Wetland Assessment for the proposed Izotsha Memorial Park Expansion

Ray Nkonyeni Municipality, KwaZulu-Natal

November 2018

CLIENT

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Report Name	**Wetland Assessment for the proposed Izotsha Memorial Park Expansion**	
Submitted to	**Isolendalo Environmental Consulting**	
Fieldwork/ Reporting	**Wayne Jackson (SACNASP Pending)**	
Wayne Jackson is a Soils Scientist & Hydrologist and has 11 years' experience in the classification of soils and wetlands, both nationally and internationally. Wayne completed a B.Sc. degree (Soil Science and Hydrology) from the University of Kwa-Zulu Natal and has 10 years of consulting experience.		
Report Reviewer	**Andrew Husted (Pr Sci Nat, 400213/11)**	
Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 13 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.		
DECLARATION		
The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Ecological Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.		

EXECUTIVE SUMMARY

GNR 982	Specialist Opinion
It is the opinion of the specialist that the project be favourably considered, and allow for the proposed development to proceed, but all prescribed mitigation measures and recommendations must be implemented.	

The Biodiversity Company was commissioned to conduct a Wetland Assessment, as part of the environmental authorisation process for the proposed Izotsha memorial park expansion near Shelley Beach in the Ray Nkonyeni Municipality, KwaZulu-Natal. A single wet season wetland assessment was conducted in November 2018.

Four (4) wetland types were identified within the project area, namely a hillslope seep (HGM 1), an unchannelled valley bottom system (HGM 2), a channelled valley bottom (HGM 3), and a depression (Dam) (HGM 4).

The overall wetland health for all HGM units were determined to be Moderately Modified (C). The depressions (Dams) were not assessed as these were not natural systems and the wetland health cannot be determined, however the depressions do provide Eco-Services and have been assessed in that section. The HGM units all showed an overall Moderate-Low level of service. With flood attenuation being the only service rated as Moderate-High for HGM 3 and HGM 4 only. The dams and channelled valley bottom provide some protection from flood events.

The Ecological Importance & Sensitivity was calculated to have a Moderate (C) level of importance for all HGM units. Although the wetland was not associated with NFEPA wetlands or protected natural habitats, the wetland falls within part of an endangered vegetation unit. The Hydrological Functionality was calculated to have a Moderate (C) level of importance for all HGM units, although the wetland's hydrology has been impacted upon, the wetland maintains a water source for downstream areas and the modifications increase the wetland's ability to protect against flood and erosion. The Direct Human Benefits were rated as having a Low (D) level of importance.

Conservative buffer zones of 15m (Post-mitigation) were suggested for the construction and operational phases of the development.

Risk Assessment

The presence and operation of the development has a smaller spatial impact but larger overall temporal impact (decades to centuries). Short term effects can occur during stormwater management activities. However, long term negative effects include alterations in stream hydrology and geomorphology which subsequently can result in a shift of ecological structures. Acute and chronic negative effects of stormwater management occur during rainfall events whereby runoff from hardened surfaces (roofing, driveways and car park areas) typically contains a mixture of contaminants such as messed garden fertilizers, metals, salts, oil and grease which enters nearby wetland systems accumulating in the instream sediments or can be dispersed into groundwater. Stormwater discharge is likely to scour the receiving areas, removing soils and modifying the geomorphology. The scouring of substrates is avoided through the implementation of appropriate energy dissipation structures.

The proposed development consists of a construction and operational phase, there has been no allowance for a decommissioning phase for the project. The project will entail the clearing of areas and excavation of foundations, establishment of roads and various activities which will pose risks to the identified wetland areas, with the level of risk determined to vary from low to moderate. The final designs must attempt to stay outside of the designated wetland areas and the 15m allocated buffer zones.

The moderate risks determined for the study are associated with the digging works, soil stockpile management and operation of equipment and machinery. Notable expected risks include the potential for erosion and increased sedimentation of the wetlands. All the risks during the construction phase of the project were determined to be low risk, after mitigation measures were applied. This is due to the fact the project area is developed currently, and mitigation measures will improve the current state of the adjacent wetland areas.

The operation of the development area poses a low risk to the identified wetlands. The moderate risks are brought about by the duration of the project; however, all risks were determined to be low after mitigation measures were applied.

It is the opinion of the specialist that the project be favourably considered, and allow for the proposed development to proceed, but all prescribed mitigation measures and recommendations must be implemented.

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DECLARATION

I, Wayne Jackson declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence and is punishable in terms of Section 24F of the Act.

Wayne Jackson

Wetland Specialist

The Biodiversity Company

26 November 2018

1 Introduction

The Biodiversity Company was commissioned to conduct a Wetland Assessment, as part of the environmental authorisation process for the proposed Izotsha memorial park expansion near Shelley Beach in the Ray Nkonyeni Municipality, KwaZulu-Natal. A single wet season wetland assessment was conducted in November 2018.

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP), enabling informed decision making as to the ecological viability of the proposed development and to provide an opinion on the whether any environmental authorisation process or licensing is required for the proposed activities.

1.1 Objectives

The aim of the assessment is to provide information to guide the proposed project with respect to the current state of the associated wetlands in the area of study. This was achieved through the following:

- Determining the ecological status of the local wetlands;
- The identification, delineation and assessment of wetlands within 500m of the project area;
- A risk assessment for the proposed development; and
- The prescription of mitigation measures and recommendations for identified risks.

2 Key Legislative Requirements

2.1 National Water Act (Act No. 36 of 1998)

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

The NWA recognises that the entire ecosystem, and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS.

For the purposes of this project, a wetland area is defined according to the NWA (Act No. 36 of 1998): “Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

Wetlands have one or more of the following attributes to meet the NWA wetland definition (DWAF, 2005):

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

2.2 National Environmental Management Act (Act No. 107 of 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

3 Project Area

Izotsha Memorial Park is situated within the Izotsha area near Shelley Beach in the Ray Nkonyeni Municipality, KwaZulu-Natal. This area is approximately 300 m from the Izotsha Road to the east and 400 m away from the R61. The land uses surrounding the project area consist of natural coastal vegetation as well as an established memorial park (Figure 1).

Figure 1: The general location of the project area

4 Limitations

The following aspects were considered as limitations;

- The Wetland Assessment was based on the results of a single survey only, and information provided should be interpreted accordingly;
- The assessment attempted to cover as much of the area as possible, focus was given to the wetland areas within the project area. The area around the project area is privately owned to which access was not granted and as such the assessment within the 500m area could only be performed at desktop level; and
- The GPS used for wetland delineations and site marking is accurate to within five meters. Therefore, data plotted digitally may be offset by at least five meters to either side.

5 Methodology

5.1 Desktop Assessment

The following information sources were considered for the desktop assessment;

- Aerial imagery (Google Earth Pro);
- Department of Water and Sanitation (DWS, 2018);
- Land Type Data (Land Type Survey Staff, 1972 - 2006);
- The National Freshwater Ecosystem Priority Areas (Nel et al., 2011); and
- Contour data (5m).

5.2 Field Survey

A survey was conducted in November 2018 by an ecologist where the wetland area in the project area was delineated and assessed. The survey was conducted during the wet season. The project area was ground-truthed on foot. Photographs were recorded during the site visit.

5.2.1 Wetland Assessment

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this study. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and also then includes structural features at the lower levels of classification (Ollis *et al.,* 2013).

5.2.1.1 Delineation

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 2. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator[1] identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.;
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

[1] The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991)

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

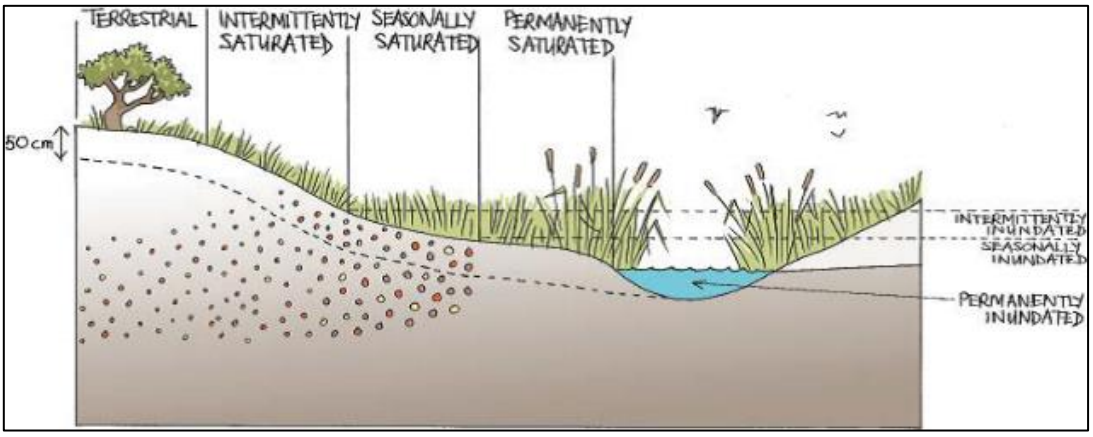

Figure 2: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013)

5.2.1.2 Present Ecological Status (PES)

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present Ecological Status (PES) score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The Present State categories are provided in Table 1.

