Water Resource Assessment for the proposed Umshwati Water Supply Scheme Pipeline Project

Umshwati, KwaZulu-Natal

November 2019

CLIENT

IN ASSOCIATION WITH INKANYEZI YETHU

Prepared for:

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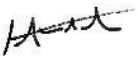
Report Name	**Water Resource Assessment for the Proposed Umshwati Water Supply Scheme**
Reference	**Umshwati Pipeline**
Submitted to	**EnviroPro Environmental Consulting (Pty) Ltd**
Report Writer (Wetlands)	**Wayne Jackson (Cert. Sci. Nat. 119037)**  Wayne Jackson is a Soils Scientist & Hydrologist and has 10 years' experience in the classification of soils, and also the delineation and assessment of wetlands. 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 Writer (Aquatics)	**Michael Ryan (Cand. Sci. Nat. 125128)**  Michael Ryan is an Aquatic Ecologst and Hydrologist with 2 years of experience in baseline river assessments and aquatics and is SASS5 accredited. Michael Ryan received his B.Sc Honours degree (Geography) from the University of Witwatersrand.
Reviewer	**Andrew Husted**  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 12 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 Environmental Impact 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.

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 in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Wayne Jackson

Cert. Sci. Nat. 119037

The Biodiversity Company

October 2019

Declaration

I, Michael Ryan 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 in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Michael Ryan

Aquatic Specialist

The Biodiversity Company

November 2019

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1 Introduction

The Biodiversity Company was commissioned by Enviropro Environmental Consulting (Pty) Ltd to conduct a water recourse baseline and impact (risk) assessment as part of the Basic Assessment (BA), environmental authorisation process and Water Use Licence Application (WULA) for a pipeline that forms part of the Umshwati Water Supply Scheme in KwaZulu-Natal, South Africa.

The wetland assessment was conducted in October 2019. The survey was focused primarily on those areas which were most likely to be impacted upon by the proposed development. Furthermore, identification and description of any sensitive receptors were recorded across the project area, and the manner in which these sensitive receptors may be affected by the activity was also investigated.

The aquatics survey was conducted on the 30th and 31st of October 2019 which constitutes a wet season survey. The assessment included defining the extent of the project area and baseline conditions of the systems. Furthermore, the identification and description of any sensitive receptors were recorded across the project area where the pipeline crossed any river system.

The project was completed in accordance with the requirements of the Water Use Authorisation in terms of Section 21(c) and (i) of the National Water Act (Act 36 of 1998) (NWA). This assessment is in accordance with the 2014 EIA Regulations (No. R. 982-985, Department of Environmental Affairs, 4 December 2014) emanating from Chapter 5 of the National Environmental Management Act (Act No. 107 of 1998). The findings and information herein are in terms of Appendix 6 of the 2014 NEMA EIA Regulations (amended in 2017).

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.

2 Project Area

The project area is situated approximately 28 km South East of Greytown, KwaZulu-Natal. The project area is surrounded by rural development that is spread out over a large area. Large sections of natural vegetation can also be found in the project area and surrounds. The project area is located in a rural setting, with the pipeline servicing communities in the province of KwaZulu-Natal, South Africa (Figure 1).

The Umshwati pipeline project is situated in the quaternary catchment U40C, U40D and U40E, within the Phongola to Mtumvuna Water Management Area (WMA 4). The proposed reticulation network will be crossing multiple tributaries of the Mvoti River (U40D-03957 and U40E-03967 Sub Quaternary Reach) (SQR), in the North Eastern Coastal Belt– Lower Aquatic Ecoregion. The system at a desktop level is regarded as largely natural (Class B by DWS, 2019a) due to rural settlements, alien invasive plants in riparian zones and subsistence farming.

The Mvoti to Umzimkulu WMA is situated along the eastern coast of South Africa, mainly within the province of KwaZulu-Natal, and borders on Lesotho to the west. The region has a mean annual precipitation rate of 800 to 1 500 mm and is considered humid. The terrain is characterised with rolling hills with the Drakensburg escarpment as the main topographic feature. A number of parallel rivers drain the Mvoti to Umzimkulu WMA, of which two originate in the Drakensberg Mountains at the border with Lesotho. The area is characterised as rural, and activities include subsistence and commercial farming (StatsSA, 2010).

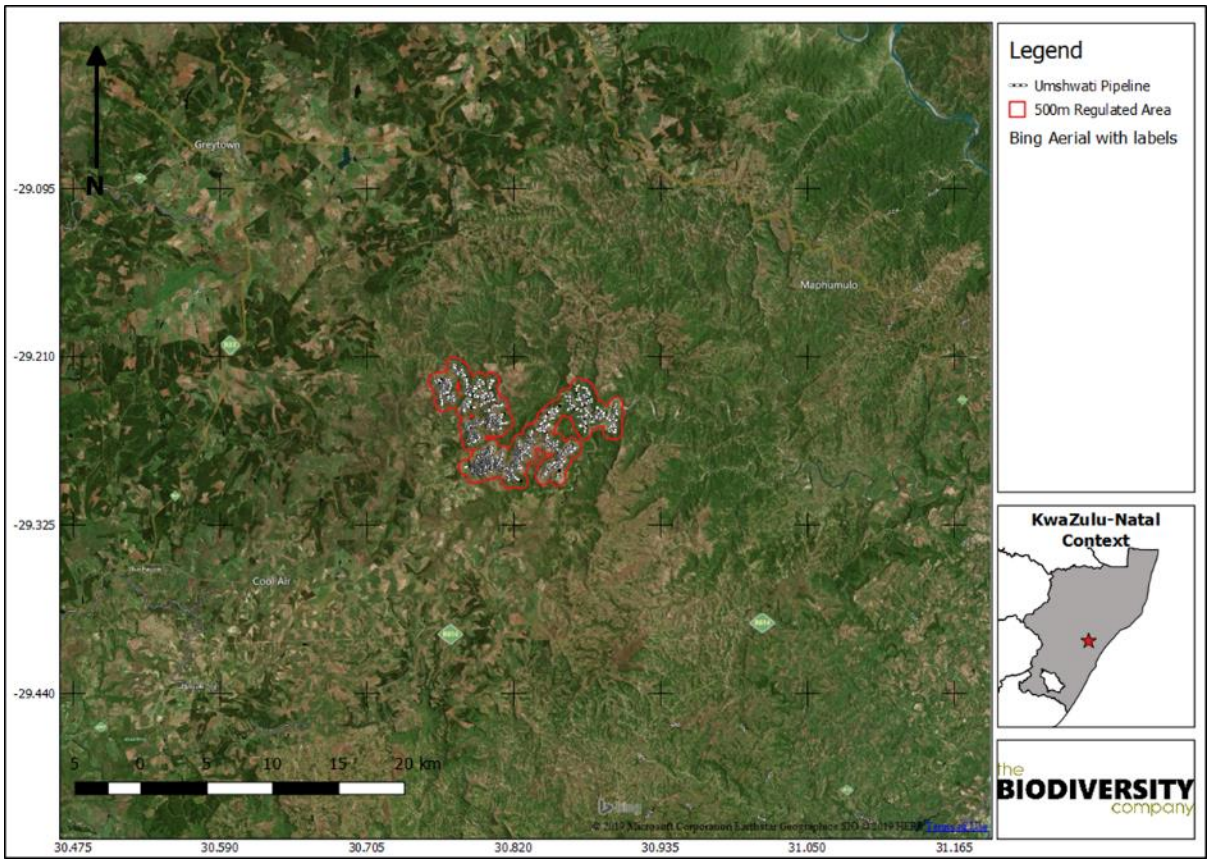


Figure 1: Regional setting of the proposed Umshwati project area

3 Scope of Work

The aim of the assessment is to provide information to guide the construction of the proposed pipeline with respect to the current state of the wetland systems in the area of study. This was achieved through the following:

- The 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.

4 Limitations

The following limitations should be noted for the study:

- Portions of the pipeline were already excavated prior to this field survey;
- The assessment was based on the results of a single wetland survey only, and information provided should be interpreted accordingly;
- Only wetlands that were likely to be impacted by proposed development activities were assessed in the field. Wetlands located within a 500 m radius of the sites but not in a position within the landscape to be measurably affected by the developments were not considered as part of this assessment;
- The GPS used for wetland delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side.

5 Key Legislative Requirements

5.1 National Water Act (NWA, 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).

5.2 National Environmental Management Act (NEMA, 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.

6 Methodology

6.1 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).

6.1.1 Wetland Identification and Mapping

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 identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
    - 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);
- 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.

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.

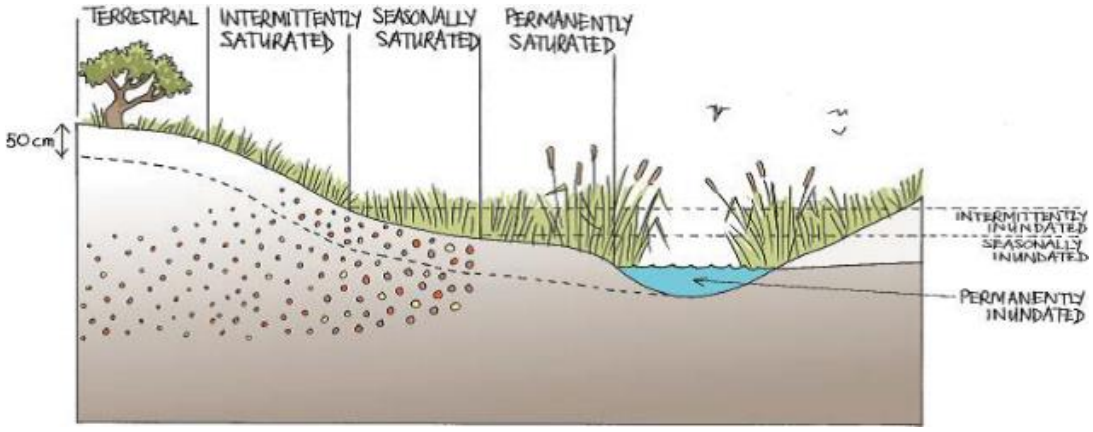


Figure 2: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al., 2013)

6.1.2 Wetland Delineation

The wetland indicators described above are used to determine the boundaries of the wetlands within the project area. These delineations are then illustrated by means of maps accompanied by descriptions.

6.1.3 Wetland Functional Assessment

Wetland functionality refers to the ability of wetlands to provide healthy conditions for the wide variety of organisms found in wetlands as well as humans. EcoServices serve as the main factor contributing to wetland functionality.

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Kotze *et al*., 2008). 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 1).

Table 1: 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

6.1.4 Present Ecological Status

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 2.

Table 2: 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**

6.1.5 Ecological Importance and Sensitivity

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**

6.1.6 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.

6.2 Aquatic Assessment

A single high flow survey was conducted in November 2019. Standard methods were used to establish the baseline PES of the considered river reaches. Details pertaining to the specific methodologies applied are provided in the relevant sections below.

