegal dumping. From a surface water sensitivity perspective, the area is thus regarded as having ***low sensitivity***. This area has a low degree of habitat integrity, and thus less functionality although not to the same degree as the transformed area covering the whole development footprint including the sport field that denuded of vegetation and thus displaying little to no habitat integrity and functionality.

Nature of the Potential Impacts Associated with the Proposed Development

As described above, the proposed housing development is thus within a transformed area that does not contain any of the residual hydromorphic soils that are located on the wetland. Even though construction activities are likely to consist of foreign, imported material, the housing development is unlikely to physically affect any residual hydric soils. It should be noted that by adhering to a 32-meter buffer the development is unlikely to have any impact on current wetland functionality or health.

It is however important to note that impacts can transpire within the area of hydromorphic soils in the case of disturbance of these soils through movement of machinery during periods of heavy rainfall when the soils would be saturated and prone to damage. Heavy machinery such as excavators can easily damage soils, causing compaction or altering the structural integrity of soils.

More importantly however (due to the existing disturbance factor), spills of hazardous materials may cause pollution of soils and could ultimately enter groundwater. Spills of oil or fuel from machinery would enter the soils adjacent to the construction area. Cement batching within the area of hydric soils could also result in polluted runoff water infiltrating the soils.

6. RECOMMENDED MITIGATION MEASURES

Due to the high degree of transformation of the area of residual hydromorphic soils, the risk of impacts in this area is considered to be low. Nonetheless a few precautionary measures are recommended:

- It is understood that due to spatial constraints, the construction activities may need to extend into the area of residual hydromorphic soils, however it is recommended a 32-meter buffer from the edge of the hydromophic soils.
- Heavy machinery must not be allowed to enter the area of residual hydromorphic soils, and this area must be designated on site as a no-go area.
- No stockpiling of any material should occur in the area of residual hydromorphic soils; if this is unavoidable the ground underneath the stockpile should be lined with a geotextile or similar material.
- Measures must be put in place to ensure that no silt from any stockpiles placed adjacent to the area of residual hydromorphic soils can enter the area of hydromorphic soils, e.g., soil berms, silt fences, etc.
- No construction activities must take place within the 32 m buffer zone of the sensitive surface water features on the site.
- No storage of any hazardous material must be placed within 50 m of the boundary of the area of residual hydromorphic soils, or within 50 m of the wetland
- No cement batching activities must be conducted within 50 m of the boundary of the area of residual hydromorphic soils.
- No soil stockpiling must occur within the 32 m buffer zone.
- Methods to prevent material from being washed off the stockpiles and entering the wetland corridor must be put in place, e.g., soil berms.

Impact Ratings Matrix

Phase	Potential Impact	Significance before mitigation	Mitigation	Significance after mitigation
Construction	Irresponsible construction practices could lead to the pollution of the area of residual hydromorphic soils, (e.g. faecal contamination, or pollution of surface water through hydrocarbons). Poor stormwater management in the construction servitude, and in the context of soil stockpiles could lead to the siltation and/or pollution of the area of residual hydromorphic soils or of the stream and riparian corridor. The movement of machinery within the area of residual hydromorphic soils could cause compaction or physical disturbance of these soils. Temporary (illegal) construction access to the stream (riparian corridor) to abstract water could cause hydrological and		•Construction to be guided by the EMPr and the mitigation measures stipulated in this report. •Construction to be monitored by an ECO according to the stipulations of the EMPr. •No batching or chemical / fuel storage areas to be located within 50m of the area of residual hydromorphic soils or the stream and associated riparian corridor. •Construction-phase storm water controls to be implemented along the stretch of the construction servitude adjacent to the area of residual hydromorphic soils, and around all stockpiles. •The narrow area of wetland habitat to the north of the upgraded section and the stream and associated riparian corridor must be strictly maintained as no-go areas. •No temporary construction accesses to be constructed into the riparian corridor of the stream, unless authorised by the Department of Water Affairs through any surface water feature and no machinery to enter any surface water feature or buffer	

	morphological impacts (erosion, channel morphology changes, undercutting of riparian areas, etc.) and degrade the resource quality riparian corridor.			
Operation	•Maintenance of the sewer pipeline which requires the pipeline to be accessed will require the excavation of overlying material, and the effective creation of a construction environment, resulting in the above construction-related impacts. •Leakage of sewage from the pipeline could pollute adjacent soils, and create faecal pollution of surrounding wetland / riverine habitats		•Any sewer maintenance activity that requires excavation of substrate adjacent to the area of residual hydromorphic soils must be conducted as a construction activity that is controlled by the same mitigation measures stipulated for construction above. •Any leakage of sewage from the pipeline must be immediately stopped and the pipeline repaired in order to prevent pollution of the area of residual hydromorphic soils and nearby watercourses and wetlands	
Decommission	•Similar general impacts as detailed during construction due to irresponsible actions during decommissioning could occur.		•Decommissioning to be guided by and EMPr compiled for decommissioning •No temporary accesses to be constructed through any surface water feature and no machinery to the riparian corridor •As decommissioning is similar in nature to construction, construction-related mitigation measures must be implemented.	

			•Refer to activity / phase specific mitigation measures above	

7. CONCLUSIONS

The investigation of the potential presence of wetland habitat and hydric soils along the proposed site for development of 150 low cost housing revealed a small patch of wetland habitat in relatively close proximity to the development area. The development itself is not likely to contain any hydric soils. Although hydric area technically remain wetland due to the degree of physical transformation of this area, its function as a habitat for biodiversity has effectively been reduced to exist. A number of mitigation measures have been specified in order to prevent further disturbance and pollution of the area of residual hydric soils, and importantly to prevent the construction footprint from encroaching into the wetland.

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The potential environmental impacts associated with the project will be evaluated according to its nature, extent, duration, intensity, probability and significance of the impacts, whereby:

Environmental Criteria	Description
Nature	A brief written statement of the environmental aspect being impacted upon by a particular action or activity
Extent	The area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact. For example, high at a local scale, but low at a regional scale
Duration	Indicates what the lifetime of the impact will be
Intensity	Describes whether an impact is destructive or benign
Probability	Describes the likelihood of an impact actually occurring
Cumulative	In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area

CRITERIA	DESCRIPTION			
EXTENT	**National (4)** The whole of South Africa	**Regional (3)** Provincial and parts of neighbouring provinces	**Local (2)** Within a radius of 2 km of the construction site	**Site (1)** Within the construction site
DURATION	**Permanent (4)** Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient	**Long-term (3)** The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory	**Medium-term (2)** The impact will last for the period of the construction phase, where after it will be entirely negated	**Short-term (1)** The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase

INTENSITY	**Very High (4)** Natural, cultural and social functions and processes are altered to extent that they permanently cease	**High (3)** Natural, cultural and social functions and processes are altered to extent that they temporarily cease	**Moderate (2)** Affected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way	**Low (1)** Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected
PROBABILTY OF OCCURANCE	**Definite (4)** Impact will certainly occur	**Highly Probable (3)** Most likely that the impact will occur	**Possible (2)** The impact may occur	**Improbable (1)** Likelihood of the impact materialising is very low