Table 1: The PES categories (Macfarlane, et al., 2009)

Impact Category	Description	Impact Score Range	Present State Category
None	**Unmodified, natural**	**0 to 0.9**	**A**
Small	**Largely Natural** with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	**1.0 to 1.9**	**B**
Moderate	**Moderately Modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	**2.0 to 3.9**	**C**
Large	**Largely Modified.** A large change in ecosystem processes and loss of natural habitat and biota has occurred.	**4.0 to 5.9**	**D**
Serious	**Seriously Modified.** The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	**6.0 to 7.9**	**E**
Critical	**Critical Modification.** The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	**8.0 to 10**	**F**

5.2.1.3 Ecosystem Services

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze, *et al,* 2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 2).

Table 2: Classes for determining the likely extent to which a benefit is being supplied

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

5.2.1.4 Ecological Importance and Sensitivity (EIS)

The method used for the EIS determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 3.

Table 3: Description of EIS categories.

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

5.3 Buffer Determination

The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane, *et al.,* 2014) was used to determine the appropriate buffer zone for the proposed activity.

5.4 Risk Assessment

The risk assessment was conducted utilising the DWS risk-based water use authorisation approach and delegation guidelines. The significance of the impact is calculated according to Table 4.

Table 4: Significance ratings matrix

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s)impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

6 Results and Discussion

6.1 Desktop Results

6.1.1 Climate

This region is characterised by summer rainfall, even though rainfall in the winter months are not uncommon. This region is frost-free and has high humidity. The mean maximum temperatures for this region is 32.6°C, whereas the mean minimum temperatures for this region is 5.7 °C in January and July respectively (Mucina & Rutherford, 2006), see Figure 3.

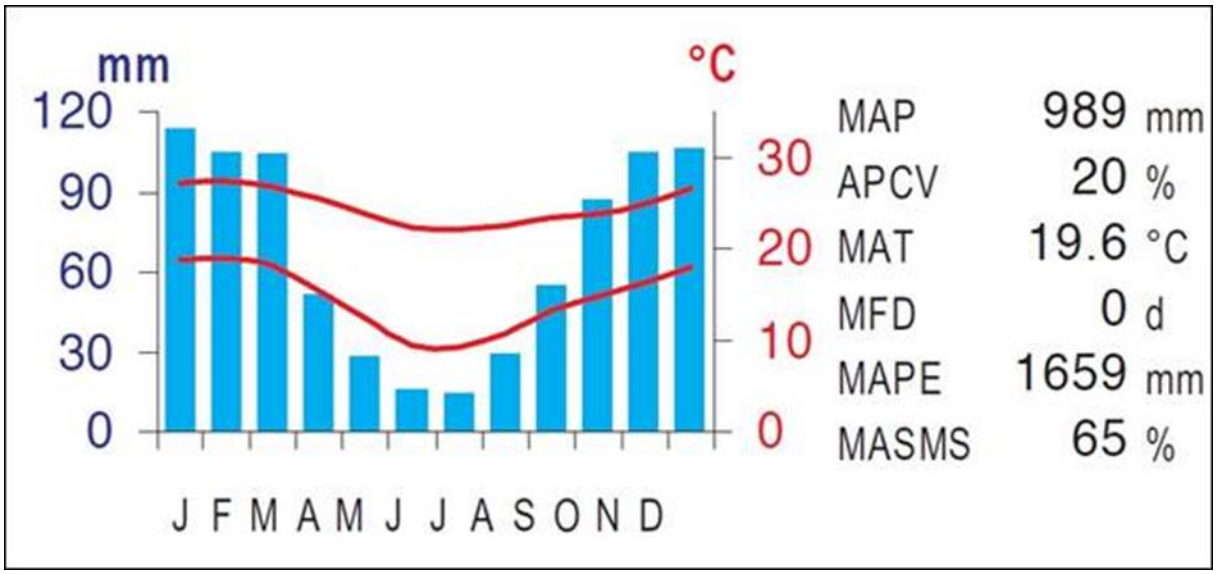

Figure 3: The climate summary for local area (Mucina & Rutherford, 2006)

6.1.2 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006) the development falls within the Hb93 and Fa603 land types. The geology of Hb93 land type is mainly quaternary sand of the Berea Formation, with small areas of sandstone of the Natal Group, tillite of the Dwyka Formation and granite. The geology of Fa603 land type is mainly tillite of the Dwyka Formation, with small areas of shale of the Pietermaritzburg Formation, Ecca Group and dolerite.

The Hb93 land type is dominated by the midslope landscape position. The soils in the midslope land position are expected to be dominated by Villafontes, Hutton, and Glenrosa soil forms. The valley bottoms should be dominated by the Katspruit soil form.

The Fa603 land type is dominated by the crest and midslope landscape positions. The soils in the crest and midslope land positions are expected to be dominated by Cartref and Glenrosa soil forms. The valley bottoms should be dominated by the Katspruit soil form.

6.1.3 Vegetation

The project area is situated across one vegetation type; KwaZulu Natal Coastal Belt Grassland, according to Mucina & Rutherford (2006) (Figure 4).

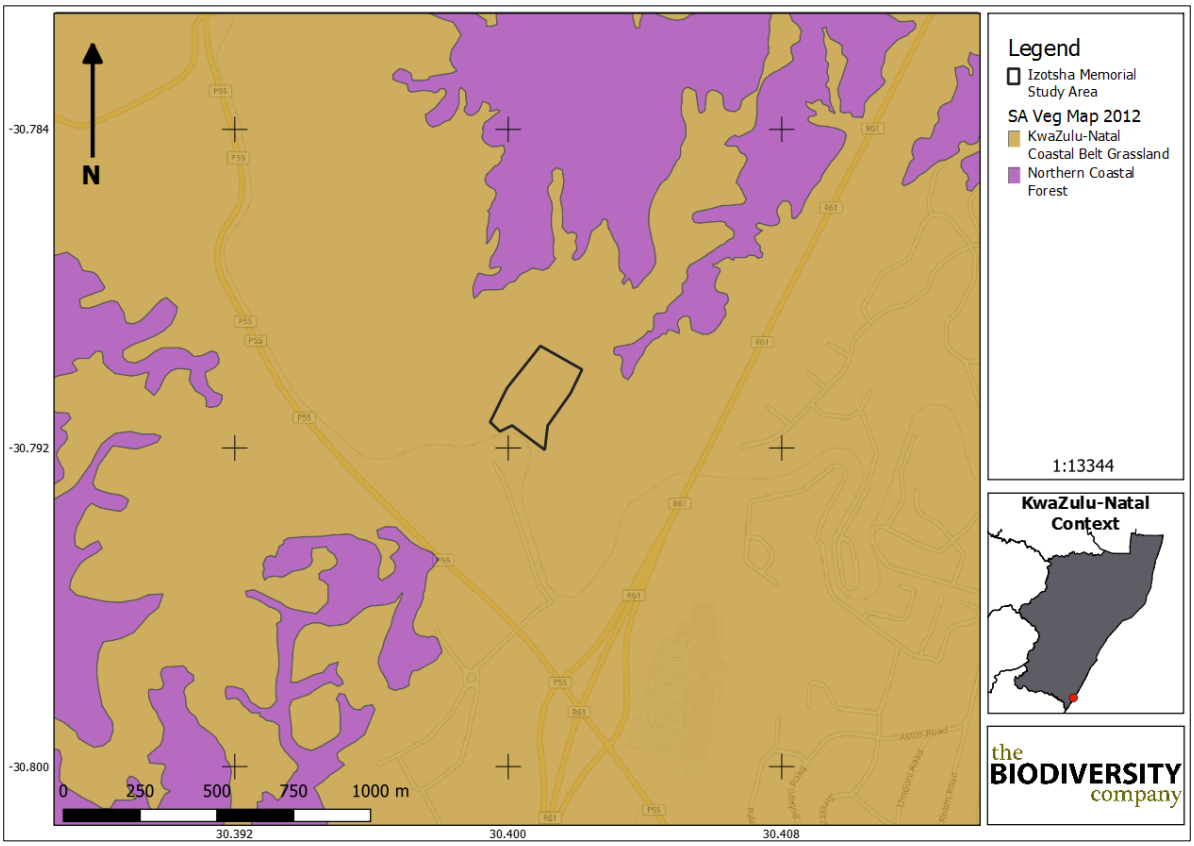

Figure 4: The Project area showing the vegetation type based on the Vegetation Map of South Africa, Lesotho & Swaziland (BGIS,2017)

KwaZulu Natal Coastal Belt Grassland (CB 3)

KwaZulu-Natal Coastal Belt Grassland is a broad coastal strip along the KwaZulu-Natal coast, from near Mtunzini in the north, via Durban to Margate and just short of Port Edward in the south. Highly dissected undulating coastal plains which presumably used to be covered to a great extent with various types of subtropical coastal forest. Some primary grassland dominated by *Themeda triandra* still occurs in hilly, high-rainfall areas where pressure from natural fire and grazing regimes prevailed. At present the KwaZulu-Natal Coastal Belt Grassland is affected by an intricate mosaic of very extensive sugarcane fields, timber

plantations and coastal holiday resorts, with interspersed secondary *Aristida* grasslands, thickets and patches of coastal thornveld (Mucina & Rutherford, 2006).