6.2.1 Water Quality

Water quality was measured in situ using a handheld calibrated Extech DO700 multi-meter. The constituents considered that were measured included: pH, conductivity (µS/cm), water temperature (°C) and Dissolved Oxygen (DO) in mg/l.

6.2.2 Aquatic Habitat Integrity

The Intermediate Habitat Assessment Index (IHIA) as described in the Procedure for Rapid Determination of Resource Directed Measures for River Ecosystems (Section D), 1999 was used to define the ecological status of the Mvoti River reach.

The IHIA model will be used to assess the integrity of the habitats from a riparian and in-stream perspective. The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale which are comparable to the characteristics of natural habitats of the region (Kleynhans, 1996).

This model compares current conditions with reference conditions that are expected to have been present. Specification of the reference condition follows an impact based approach where the intensity and extent of anthropogenic changes are used to interpret the impact on the habitat integrity of the system. To accomplish this, information on abiotic changes that can potentially influence river habitat integrity are obtained from surveys or available data sources. These changes are all related and interpreted in terms of modification of the drivers of the system, namely hydrology, geomorphology and physico-chemical conditions and how these changes would impact on the natural riverine habitats. The criteria and ratings utilised in the assessment of habitat integrity in the current study are presented in Table 4 and Table 5 respectively.

Table 4: Criteria used in the assessment of habitat integrity (Kleynhans, 1996)

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly or alternatively agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments.
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.

Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also, a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river. Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochtonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the riverbank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

Table 5: Descriptions used for the ratings of the various habitat criteria

Impact Category	Description	Score
None	No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

6.2.3 Riparian Habitat Delineation

The riparian delineation was completed according to DWAF (2005a). Typical riparian cross sections and structures are provided in. Indicators such as topography and vegetation were the primary indicators used to define the riparian zone. Contour data obtained from topography spatial data was also utilised to support the infield assessment.

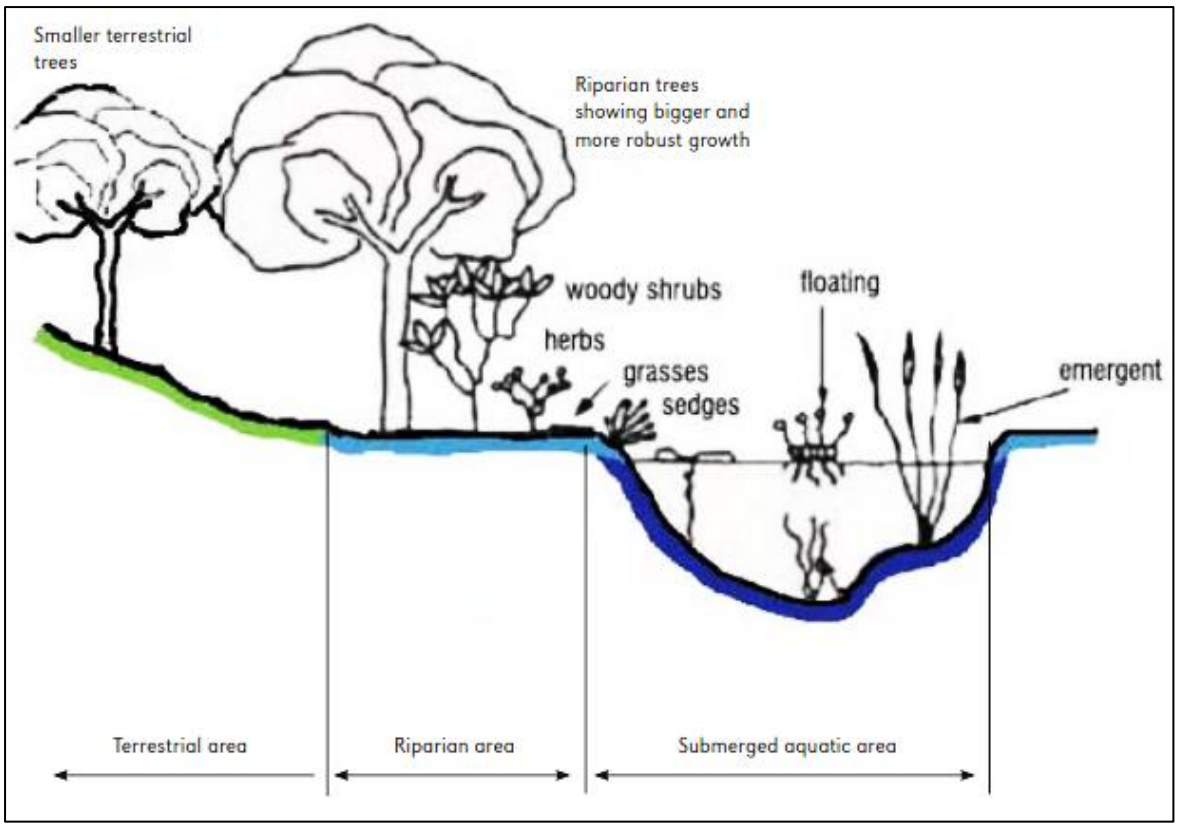


Figure 3: Riparian Habitat Delineations (DWAF, 2005a)

6.2.4 Aquatic Macroinvertebrate Assessment

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour *et al.,* 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.,* 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

6.2.4.1 Invertebrate Habitat Assessment

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour *et al.,* 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.,* 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

6.2.4.2 South African Scoring System

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g. Chironomidae) to highly sensitive families (e.g. Perlidae). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the "Aquatic Invertebrates of South African Rivers" Illustrations book, by Gerber and Gabriel (2002). Identification of organisms was made to family level (Thirion *et al.,* 1995; Dickens and Graham, 2002; Gerber and Gabriel, 2002).

All SASS5 and ASPT scores are compared with the SASS5 Data Interpretation Guidelines (Dallas, 2007) for the North Eastern Coastal Belt - lower ecoregion (Figure 3). This method seeks to develop biological bands depicting the various ecological states and is derived from data contained within the Rivers Database and supplemented with other data not yet in the database.

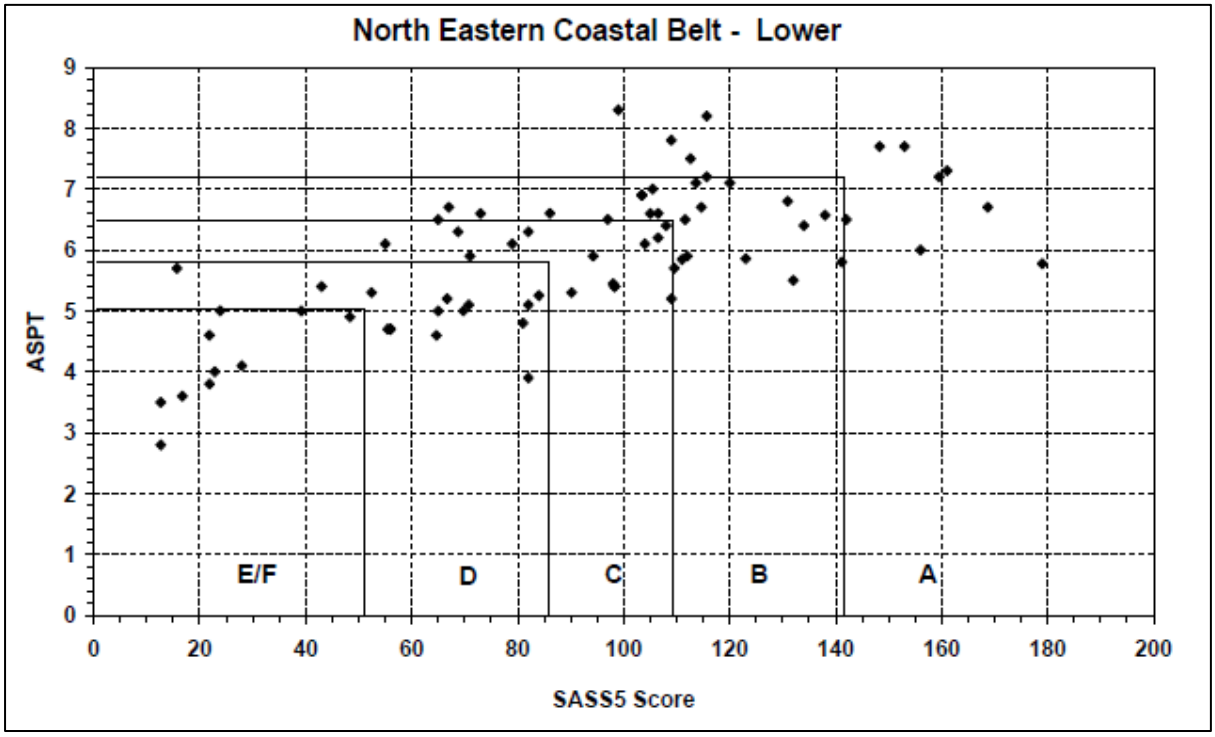


Figure 4: Biological Bands for the North Eastern Coastal Belt - Lower Ecoregion, calculated using percentiles

6.3 Fish Presence

Fish were captured through minnow traps and electroshocking (Figure 5). All fish were identified in the field and released at the point of capture. Fish species were identified using the guide Freshwater Fishes of Southern Africa (Skelton, 2001). The identified fish species were compared to those expected to be present for the quaternary catchment. The expected

fish species list was developed from a literature survey and included sources such as (Kleynhans *et al*., 2007 and Skelton 2001).

Figure 5: Example of methodology used to catch fish species.

6.4 Water Resource Risk Assessment

The risk assessment will be completed in accordance with the requirements of the DWS General Authorisation (GA) in terms of Section 39 of the NWA for water uses as defined in Section 21(c) or Section 21(i) (GN 509 of 2016). The significance of the impact is calculated according to Table 6.

Table 6: 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.

7 Desktop Assessment

7.1.1 National Freshwater Ecosystem Priority Area Status

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach for the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*. 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National

Environment Management Biodiversity Act's biodiversity goals (NEM:BA) (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011).

There are no NFEPA wetlands within the 500 m regulated area, however the wetland vegetation classification within this region is the Sub-Escarpment Savanna and the Sub-Escarpment Grassland Group 3 wetland vegetation units. The Savanna unit is listed as Critically Endangered and currently not protected, whilst the Grassland unit is listed as Endangered and currently not protected (NBA, 2011).

7.1.2 Regional Soils and Geology

The geology of the area is mainly sandstone of the Natal Group with small areas of tillite of the Dwyka Formation and dolerite. The eastern portion consists of Granite with some sandstone in the mountains. The Mvoti river area consists of Granite and Alluvium.

According to the land type database (Land Type Survey Staff, 1972 - 2006) the pipeline mainly traverses through the following land types; the Bb108, Fa436, Fa460 and Fb434. It is expected that, the dominant soils in the crest and midslope positions will be soils of the Mispah, Glenrosa, Hutton, and Westleigh forms. The soils that dominated the footslopes and the valley bottoms are Katspruit, Oakleaf, and Dundee soil forms.