Conservation Status of the Vegetation Type

According to Mucina & Rutherford (2006), this vegetation type is classified as Endangered. The national target for conservation protection for this vegetation type is 25%, but only very small part statutorily conserved in Ngoye, Mbumbazi and Vernon Crookes Nature Reserves. About 50% is transformed for cultivation, by urban sprawl and for road-building. Alien species found in this vegetation type includes *Chromolaena odorata, Lantana camara, Melia azedarach* and *Solanum mauritianum*.

6.1.4 Critical Biodiversity Areas (CBAs)

The KZN BSP also provides a spatial representation of land and coastal marine area required to ensure the persistence and conservation of biodiversity within KZN, reflected as **Critical Biodiversity Areas (CBAs).**

Based on the Biodiversity Assessment (TBC, 2018) it can be concluded that the proposed development is likely to impact an area designated CBA: Irreplaceable (Figure 5). The main project area intersects with a CBA: Irreplaceable, predominantly the north-west and western portions.

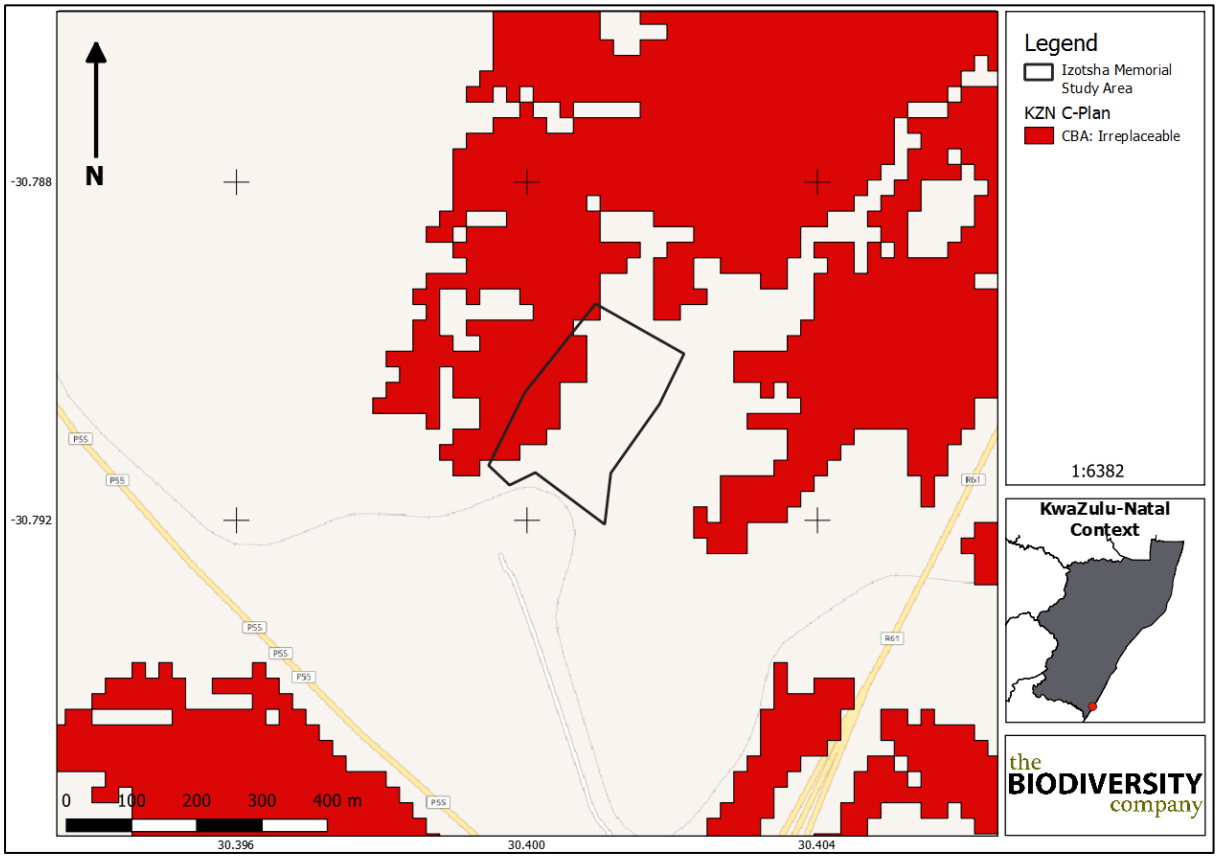

Figure 5: The project area superimposed on the KZN BSP (2014)

6.1.5 Wetland NFEPAs

Four (4) wetland areas classified within the NFEPA dataset were identified within the 500m regulated area of the proposed Development project area. The wetlands were all classified as artificial bench flat wetlands. Therefor these were not considered for this study.

6.2 Wetland Field Assessment

The wetland delineation is shown in Figure 6. Four (4) wetland types were identified within the project area, namely a hillslope seep (HGM 1), an unchannelled valley bottom system (HGM 2), a channelled valley bottom (HGM 3), and a depression (Dam) (HGM 4).

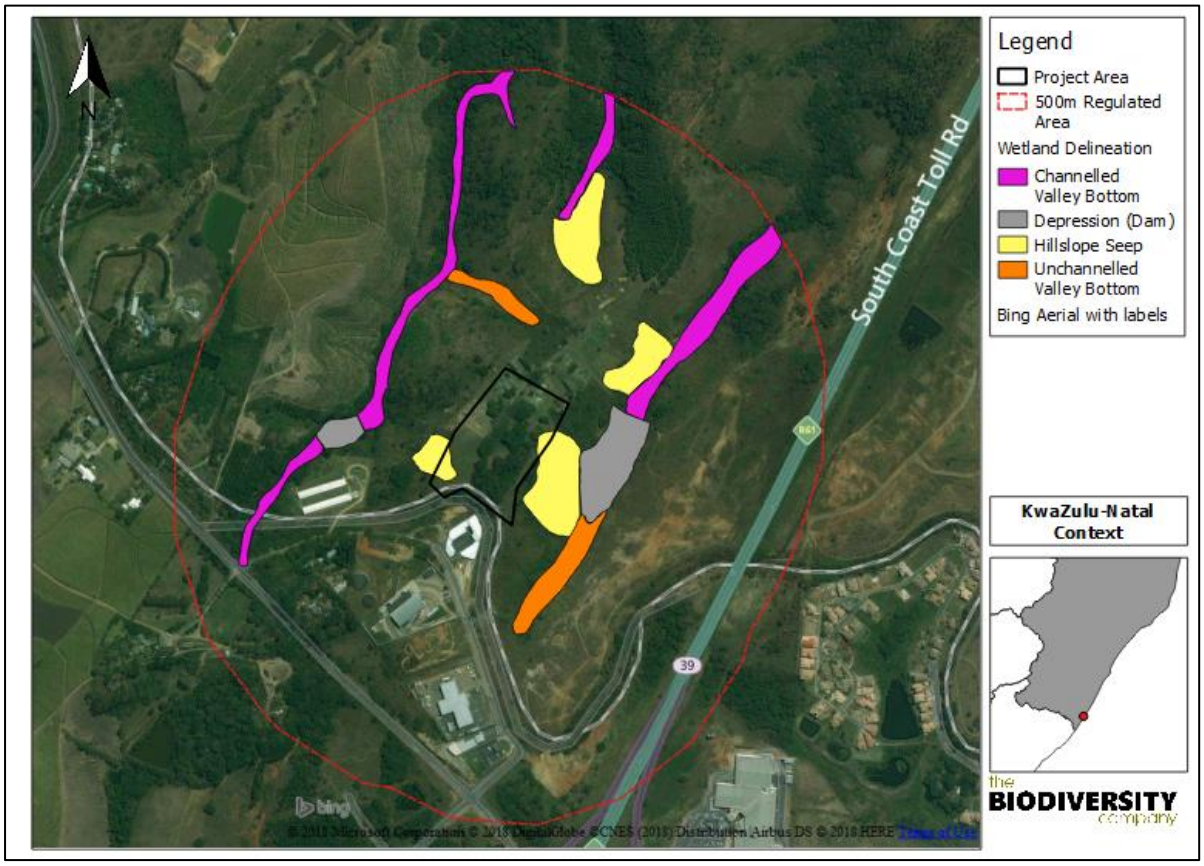

Figure 6: The wetland delineation for the Izotsha Memorial project

6.2.1 Wetland Landscape Position

The project area is situated on the crest of a watershed and the slopes are between 4% & 16%. The wetlands within the project area were identified to be hillslope seeps. The landscape outside of the project area, but within the 500m regulated area is relatively steep with channelled and unchannelled valley bottom wetlands. These systems have been dammed (depression wetlands). The hillslope seep wetland landscape is presented in Figure 7.

Figure 7: The hillslope seep within the project area with Setaria megaphylla on the right

6.2.1.1 Hillslope Seep

Hillslope seep are wetland areas located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope. Seeps are often located on the side-slopes of a valley, but they do not, typically, extend onto a valley floor. Water inputs are primarily via subsurface flows from an up-slope direction. Water movement through the seep is mainly in the form of interflow, with diffuse overland flow often being significant during and after rainfall events (Ollis *et al.* 2013). A conceptual diagram of a seep, showing the dominant movement of water into, through and out of a typical seep is provided in Figure 8.