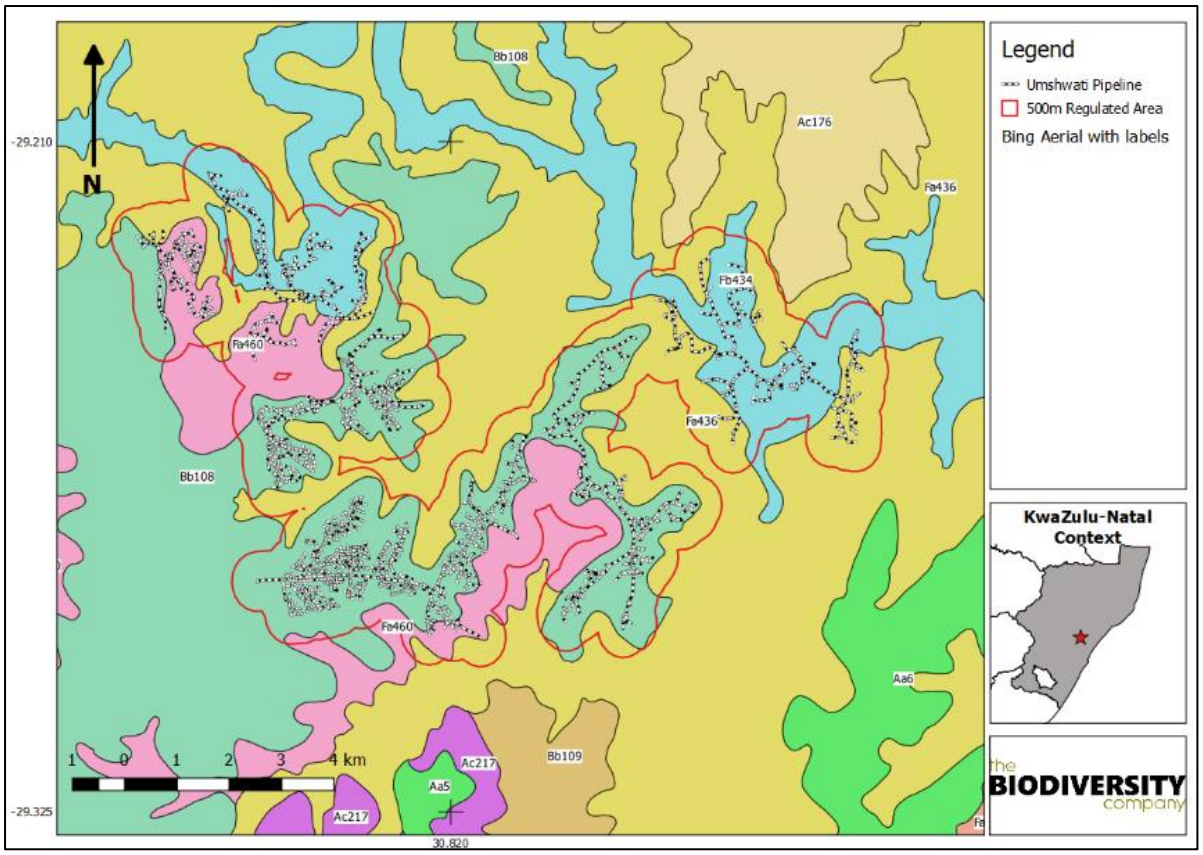


Figure 6: Project area showing the land types (Land Type Survey Staff, 1972 - 2006)

7.1.3 Desktop Vegetation

The project area falls across three vegetation types namely the Natal Hinterland Thornveld, Dry Coast Hinterland Grassland and Moist Coastal Hinterland Grassland (Figure 7).

7.1.3.1 SVs3 - Natal Hinterland Thornveld

KwaZulu-Natal Province: Patches, scattered immediately above SVs 6 Eastern Valley Bushveld, at altitudes 450–900 m in river valleys of mainly the Mpisi (in the Thukela River catchment), Mvoti, Umgeni (below the Howick Falls), Mlazi, and Lufafa (vicinity of Ixopo) and Mtungwane (tributaries of the Mkomazi).

Vegetation is open Thornveld dominated by Acacia species on undulating plains found on upper margins of river valleys.

7.1.3.2 Gs 19 - Dry Coast Hinterland Grassland

KwaZulu-Natal and Eastern Cape Provinces: From Melmoth in the north to near Libode in the former Transkei (including Camperdown, Umlaas Road, Eston, Bisi, iZingolweni, Ngqeleni near Mthatha) generally occurring above the SVs 3 KwaZulu-Natal Hinterland Thornveld, SVs 7 Bisho Thornveld and the SVs 6 Eastern Valley Bushveld. Altitude 450 - 900 m.

The landscape and vegetation features include; Undulating plains and hilly landscape mainly associated with drier coast hinterland valleys in the rain-shadow of the rain-bearing frontal weather systems from the east coast. Sour sparse wiry grassland dominated by unpalatable Ngongoni grass (*Aristida junciformis*) with this monodominance associated with low species diversity. In good condition dominated by *Themeda triandra* and *Tristachya leucothrix*. Wooded areas are found in valleys at lower altitudes, where this vegetation unit grades into SVs 3 KwaZulu-Natal Hinterland Thornveld and SVs 7 Bisho Thornveld. Termitaria support bush clumps with Acacia species, *Cussonia spicata, Ehretia rigida, Grewia occidentalis* and *Coddia rudis*.

This vegetation unit is statutorily conserved in Oribi Gorge Nature Reserve.

7.1.3.3 Gs 20 – Moist Coastal Hinterland Grassland

The Ngongoni Veld (Moist Coastal Hinterland Grassland) vegetation unit is found in the KwaZulu-Natal and Eastern Cape Provinces. The vegetation occurs on moderately undulating plains, including some low hills valley bottoms at altitudes ranging between 400m – 900m. The vegetation is a tall dense grass land dominated by the Ngongoni grass (Arsitida junciformis) and has a low species diversity as a result of this mono-dominance.

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*.

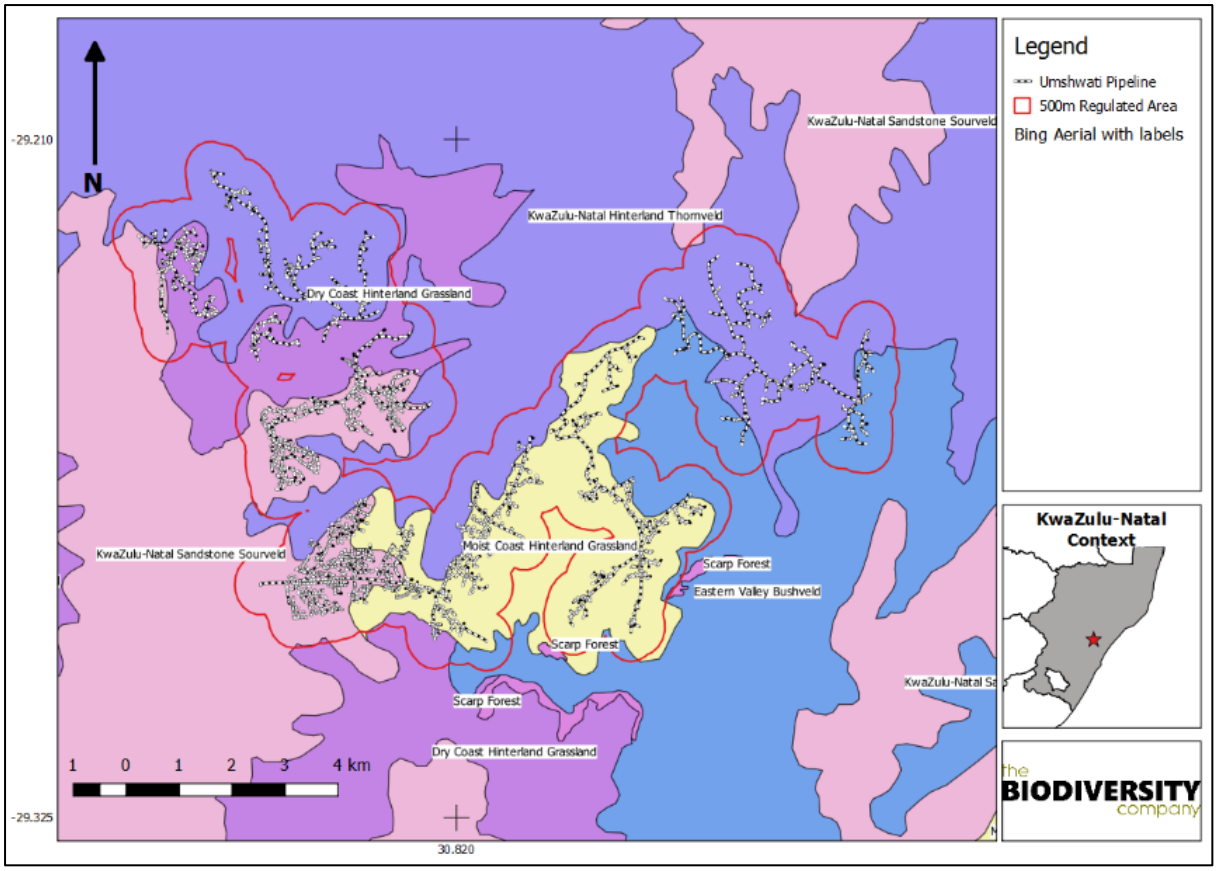


Figure 7: Project area showing the vegetation type based on the Vegetation Map of South Africa, Lesotho & Swaziland (BGIS, 2017)

7.1.4 National Freshwater Ecosystem Priority Areas (NFEPA) for Sub-Quaternary Reach U40D-03957 and U40D-03967.

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al.,* 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (NEM:BA) (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011).

According to Nel *et al.* (2011), the construction of the Umshwati water transfer scheme project area falls predominantly within a Sub-quaternary catchment along the U40D-03957 and U40D-03967 Sub-Quaternary Reach's (Figure 12). The area is not considered sensitive however the system cannot be neglected due to the wetland FEPA's downstream in other catchments.

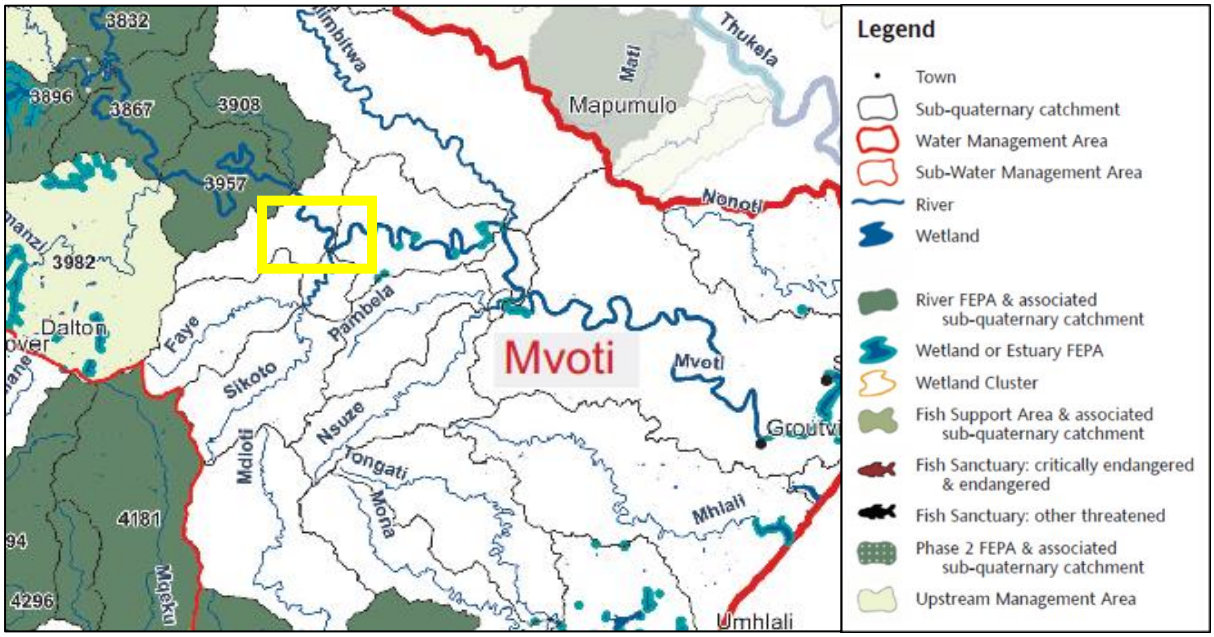


Figure 8: Map illustrating fish and river FEPAs for the project area, the project area is represented by the yellow square (Nel et al., 2011)

7.2 Status of sub-quaternary reach U40D-03957 and U40D-03967

Desktop information for SQR's was obtained from DWS, 2019. The U70C-04859 SQR spans 27.73 km. The PES category of the reach is classed as largely natural (class B) (Table 5). The U40D-03967 SQR spans 8.43 km. The PES category of the reach is classed as largely natural (class B) (Table 5). The largely natural state of the reach was due to impacts to instream habitat, wetland and riparian zone continuity, flow modifications and moderate potential impacts on physico-chemical conditions (water quality). Anthropogenic impacts identified within the Mvoti River sub-quaternary catchment include rural settlements, subsistence farming, road crossings, abstraction, alien invasive plants in the riparian zone.

Table 7: Summary of the Present Ecological State of the SQRs associated with the Mvoti River reach (DWS, 2019)

SQR Importance and Sensitivity	Score
U40D-03957	
Present Ecological Status	Largely Natural (class B)
Ecological Importance	Very High
Ecological Sensitivity	High
Default Ecological Category	A
U40D-03967	
SQR Importance and Sensitivity	**Score**
Present Ecological Status	Largely Natural (class B)
Ecological Importance	High

Ecological Sensitivity	High
Default Ecological Category	B

7.3 Expected Fish Species

An expected species list was generated from DWS (2019), and Skelton (2011) for the U40D-03957 and U40D-03967 SQR's. A total of 11 fish species are expected to occur in the Mvoti River which are presented in Table 8. The conservational status of fish species was assessed against the IUCN database 2019 (IUCN, 2019).

The expected species are generated on a reach basis, and the occurrence of all species in the system is unlikely as different species are specialists of different habitats which are present along a reach. The Mvoti river reach does however a great diversity of habitat and therefore a wide range of fish species are expected. This includes one Near Threatened (NT) species and one Vulnerable (VU) species.

The only vulnerable species identified is *Enteromius gurneyi* (Redtail Barb) (Figure 9). This species is a specialist who is only found in clear streams of the sandstone belt in pools of water at altitude of between 300-1000m in KwaZulu - Natal. It is often the only fish species apart from eels in a river (Skelton., 2001). Due to the potential of vulnerable fish species, construction activities need to make impacts minimal and consider fish migrations (fish ways), especially for *Anguilla mossambica* and *Awaous aeneofuscus.*

Figure 9: Enteromius gurneyi (Redtail Barb)

Table 8: Expected fish species

Species	Common Name	IUCN Status (2019)
Amphilius natalensis	Natal Mountain Catfish	LC
Anguilla mossambica	African Longfin Eel	LC
Awaous aeneofuscus	Freshwater Goby	LC
Clarias gariepinus	Sharptooth Catfish / Barbel	LC
Enteromius gurneyi	Redtail Barb	VU
Enteromius paludinosus	Straightfin Barb	LC
Enteromius trimaculatus	Threespot Barb	LC
Enteromius viviparus	Bowstripe Barb	LC

Species	Common Name	IUCN Status (2019)
Labeobarbus natalensis	KwaZulu-Natal Yellowfish	LC
Oreochromis mossambicus	Mozambique Tilapia	NT
Tilapia sparrmanii	Banded Tilapia	LC

LC - Least Concern, NT – Near Threatened, VU – Vulnerable

8 Results & Discussion

8.1 Field Survey

The field survey for the Umshwati pipeline project was conducted in October 2019. The survey focused primarily on those areas which were most likely to be impacted upon by the proposed development. Furthermore, identification and description of any sensitive receptors were recorded across the project area, and the manner in which these sensitive receptors may be affected by the activity was also investigated.

8.2 Wetland Delineation

The wetland area was delineated in accordance with the DWAF (2005) guidelines (see Figure 11). One wetland type was identified; namely the channelled valley bottom systems. These comprised of four (4) HGM units, which were identified and delineated for this assessment.

The **bulk water pipeline** as shown in Figure 12 does not cross any drainage lines and there are no wetlands within the 500m regulated area. Therefor no impacts are anticipated on the wetlands for this portion of the project.

The **reticulation pipeline** crosses several drainage lines as well as crosses the four wetland HGM units. These are shown in more detail in the zoomed maps (Figure 13 & Figure 14).

The pipeline traverses through all HGM units. The wetland classification as per SANBI guidelines (Ollis *et al.* 2013) is presented in Table 9.

Table 9: Wetland classification as per SANBI guideline (Ollis et al., 2013)

Wetland Name	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	North Eastern Coastal Belt	Sub-Escarpment Savanna	Valley Floor	Channelled Valley Bottom	N/A	N/A
HGM 2	Inland	North Eastern Coastal Belt	Sub-Escarpment Savanna	Valley Floor	Channelled Valley Bottom	N/A	N/A
HGM 3	Inland	North Eastern Coastal Belt	Sub-Escarpment Savanna	Valley Floor	Channelled Valley Bottom	N/A	N/A
HGM 4	Inland	North Eastern Coastal Belt	Sub-Escarpment Savanna	Valley Floor	Channelled Valley Bottom	N/A	N/A

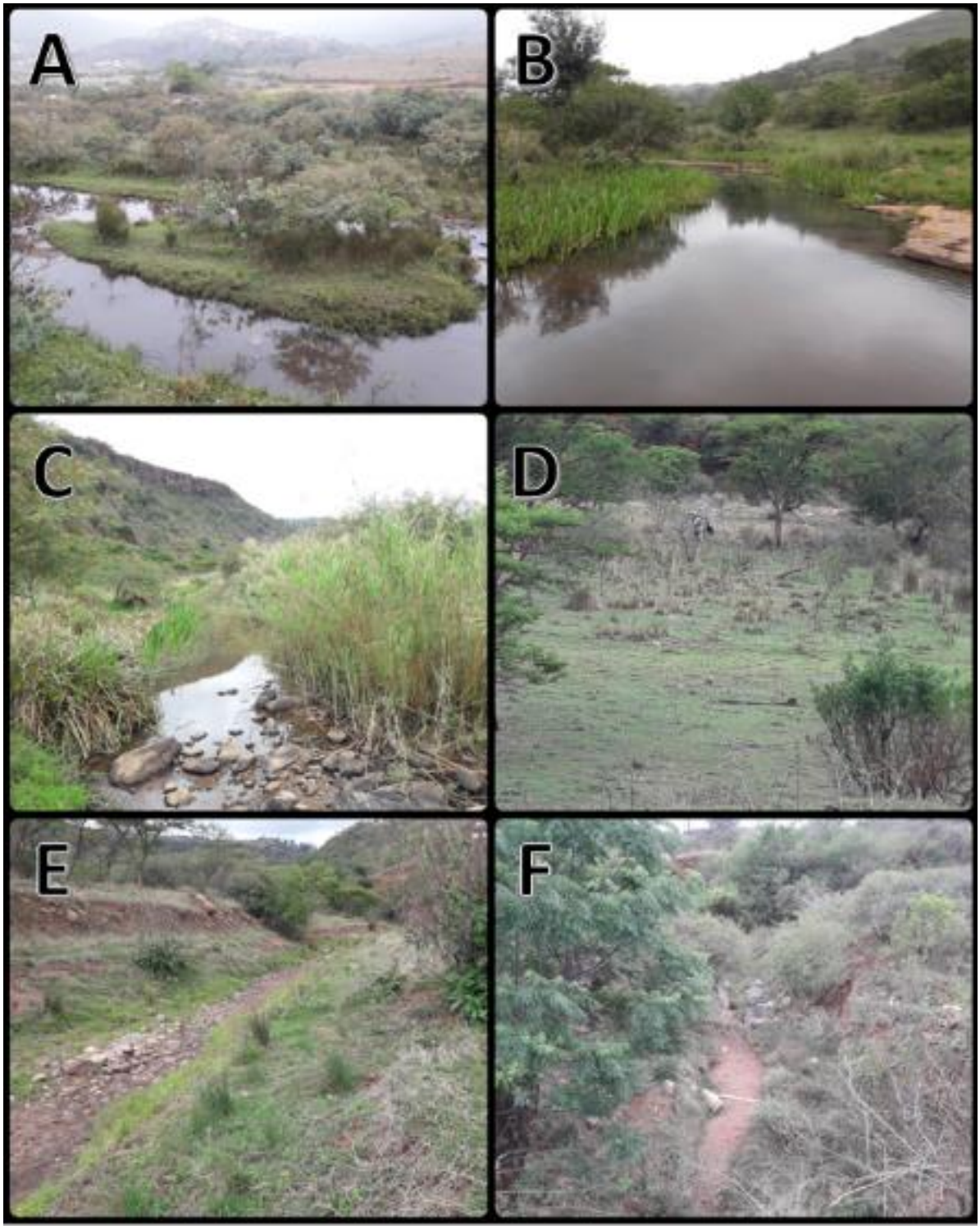


Figure 10: Photographs of the wetlands identified within the 500m regulated area. A to D) Channelled valley bottom, E & F) Drainage lines.