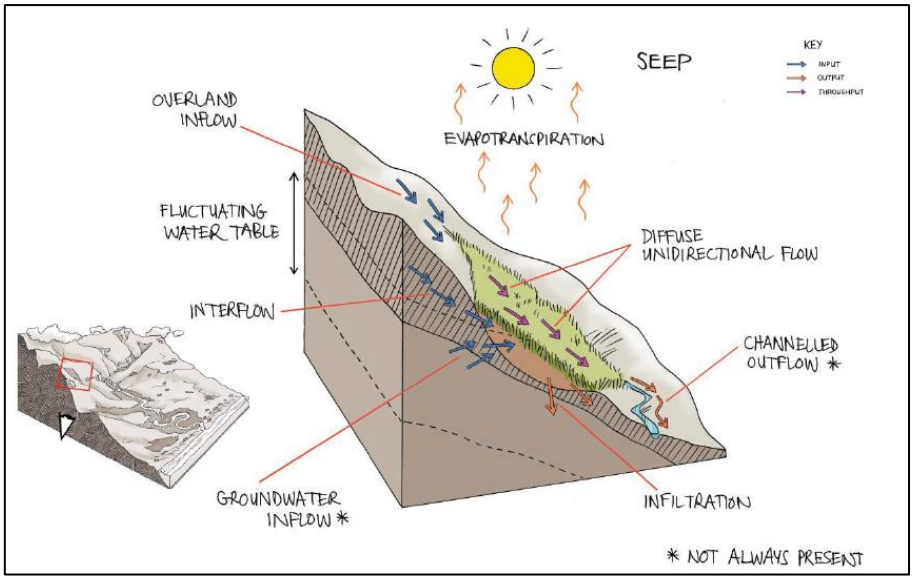

Figure 8: Illustration of hillslope seep flow dynamics (Ollis et al. 2013)

6.2.1.2 Unchannelled Valley Bottom

Unchannelled valley bottom wetland is a valley bottom wetland without a river channel running through it. Unchannelled valley bottom wetlands are characterised by their location on valley floors, an absence of distinct channel banks, and the prevalence of diffuse flows (Ollis *et al*. 2013). This has been illustrated in Figure 9.

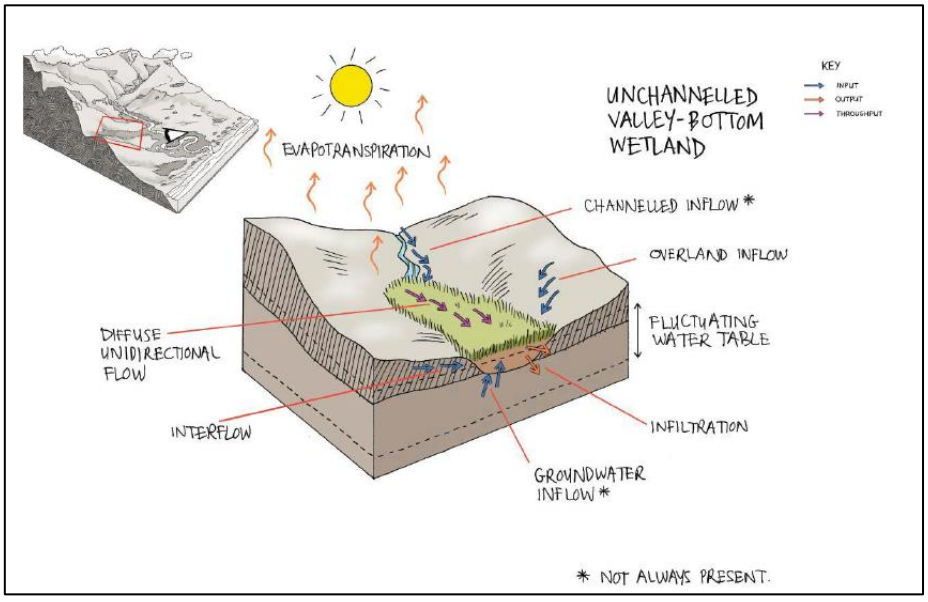

Figure 9: Illustration of unchannelled valley bottom flow dynamics (Ollis et al. 2013)

6.2.1.3 Channelled Valley Bottom

Channelled valley bottom wetland are characterised by their location on valley floors, the absence of characteristic floodplain features and the presence of a river channel flowing through the wetland (Ollis *et al*. 2013). This has been illustrated in Figure 10.

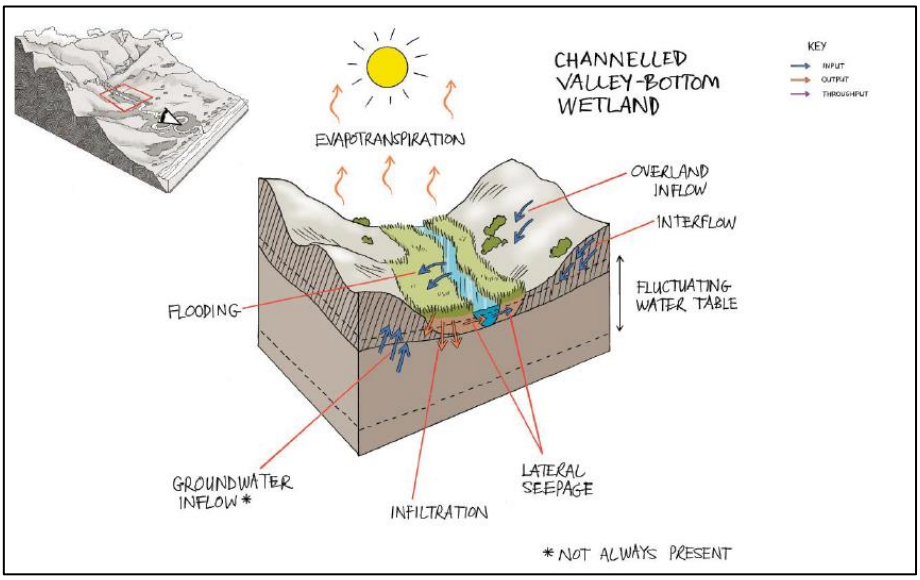

Figure 10: Illustration of channelled valley bottom flow dynamics (Ollis et al. 2013)

6.2.2 Wetland Vegetation

Wetland plants are classified as hydrophytic which refers to their adaptation to survive in highly saturated soils. The identified wetland plant species included *Cyperus congestus, Pycreus sspp.*, and *Imperata cylindrica*. Photographs of the identified species are presented in Figure 11.

Figure 11: The identified wetland plant species, A) Cyperus congestus (left), and Pycreus spp., B) Imperata cylindrica

6.2.3 Wetland Soils

The soils within the project area was dominated by sandy profiles of the Fernwood, Villafontes, and Longlands soil forms (Figure 12). The identification of mottling or plinthic features in sandy soils near the coast does pose a challenge.

The Fernwood, Villafontes, and Longlands soil forms are all classified with an Orthic A-horizon overlaying an E-horizon. This indicates water rapidly moving into the soil profile and then moving laterally bleaching the soil, and essentially washing all nutrients and clay downslope. Leaving the sandy bleached horizons. The C-horizon of these three (3) soil types all differ with regards to the level of wetness. The Longlands showing a soft plinthic horizon and indicating current wetland conditions.

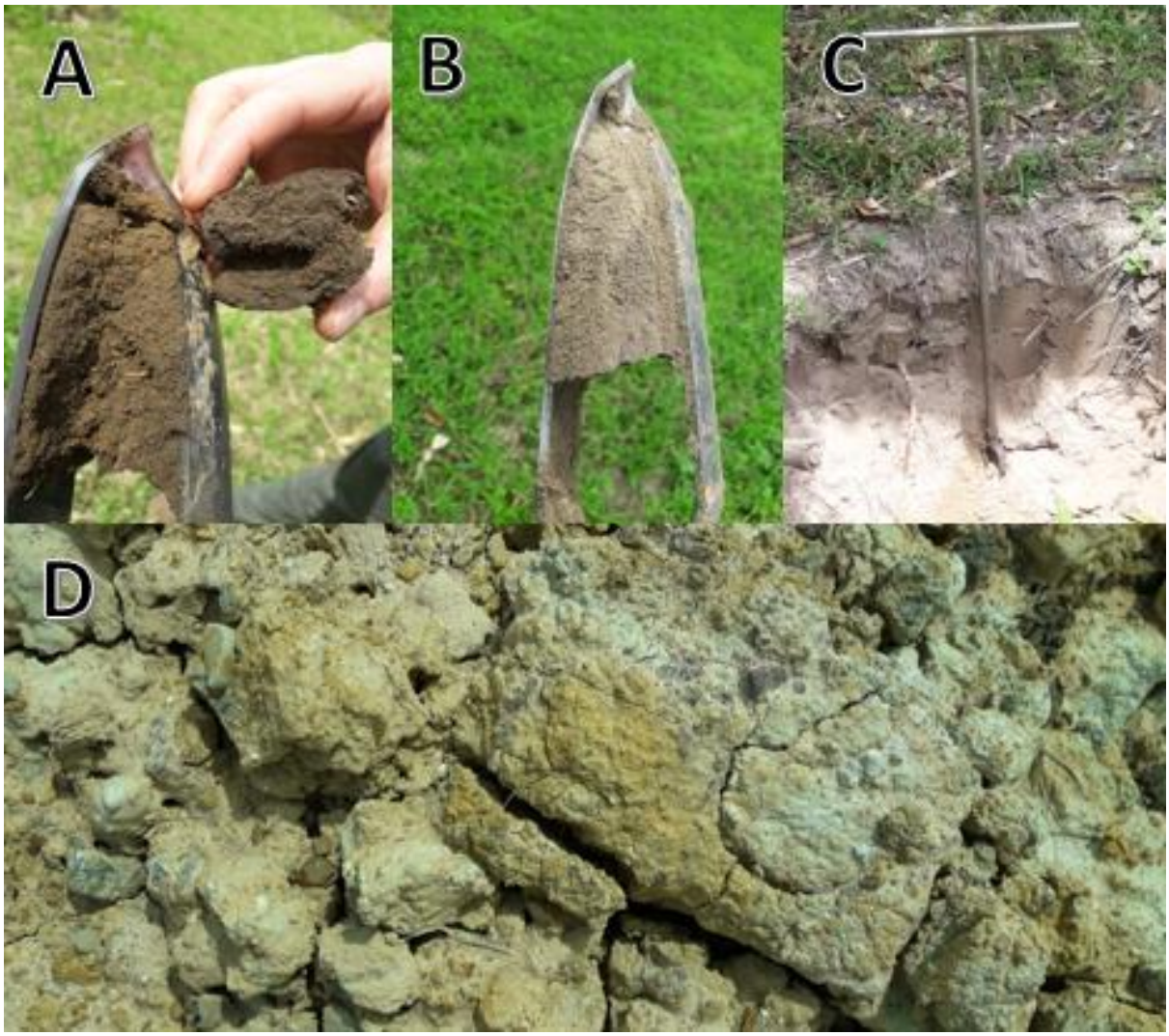

Figure 12: The identified soils within the project area, A) Pinedene/ Tukulu, B) Fernwood, C) Villafontes, D) Longlands

6.2.4 Hydrogeomorphic Unit Classification

Four (4) Hydrogeomorphic units were identified within the regulated area. The identified wetlands were classified as hillslope seep, unchannelled valley bottom, channelled valley bottom, and depression wetlands. The classification of the HGM unit is presented in Table 5.

Table 5: Wetland classification as per SANBI guideline (Ollis et al., 2013)

HGM Unit	Level 1	Level 2		Level 3		Level 4	
	System	DWS Ecoregion	NFEPA Wet Veg Group	Landscape Unit	4A (HGM)	4B	4C
1	Inland	North Eastern Coastal Belt	Indian Ocean Coastal Belt	Slope	Hillslope Seep	With channelled outflow	N/A
2	Inland			Valley Floor	Unchannelled Valley Bottom	N/A	N/A
3	Inland			Valley Floor	Channelled Valley Bottom	N/A	N/A
4	Inland			Valley Floor	Depression (Dam)	Dammed	N/A

6.2.5 Present Ecological State (PES)

The PES for the assessed wetlands is presented in Table 6. The overall wetland health for all HGM units were determined to be Moderately Modified (C). The depressions (Dams) were not assessed as these were not natural systems and the wetland health cannot be determined, however the depressions do provide Eco-Services and have been assessed in that section.

Table 6: Summary of the wetland PES

Wetland	Hydrology		Geomorphology		Vegetation	
	Rating	Score	Rating	Score	Rating	Score
HGM 1	C: Moderately Modified	3.5	C: Moderately Modified	2.3	D: Largely Modified	4.2
Overall PES Score	3.4		Overall PES Class		C: Moderately Modified	
HGM 2	C: Moderately Modified	3.5	C: Moderately Modified	2.1	C: Moderately Modified	3.4
Overall PES Score	3.1		Overall PES Class		C: Moderately Modified	
HGM 3	C: Moderately Modified	3.5	C: Moderately Modified	2.5	C: Moderately Modified	3.4
Overall PES Score	3.2		Overall PES Class		C: Moderately Modified	

A summary for the respective modules is as follows, with Figure 13 showing some of the impacts:

- The hydrological component for the HGM units were rated as Moderately Modified (C). These units have all been impacted on by alien vegetation encroachment and reduced vegetation cover in places. The reduced vegetation increases runoff potential and the risk of erosion. The hillslope seeps hydrology has been altered by the current

development through the excavation of graves and the road within the development. These aspects alter the subsurface flows and linkages to hillslope seeps hydrology.

- The geomorphology component for the HGM units were all rated as Moderately Modified (C). The excavation of graves and the current road have altered the subsurface flows and linkages to hillslope seeps hydrology. The geomorphological change might look subtle at the surface, but dose play some role in the sub-surface. The dams within the valley bottom wetlands impacts on the flows and natural geomorphological process, through reduced sediment loads, which could increase erosion potential downstream.
- The vegetation component for the HGM units range from Moderately Modified (C) to Largely Modified (D). Alien invasive species were the main impact on these HGM units along with the dammed areas.

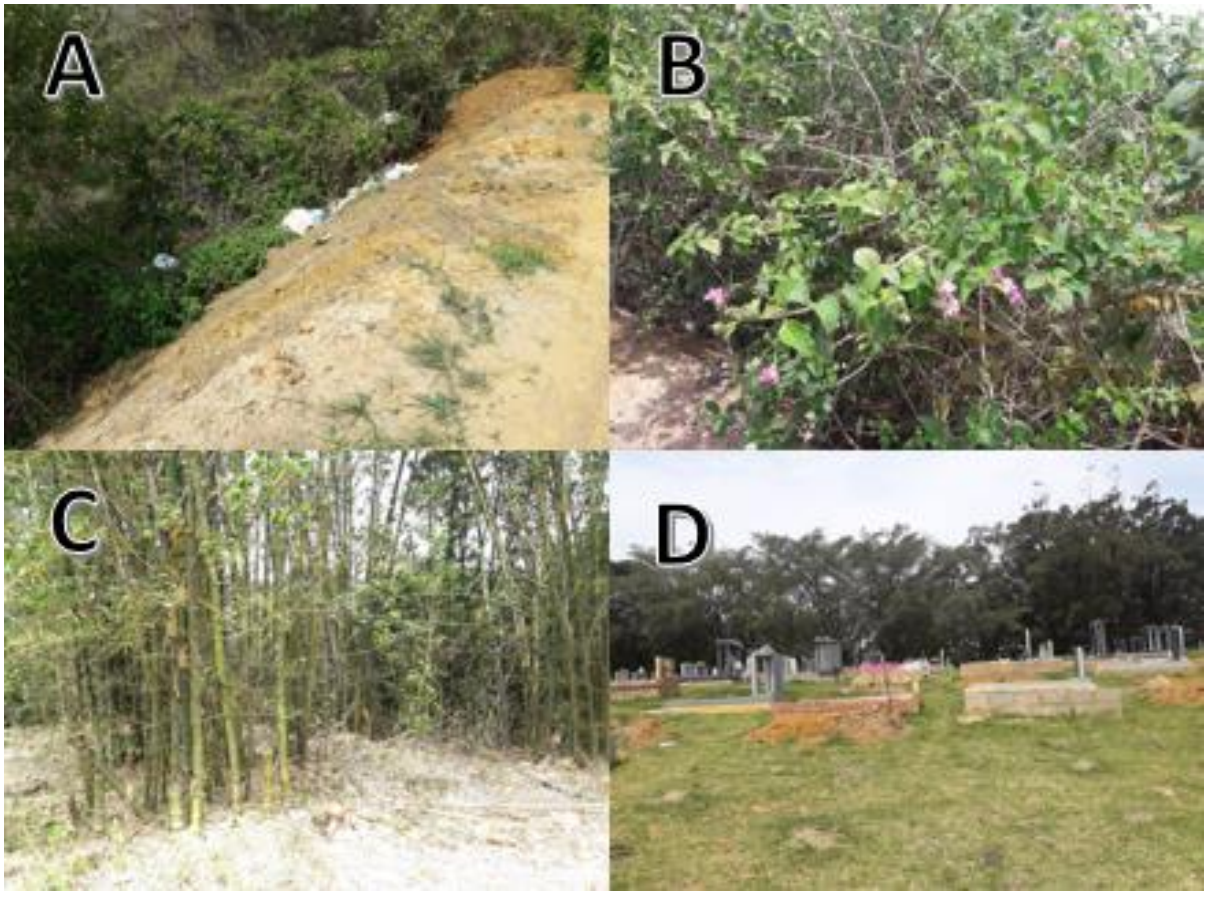

Figure 13: Photographs of some impacts effecting the wetland health ratings. A) Waste disposal and soil stockpiles, B) Alien vegetation, C) Chinese bamboo in the stream channels reducing flow, D) excavation of possible interflow areas for graves

6.2.6 Ecosystem Services Assessment

The Ecosystem services provided by the wetlands identified within the project area were assessed and rated using the WET-EcoServices method (Kotze, *et al*. 2009). The summarised results for the wetlands are shown in Table 7.