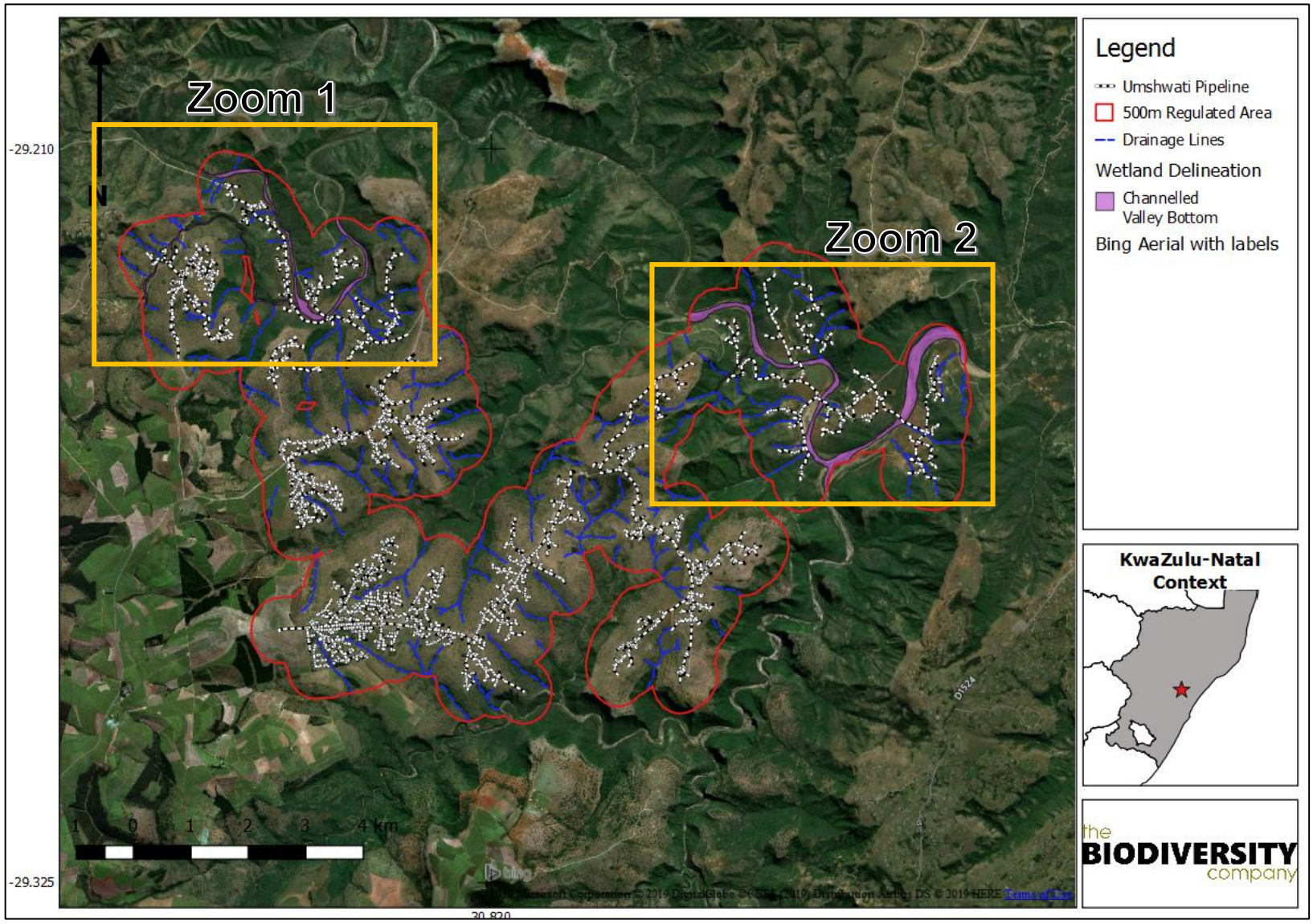


Figure 11: The delineated watercourses within 500 m of the project area

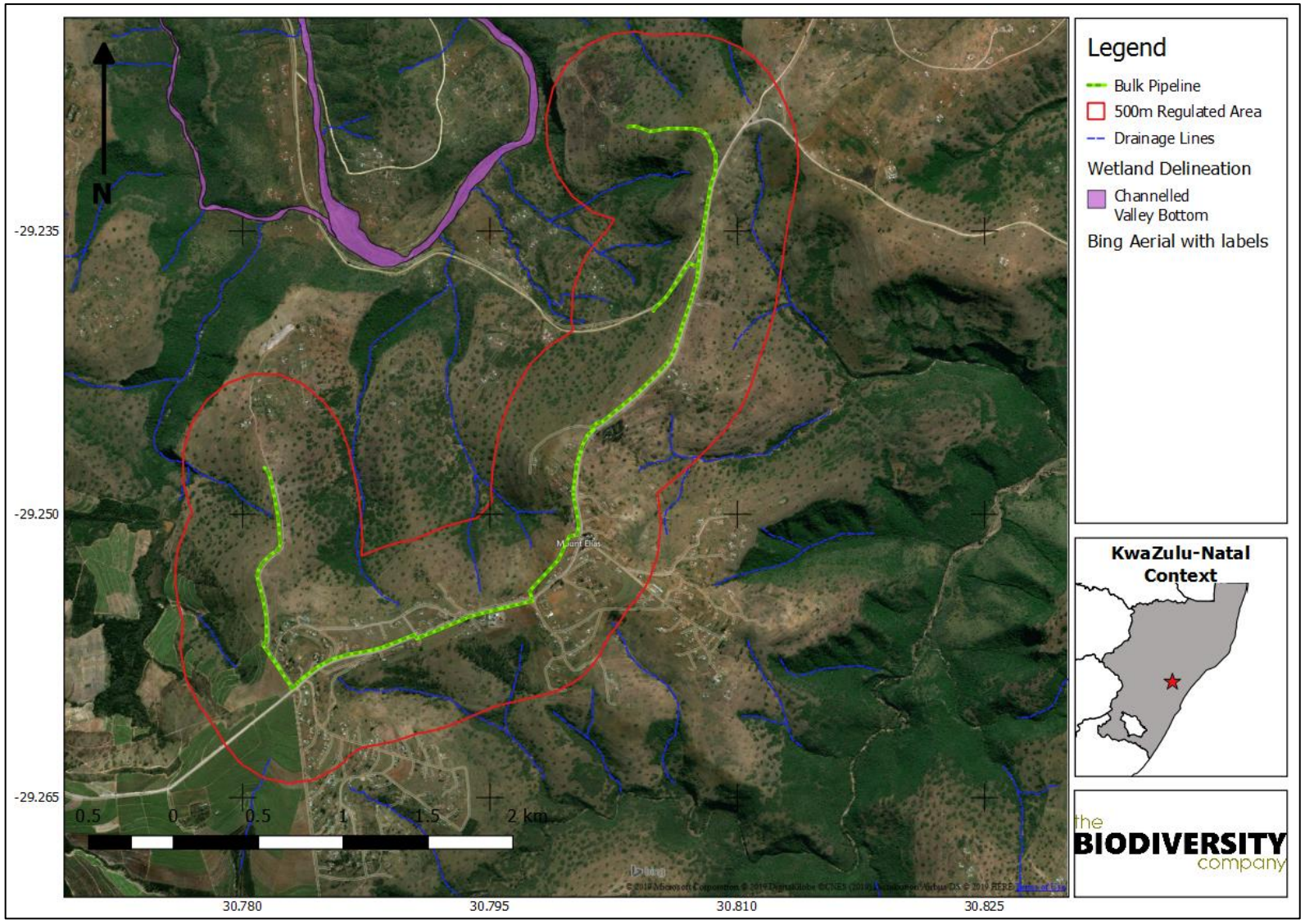


Figure 12: The wetlands in association with the bulk water pipeline layout

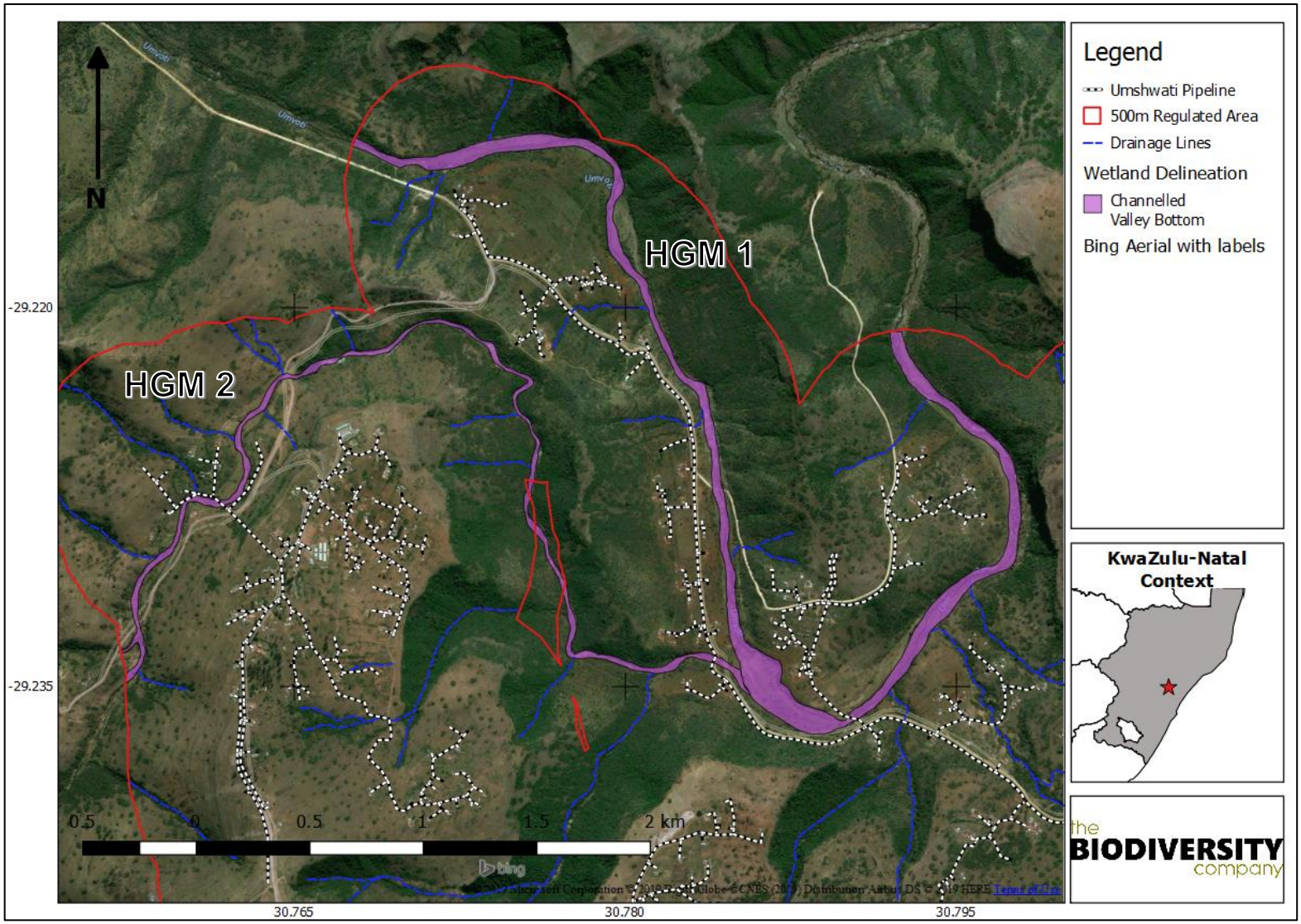


Figure 13: The wetland area to the north west (Zoom 1)

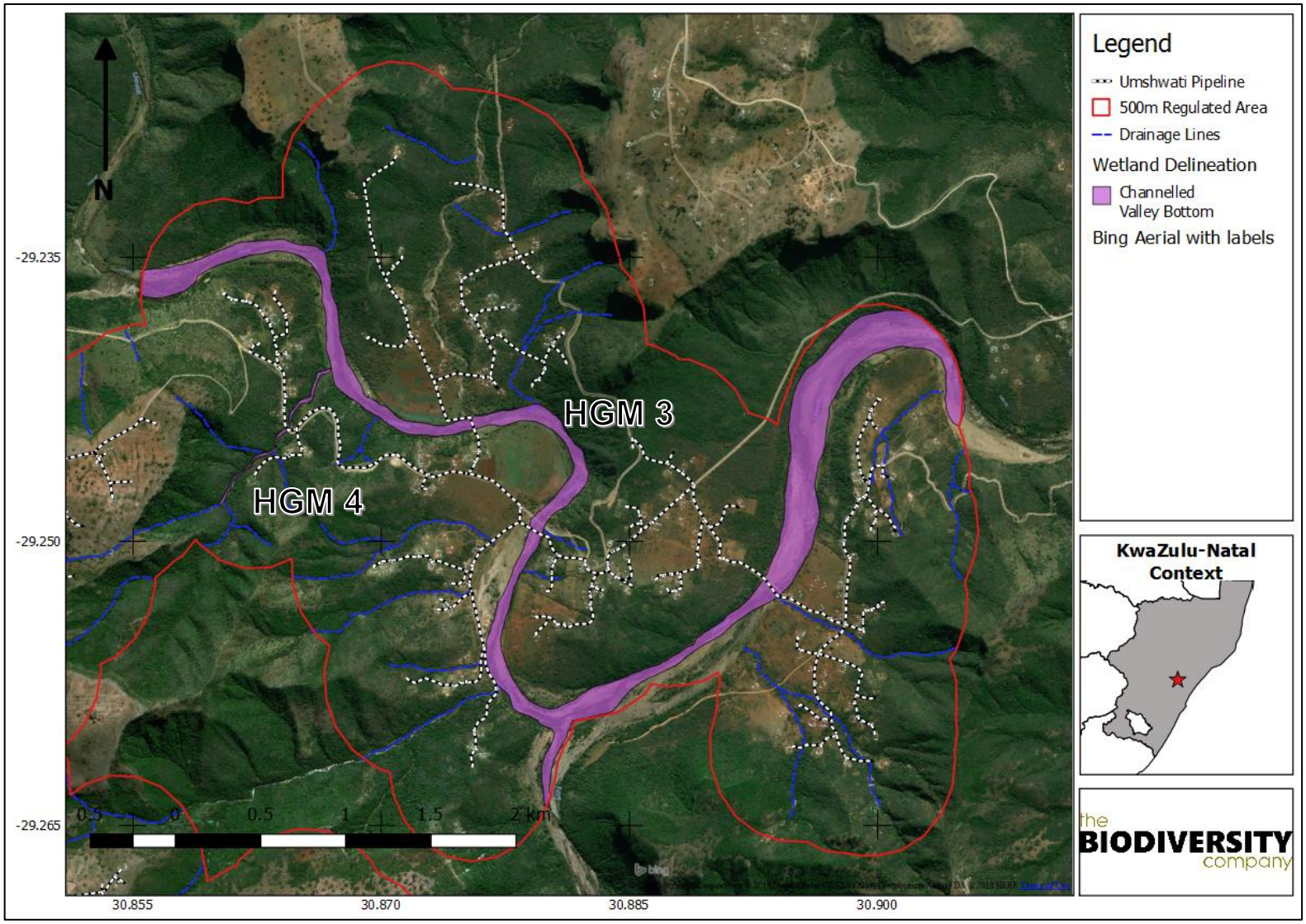


Figure 14: The wetland area to the east (Zoom 2)

Vegetation plays a considerable role in identifying, classifying and accurately delineating wetlands, (DWAF, 2005). The late dry season survey has limited the effectiveness of wetland vegetation identification. The only wetland species that could be identified were *Juncus kraussii*, *Phargmites australis/mauritianus, Cyperus dives* and *Cyperus digitatus*. (Figure 15).

According to (DWAF, 2005), soils are the most important characteristic of wetlands in order to accurately identify and delineate wetland areas. The dominant soils within the wetland zones were classified as Dundee, Katspruit and Westleigh soil forms (Figure 16).

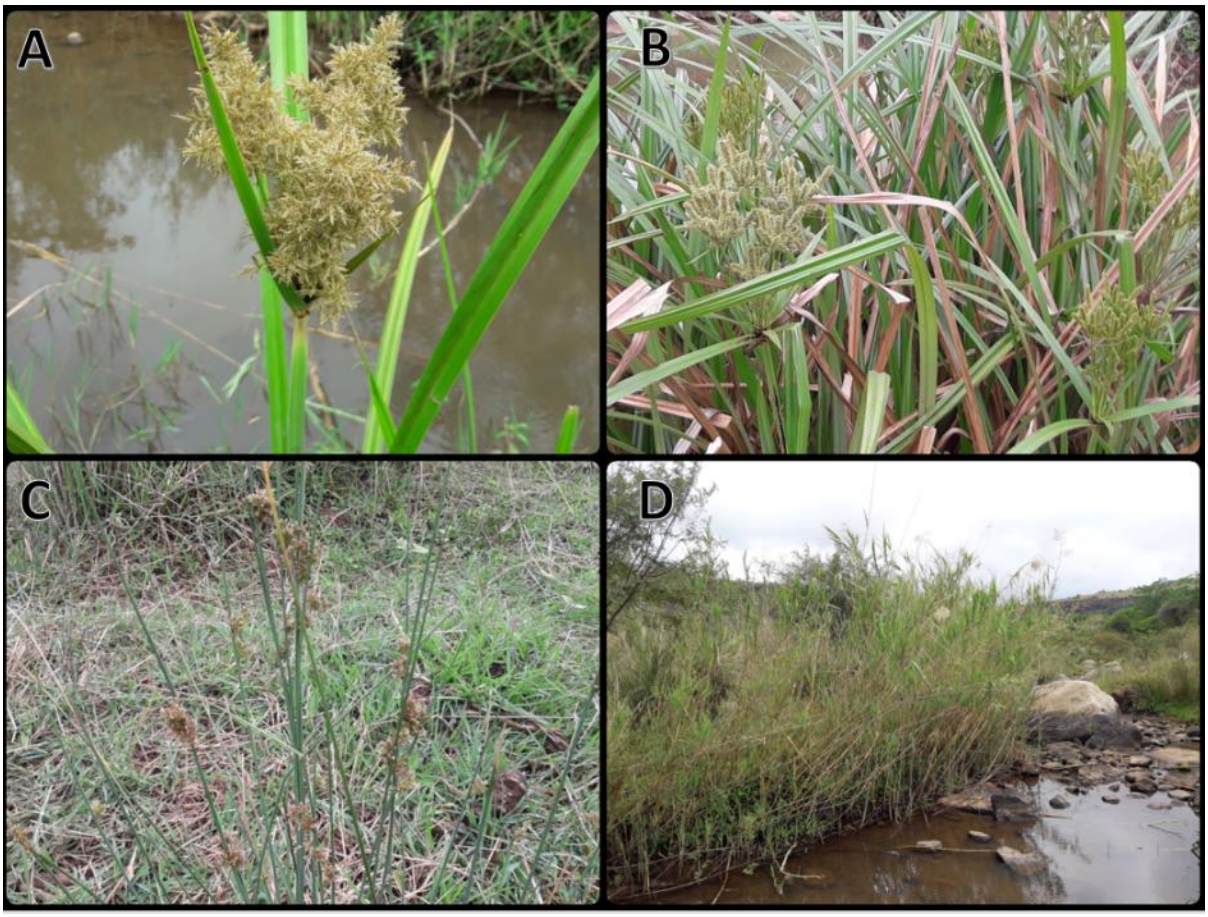


Figure 15: Wetland vegetation within the project area. A) Cyperus digitatus. B) Cyperus dives. C) Juncus kraussii D) Phragmites australis/mauritianus

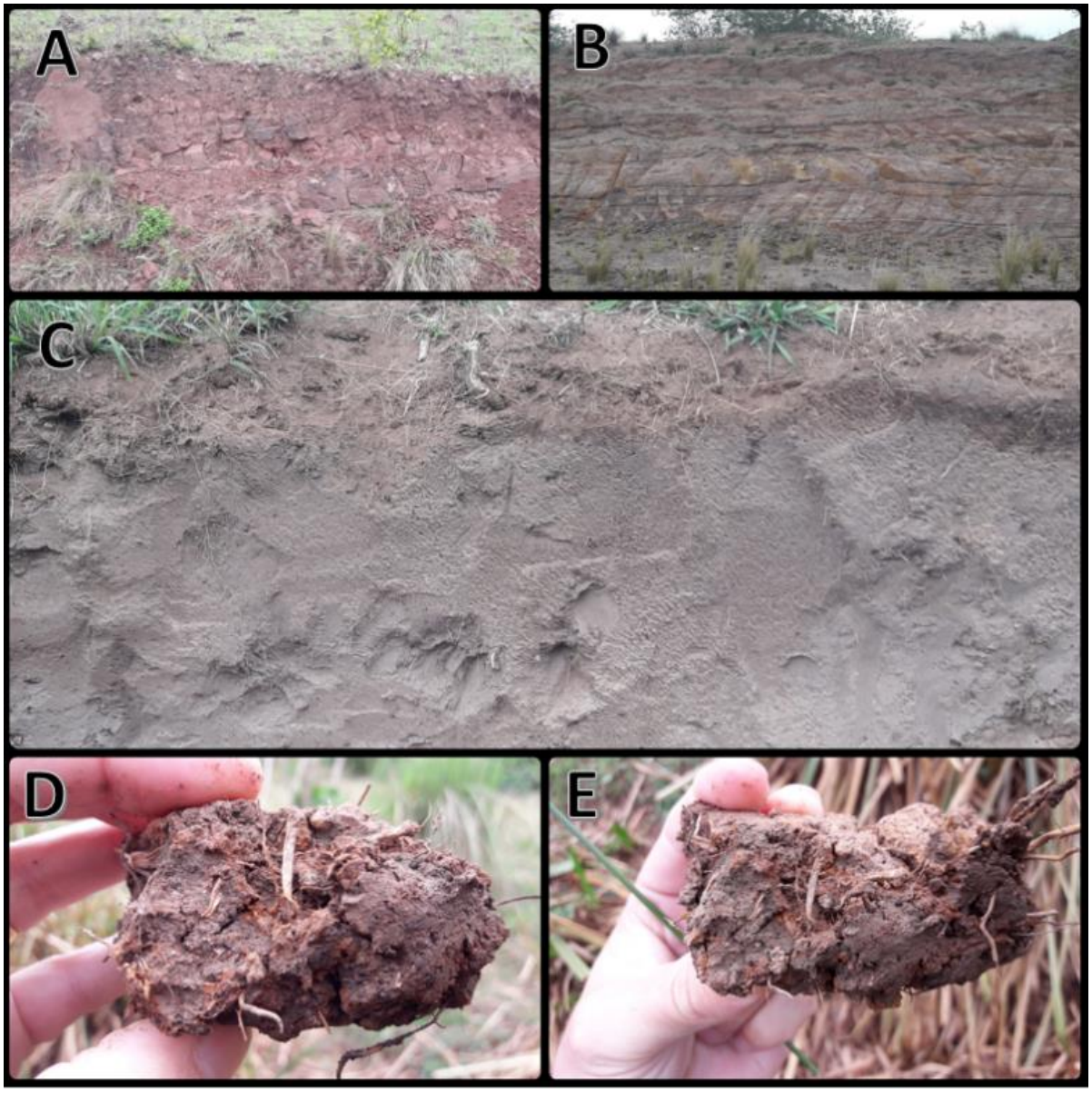


Figure 16: Identified wetland soils within the project area. A & B) Glenrosa and Mispah soil forms. C) Dundee soil profile. D & E) Mottles in soil.