The HGM units all showed an overall Moderate-Low level of service. With flood attenuation being the only service rated as Moderate-High for HGM 3 and HGM 4 only. The dams and channelled valley bottom provide some protection from flood events.

Table 7: The Ecosystem Service provided by the wetland

Wetland Unit					HGM 1	HGM 2	HGM 3	HGM 4
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		1.7	2.0	2.1	2.1
			Streamflow regulation		0.8	1.0	1.0	1.2
			Water Quality enhancement benefits	Sediment trapping	1.4	1.6	1.7	1.7
				Phosphate assimilation	1.5	1.7	1.4	1.4
				Nitrate assimilation	1.6	1.6	1.1	1.1
				Toxicant assimilation	1.3	1.7	1.4	1.5
				Erosion control	1.4	1.9	2.0	2.0
			Carbon storage		0.7	1.3	1.3	1.7
	Direct Benefits	Biodiversity maintenance			1.1	1.2	1.0	1.0
		Provision benefits	Provisioning of water for human use		0.3	0.5	0.5	0.7
			Provisioning of harvestable resources		0.0	0.0	0.0	0.0
			Provisioning of cultivated foods		0.0	0.0	0.0	0.0
		Cultural benefits	Cultural heritage		0.0	0.0	0.0	0.0
			Tourism and recreation		0.0	0.1	0.1	0.3
			Education and research		0.8	0.3	0.3	0.3
Overall					12.5	14.9	13.8	14.8
Average					0.8	1.0	0.9	1.0

6.2.7 Ecological Importance & Sensitivity (EIS)

The EIS assessment was applied to the identified wetland in the project area in order to assess the levels of sensitivity and ecological importance of the wetland. The results of the assessment are shown in Table 8.

The Ecological Importance & Sensitivity was calculated to have a Moderate (C) level of importance for all HGM units. Although the wetland was not associated with NFEPA wetlands or protected natural habitats, the wetland falls within part of an endangered vegetation unit. The Hydrological Functionality was calculated to have a Moderate (C) level of importance for all HGM units, although the wetland's hydrology has been impacted upon, the wetland maintains a water source for downstream areas and the modifications increase the wetland's ability to protect against flood and erosion. The Direct Human Benefits were rated as having a Low (D) level of importance.

Table 8: The EIS results for the identified wetland

Wetland Importance and Sensitivity	HGM 1	HGM 2	HGM 3	HGM 4
Ecological Importance & Sensitivity	1.6	2.0	2.0	1.7
Hydrological/Functional Importance	1.3	1.6	1.5	1.6
Direct Human Benefits	0.5	0.1	0.1	0.2

6.2.8 Buffer Zones

The wetland buffer zone tool was used to calculate the appropriate buffer required for the development. The model shows that the largest risks (Moderate) posed by the project during the construction phase is that of "increased sediment inputs and turbidity" and "inputs of metal contaminants". During the operational phase, the High risks identified for the project included Alteration of flow volumes" and "altered patterns of flows" (Table 11). These risks are calculated with no prescribed mitigation and the calculated buffer requirement is presented in Table 9.

Table 9: Pre-mitigation buffer requirement

Required Buffer before mitigation measures have been applied	
Construction Phase	26m
Operational Phase	20m

According to the buffer guideline (Macfarlane*, et al*. 2014) a high-risk activity would require a buffer that is 95% effective to reduce the risk of the impact to a low level threat.

The risks were then reduced to Low with the prescribed mitigation measures and therefore the recommended buffer was calculated to be 15m (Table 10) for the construction and operational phases.

Table 10: Post-mitigation buffer requirement

Required Buffer after mitigation measures have been applied	
Construction Phase	15 m
Operational Phase	15 m

A conservative buffer zone was suggested of 15 m for the construction and operation phases respectively, this buffer is calculated assuming mitigation measures are applied. This would typically include a commitment to rehabilitate and manage buffer zones to ensure that these areas function optimally.

Table 11: The risk results from the wetland buffer model for the proposed Development project

Threat Posed by the proposed land use / activity		Specialist Threat Rating	Threat Rating after Mitigation	Recommended Mitigation
Construction Phase	1. Alteration to flow volumes	Very Low	Very Low	
	2. Alteration of patterns of flows (increased flood peaks)	Low	Low	
	3. Increase in sediment inputs & turbidity	Very High	Medium	The development final layout must avoid the wetland areas. All impacts from the construction will be indirect. The access route will use existing roads and crossings. Mitigation will include silt traps, dry season construction, stormwater management, sediment trapping berms and minimal footprint disturbance.
	4. Increased nutrient inputs	Very Low	Very Low	
	5. Inputs of toxic organic contaminants	Very Low	Very Low	
	6. Inputs of toxic heavy metal contaminants	Low	Low	
	7. Alteration of acidity (pH)	Low	Low	
	8. Increased inputs of salts (salinization)	N/A	N/A	
	9. Change (elevation) of water temperature	Very Low	Very Low	
	10. Pathogen inputs (i.e. disease-causing organisms)	Very Low	Very Low	
Operational Phase	1. Alteration to flow volumes	High	Low	The proposed development will not traverse wetland areas. The following are mitigation measures to aid in the reduction of impacts: • Stormwater management plan; • Green/soft engineering for stormwater systems; • Rainwater harvesting; • Linkage to municipal sewage system; • Signage to discourage littering and pollution; • Adequate refuse points and refuse removal; • No activities to rake place within wetland and buffer zones • Rehabilitation of vegetation in disturbed areas; • Water velocity (dissipaters) management and plants at stormwater discharge points
	2. Alteration of patterns of flows (increased flood peaks)	High	Low	
	3. Increase in sediment inputs & turbidity	Medium	Low	
	4. Increased nutrient inputs	Medium	Low	
	5. Inputs of toxic organic contaminants	Medium	Low	
	6. Inputs of toxic heavy metal contaminants	Medium	Low	
	7. Alteration of acidity (pH)	Very Low	Very Low	
	8. Increased inputs of salts (salinization)	Very Low	Very Low	
	9. Change (elevation) of water temperature	Very Low	Very Low	
	10. Pathogen inputs (i.e. disease-causing organisms)	Medium	Low	