8.2.1 Wetland Unit Setting

8.2.1.1 Channelled Valley Bottom

Channelled valley bottom wetlands 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 17.

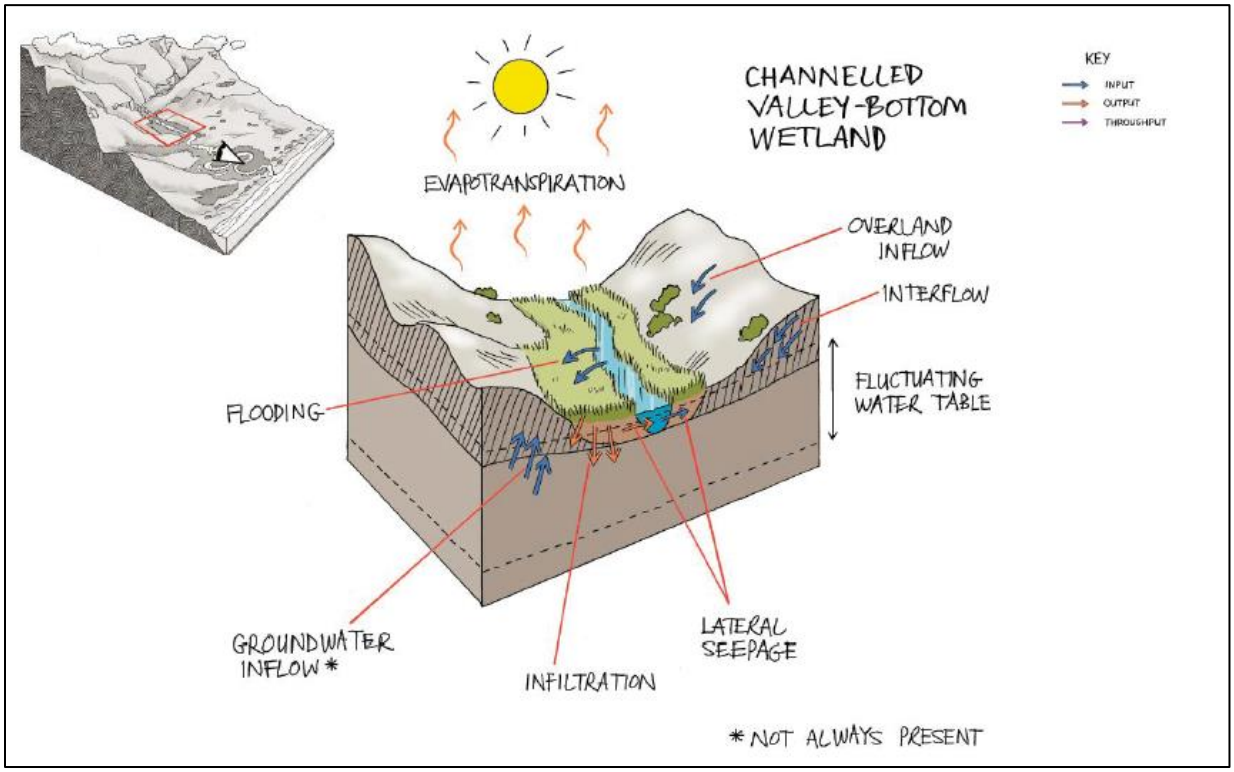


Figure 17: Illustration of channelled valley bottom flow dynamics (Ollis et al. 2013)

8.2.2 Riparian Habitat Delineation

Riparian areas have high conservation value and can be considered most important part of a watershed for a wide range of values and resources. They provide important habitat for a large volume of wildlife and often forage for domestic animals. The vegetation they contain are an important part of the water balance for the hydrological cycle through evapotranspiration. They are crucial for riverbank stability and in preventing erosion within the channel (Elmore, and Beschta., 1987). Therefore, they are considered as high priority areas and should be avoided at all costs. The delineation of the watercourse extents riparian zone observed in the study area along with the wetland boundary are presented in Figure 18, Figure 19, Figure 20, Figure 21, Figure 22, Figure 23 and Figure 24.

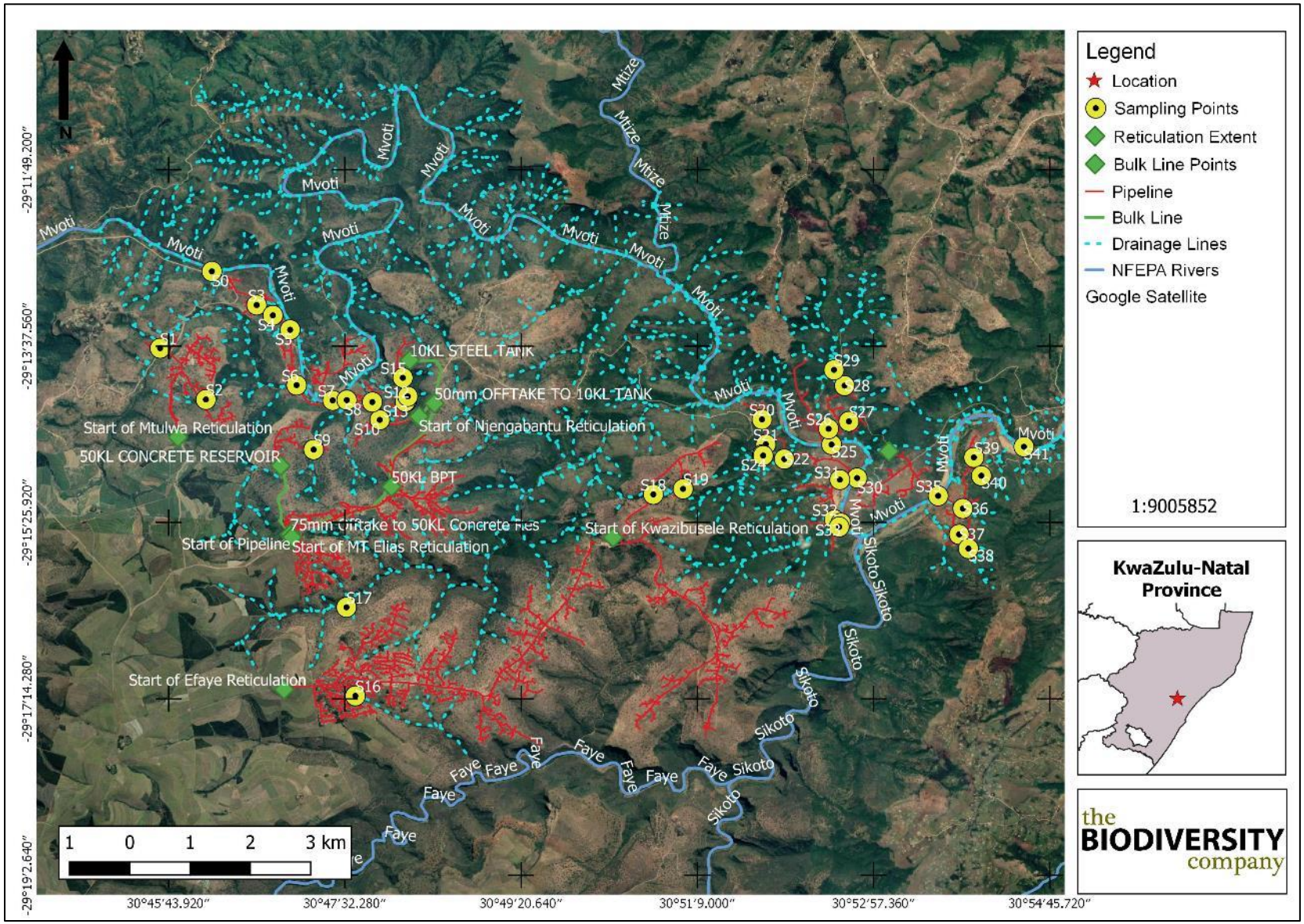


Figure 18: Riparian area delineation and buffer as well as accompanied drainage lines for the project area (November 2019)

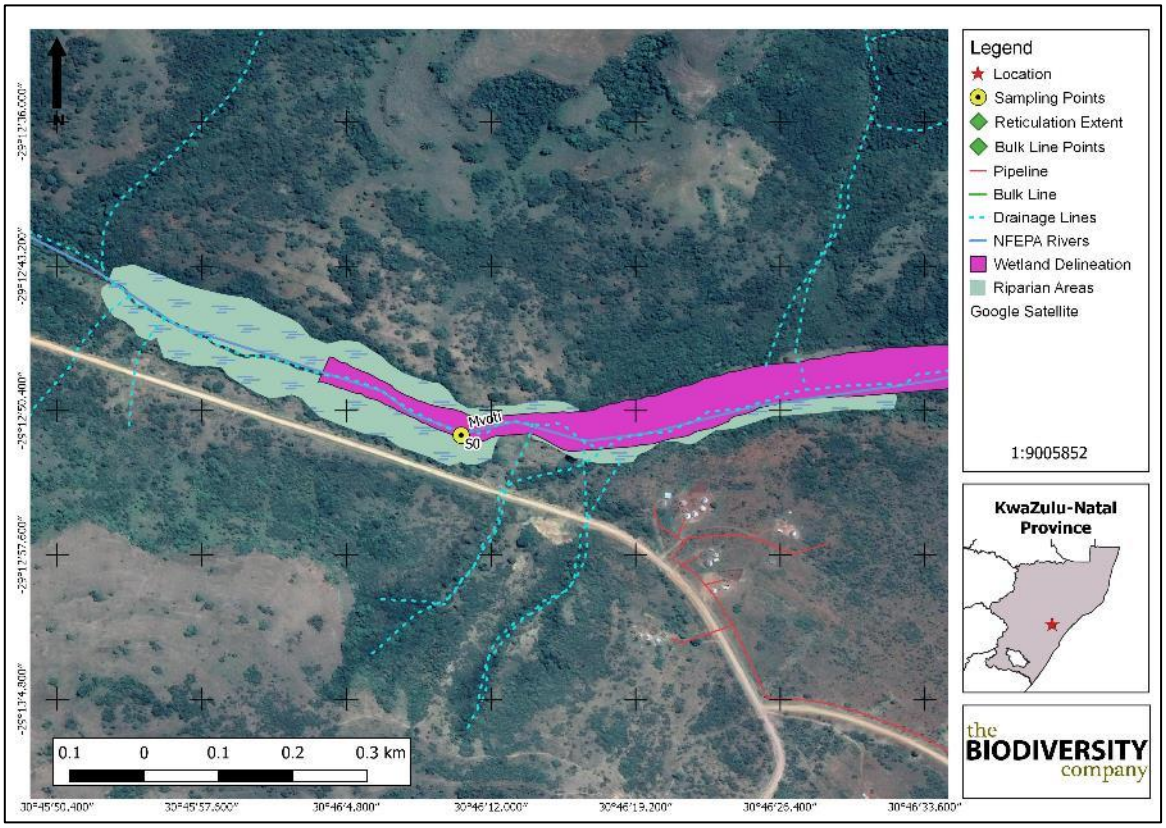


Figure 19: Riparian area delineation and buffer around Site S0 as well as accompanied drainage lines (November 2019)