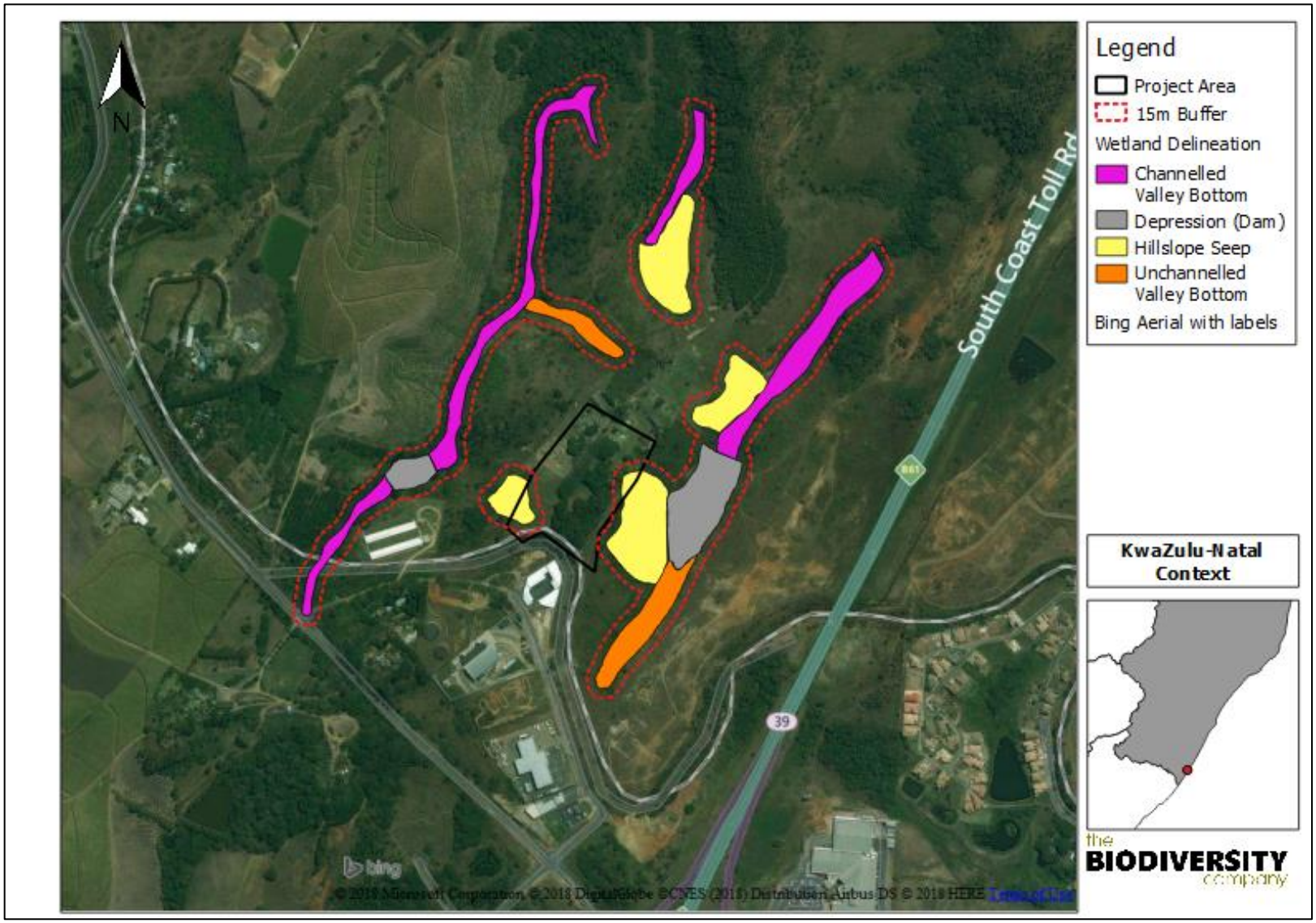

Figure 14: 15m buffer zone for the Izotsha Memorial Development project

7 Risk Assessment

The presence and operation of the development has a smaller spatial impact but larger overall temporal impact (decades to centuries). Short term effects can occur during stormwater management activities. However, long term negative effects include alterations in stream hydrology and geomorphology which subsequently can result in a shift of ecological structures. Acute and chronic negative effects of stormwater management occur during rainfall events whereby runoff from hardened surfaces (roofing, driveways and car park areas) typically contains a mixture of contaminants such as messed garden fertilizers, metals, salts, oil and grease which enters nearby wetland systems accumulating in the instream sediments or can be dispersed into groundwater. Stormwater discharge is likely to scour the receiving areas, removing soils and modifying the geomorphology. The scouring of substrates is avoided through the implementation of appropriate energy dissipation structures.

Table 13, Table 14 and Table 15 present the aspects considered for the risk assessment, and the scoring to determine the level of risks posed.

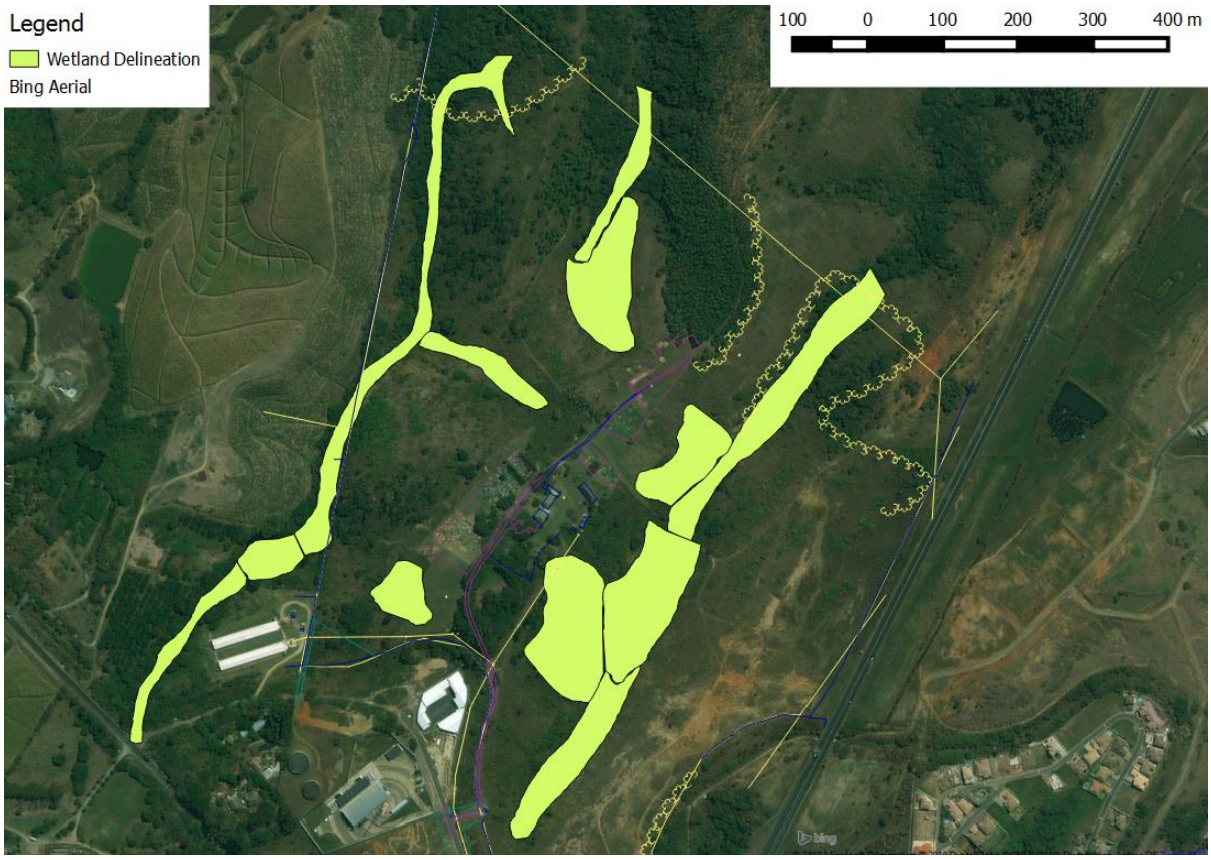

Figure 15: The project aspects in relation to the delineated wetland areas

Table 12: Impacts assessed for the proposed project

Andrew Husted	Pr Sci Nat	400213/11
Activity	**Aspect**	**Impacts to Wetlands**
Development Construction	Clearing of vegetation	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Stripping of soil	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Establishment of access roads	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Access roads wetland crossing	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Excavation of foundations	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Delivery of building material (heavy vehicles)	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Operation of machinery and vehicles within watercourse area	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Operation of machinery and vehicles in adjacent areas	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Waste and ablutions facilities	• Inputs of toxic organic contaminants
	Mixing and pouring concrete	• Inputs of toxic organic contaminants
	Storage of materials on site	• Inputs of toxic organic contaminants
	Final landscaping and shaping	• Increase in sediment inputs & turbidity • Inputs of toxic heavy metal contaminants • Alteration of acidity (pH)
	Final access road upgrades and stabilisation	• Alteration to flow volumes

		• Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Post-construction rehabilitation	• Increase in sediment inputs & turbidity
Operation of development and access roads	Alteration of in channel flows	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Alteration of surface drainage and runoff	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Increased traffic in the area (proximity to watercourse)	• Increase in sediment inputs & turbidity
	Stormwater management system	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity • Alteration of acidity (pH)
	Establishment of alien plants on disturbed areas	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks)
	Solid waste disposal in wetland areas	• Inputs of toxic heavy metal contaminants • Alteration of acidity (pH)
	Increased organic pollutants	• Inputs of toxic organic contaminants
	Sedimentation of wetland areas (altered flows)	• Alteration to flow volumes • Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity
	Human disturbance in wetland areas	• Alteration of patterns of flows (increased flood peaks) • Increase in sediment inputs & turbidity

Table 13: DWS Risk Impact Matrix for the proposed project

Aspect	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase								
Clearing of vegetation	2	2	2	1	1,75	2	2	5,75
Stripping of soil	2	2	2	1	1,75	2	2	5,75
Establishment of access roads and pipelines	3	2	2	3	2,5	3	2	7,5
Access roads wetland crossing	2	1	2	3	2	3	2	7
Excavation of foundations	2	1	2	2	1,75	3	2	6,75
Delivery of building material (heavy vehicles)	3	2	3	2	2,5	2	2	6,5
Operation of machinery and vehicles within watercourse area	2	2	2	2	2	2	2	6
Operation of machinery and vehicles in adjacent areas	2	2	2	2	2	2	2	6
Waste and ablutions facilities	1	3	1	3	2	3	2	7
Mixing and pouring concrete	1	3	1	3	2	3	2	7
Storage of materials on site	1	3	1	3	2	3	2	7
Final landscaping and shaping	3	2	3	2	2,5	2	2	6,5
Final access road upgrades and stabilisation	1	1	2	1	1,25	2	2	5,25
Post-construction rehabilitation	1	1	2	1	1,25	2	2	5,25
Operational Phase								
Alteration of in channel flows	3	1	3	2	2,25	2	4	8,25
Alteration of surface drainage and runoff	3	1	3	2	2,25	3	4	9,25
Increased traffic in the area (proximity to watercourse)	1	1	1	1	1	1	4	6
Stormwater management system	3	2	3	2	2,5	2	4	8,5
Establishment of alien plants on disturbed areas	2	2	2	3	2,25	2	3	7,25
Solid waste disposal in wetland areas	2	3	2	2	2,25	3	4	9,25
Increased organic pollutants	1	3	1	2	1,75	3	4	8,75
Sedimentation of wetland areas (altered flows)	2	2	2	2	2	3	4	9

Aspect	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Human disturbance in wetland areas	1	2	2	1	1,5	1	4	6,5

Table 14: DWS Risk Impact Matrix for the proposed project continued

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Clearing of vegetation	1	2	1	3	7	40,25	**Low**	**Low**
Stripping of soil	1	2	1	3	7	40,25	**Low**	**Low**
Establishment of access roads and pipelines	1	3	5	1	10	75	**Moderate**	**Low**
Access roads wetland crossing	1	3	5	1	10	70	**Moderate**	**Low**
Excavation of foundations	1	3	5	2	11	74,25	**Moderate**	**Low**
Delivery of building material (heavy vehicles)	1	3	5	2	11	71,5	**Moderate**	**Low**
Operation of machinery and vehicles within watercourse area	1	3	**1**	3	8	46	**Low**	**Low**
Operation of machinery and vehicles in adjacent areas	1	2	5	1	9	67,5	**Moderate**	**Low**
Waste and ablutions facilities	1	2	5	2	10	70	**Moderate**	**Low**
Mixing and pouring concrete	1	2	5	2	10	70	**Moderate**	**Low**
Storage of materials on site	1	2	5	2	10	70	**Moderate**	**Low**
Final landscaping and shaping	1	3	5	2	11	74,25	**Moderate**	**Low**
Final access road upgrades and stabilisation	1	1	1	3	6	39	**Low**	**Low**
Post-construction rehabilitation	1	1	1	3	6	36	**Low**	**Low**
Operational Phase								
Alteration of in channel flows	4	3	1	1	9	74,25	**Moderate**	**Low**
Alteration of surface drainage and runoff	2	2	1	1	6	55,5	**Moderate**	**Low**
Increased traffic in the area (proximity to watercourse)	2	1	1	1	5	30	**Low**	**Low**
Stormwater management system	2	2	1	2	7	59,5	**Moderate**	**Low**

Establishment of alien plants on disturbed areas	2	2	5	2	11	79,75	**Moderate**	**Low**
Solid waste disposal in wetland areas	3	3	1	1	8	74	**Moderate**	**Low**
Increased organic pollutants	2	2	1	2	7	61,25	**Moderate**	**Low**
Sedimentation of wetland areas (altered flows)	2	1	1	2	6	54	**Low**	**Low**
Human disturbance in wetland areas	2	2	1	2	7	45,5	**Low**	**Low**

(*) denotes - In accordance with General Notice 509 “Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below.”

The proposed development consists of a construction and operational phase, there has been no allowance for a decommissioning phase for the project. The project will entail the clearing of areas and excavation of foundations, establishment of roads and various activities which will pose risks to the identified wetland areas, with the level of risk determined to vary from low to moderate. The final designs must attempt to stay outside of the designated wetland areas and the 15m allocated buffer zones.

The moderate risks determined for the study are associated with the digging works, soil stockpile management and operation of equipment and machinery. Notable expected risks include the potential for erosion and increased sedimentation of the wetlands. All the risks during the construction phase of the project were determined to be low risk, after mitigation measures were applied. This is due to the fact the project area is developed currently, and mitigation measures will improve the current state of the adjacent wetland areas.

The operation of the development area poses a low risk to the identified wetlands. The moderate risks are brought about by the duration of the project; however, all risks were determined to be low after mitigation measures were applied.

All moderate risk ratings were re-allocated a low status due to implementation of mitigation methodologies.

7.1 Development specific mitigation measures

The following mitigation measures are provided:

- Adhere to the buffer zone (where applicable) and work outside of this buffer;
- Silt traps and sediment trapping berms must be in place in drainage lines around the construction site;
- A suitable storm water plan must be compiled for the development. This plan must attempt to displace and divert storm water from the road and discharge the water into adjacent areas without eroding the receiving areas. It is preferable that run-off velocities be reduced with energy dissipaters and flows discharged into the local watercourses;
- Stormwater infrastructure should be maintained regularly; and
- All removed soil and material must not be stockpiled within the watercourse and buffer. stockpiles must be protected from erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds.

7.2 Road construction specific mitigation measures

The following road construction specific mitigation measures are provided:

- To minimise the impact on both surface water flow and interflow, portions of the road must include a coarse rock layer that has been specifically incorporated to increase the porosity and permeability of the sub-layers of the road;
- Exposed road surfaces awaiting grading must be stabilised to prevent the erosion of these surfaces. Signs of erosion must be addressed immediately to prevent further erosion of the road; and

- Silt traps and fences must be placed in the preferential flow paths along the road to prevent sedimentation of the watercourse.

7.3 General mitigation measures

The following general mitigation measures are provided:

- The wetland areas outside of the specific project site area must be avoided;
- The construction vehicles and machinery must make use of existing access routes as much as possible, before adjacent areas are considered for access;
- Laydown yards, camps and storage areas must be beyond the wetland areas. Where possible, the construction of the pipeline and crossings must take place from the existing road servitudes;
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly;
- Construction must take place during the dry season (April-September). If construction will be over a prolonged period, ensure that clearing, excavation and foundations are laid down in the dry season to reduce the erosion potential of the exposed surfaces;
- Temporary storm water management systems must be in place and preferential runoff channels be filled with aggregate and/or logs (branches included) to dissipate flows, limiting erosion and sedimentation;
- The footprint area of the must be kept a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas;
- Prevent uncontrolled access of vehicles through the wetland systems that can cause a significant adverse impact on the hydrology and alluvial soil structure of these areas;
- All chemicals and toxicants to be used for the pipeline construction must be stored outside the channel system and in a bunded area;
- All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site;
- All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- Have action plans on site, and training for contactors and employees in the event of spills, leaks and other impacts to the aquatic systems;
- All removed soil and material must not be stockpiled within the system. Stockpiling should take place outside of the watercourse. All stockpiles must be protected from

erosion, stored on flat areas where run-off will be minimised, and be surrounded by bunds;

- Erosion and sedimentation into drainage channels must be minimised through the effective stabilisation (gabions and Reno mattresses) and the re-vegetation of any disturbed banks;
- Temporary and permanent erosion control methods may include silt fences, flotation silt curtains, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed embankments, erosion mats, and mulching;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil;
- No dumping of construction material on-site may take place;
- All waste generated on-site during construction must be adequately managed. Separation and recycling of different waste materials should be supported.

8 Recommendations

- Include green or soft engineering for stormwater management and harvesting of rainwater.
- Adhere to 15m buffer, and management of the buffer zone.
- An alien invasive plant management plan needs to be compiled and implemented post construction to control current invaded areas and prevent the growth of invasive on cleared areas.

9 Conclusion

Four (4) wetland types were identified within the project area, namely a hillslope seep (HGM 1), an unchannelled valley bottom system (HGM 2), a channelled valley bottom (HGM 3), and a depression (Dam) (HGM 4).

The overall wetland health for all HGM units were determined to be Moderately Modified (C). The depressions (Dams) were not assessed as these were not natural systems and the wetland health cannot be determined, however the depressions do provide Eco-Services and have been assessed in that section. The HGM units all showed an overall Moderate-Low level of service. With flood attenuation being the only service rated as Moderate-High for HGM 3 and HGM 4 only. The dams and channelled valley bottom provide some protection from flood events.

The Ecological Importance & Sensitivity was calculated to have a Moderate (C) level of importance for all HGM units. Although the wetland was not associated with NFEPA wetlands or protected natural habitats, the wetland falls within part of an endangered vegetation unit. The Hydrological Functionality was calculated to have a Moderate (C) level of importance for all HGM units, although the wetland's hydrology has been impacted upon, the wetland maintains a water source for downstream areas and the modifications increase the wetland's ability to protect against flood and erosion. The Direct Human Benefits were rated as having a Low (D) level of importance.

Conservative buffer zones of 15m (Post-mitigation) were suggested for the construction and operational phases of the development.

Risk Assessment

The presence and operation of the development has a smaller spatial impact but larger overall temporal impact (decades to centuries). Short term effects can occur during stormwater management activities. However, long term negative effects include alterations in stream hydrology and geomorphology which subsequently can result in a shift of ecological structures. Acute and chronic negative effects of stormwater management occur during rainfall events whereby runoff from hardened surfaces (roofing, driveways and car park areas) typically contains a mixture of contaminants such as messed garden fertilizers, metals, salts, oil and grease which enters nearby wetland systems accumulating in the instream sediments or can be dispersed into groundwater. Stormwater discharge is likely to scour the receiving areas, removing soils and modifying the geomorphology. The scouring of substrates is avoided through the implementation of appropriate energy dissipation structures.

The proposed development consists of a construction and operational phase, there has been no allowance for a decommissioning phase for the project. The project will entail the clearing of areas and excavation of foundations, establishment of roads and various activities which will pose risks to the identified wetland areas, with the level of risk determined to vary from low to moderate. The final designs must attempt to stay outside of the designated wetland areas and the 15m allocated buffer zones.

The moderate risks determined for the study are associated with the digging works, soil stockpile management and operation of equipment and machinery. Notable expected risks include the potential for erosion and increased sedimentation of the wetlands. All the risks during the construction phase of the project were determined to be low risk, after mitigation measures were applied. This is due to the fact the project area is developed currently, and mitigation measures will improve the current state of the adjacent wetland areas.

The operation of the development area poses a low risk to the identified wetlands. The moderate risks are brought about by the duration of the project; however, all risks were determined to be low after mitigation measures were applied.

It is the opinion of the specialist that the project be favourably considered, and allow for the proposed development to proceed, but all prescribed mitigation measures and recommendations must be implemented.

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