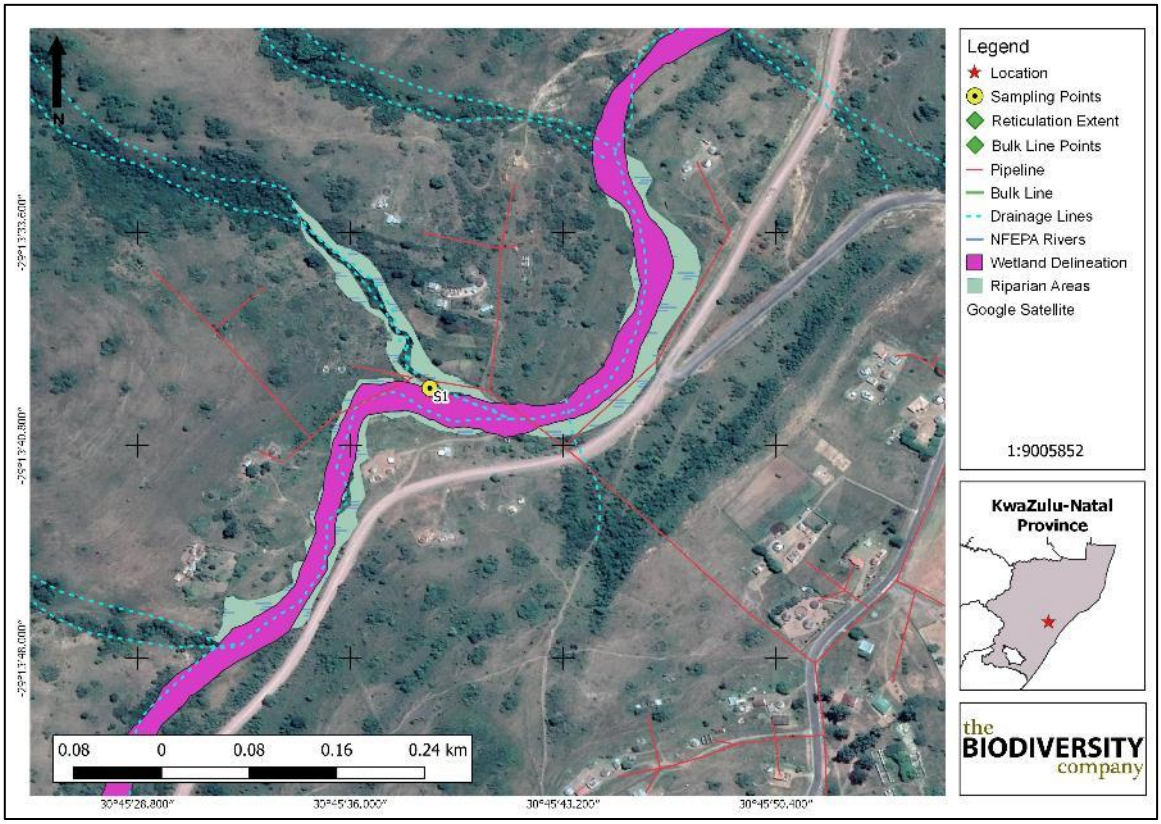


Figure 20: Riparian area delineation and buffer around Site S1 as well as accompanied drainage lines (November 2019)

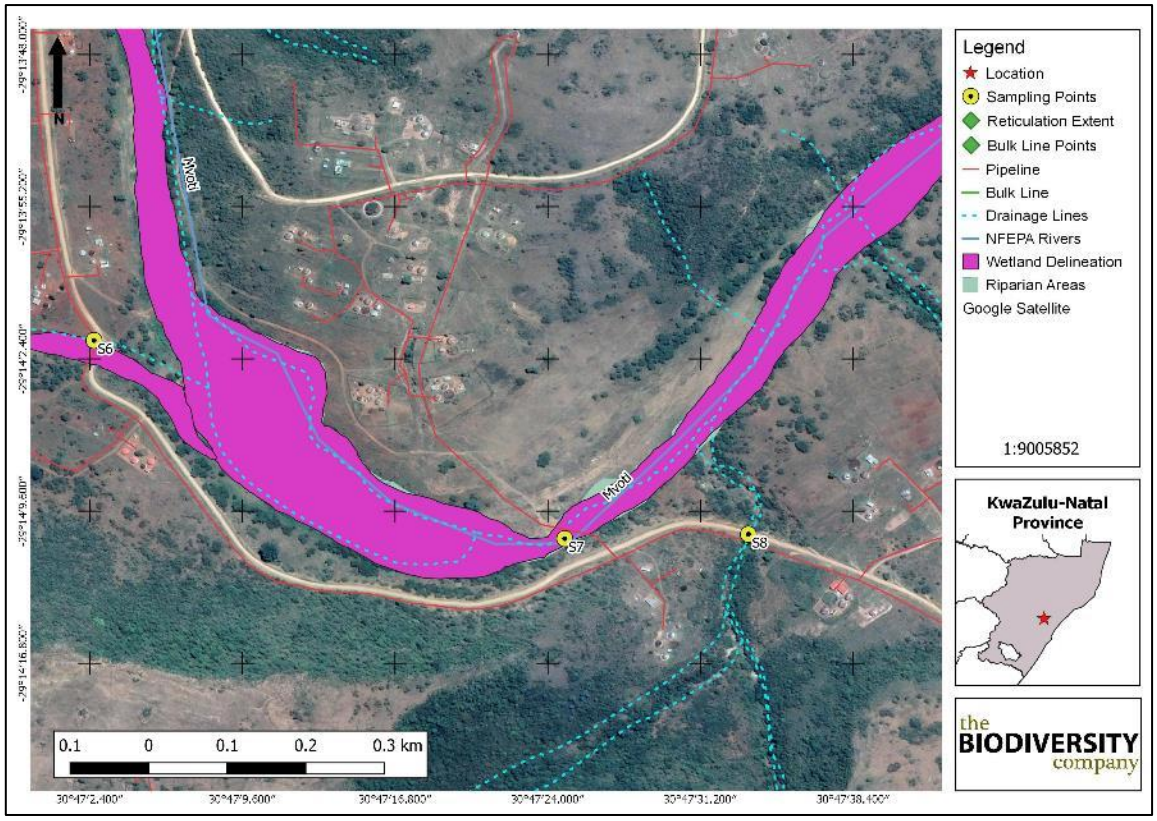


Figure 21: Riparian area delineation and buffer around Site S7 as well as accompanied drainage lines (November 2019)

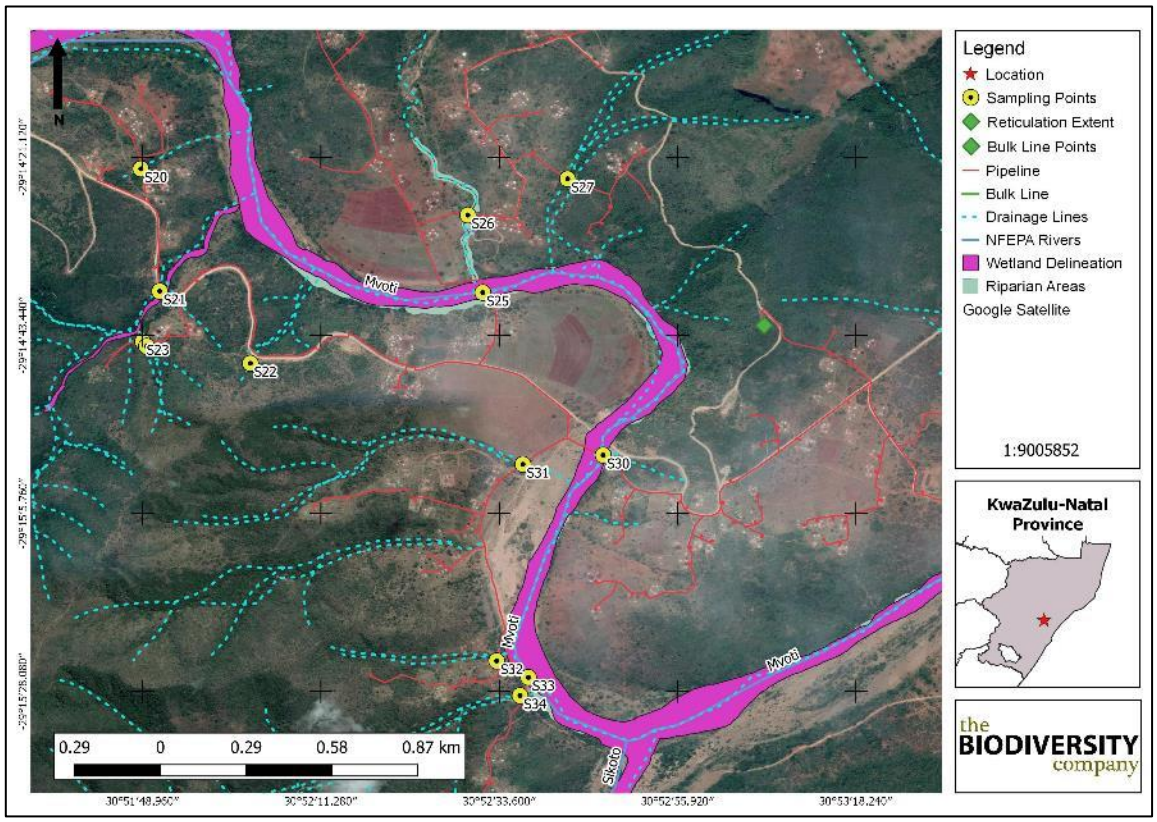


Figure 22: Riparian area delineation and buffer around Site S25, S26, S30, S33 as well as accompanied drainage lines (November 2019)

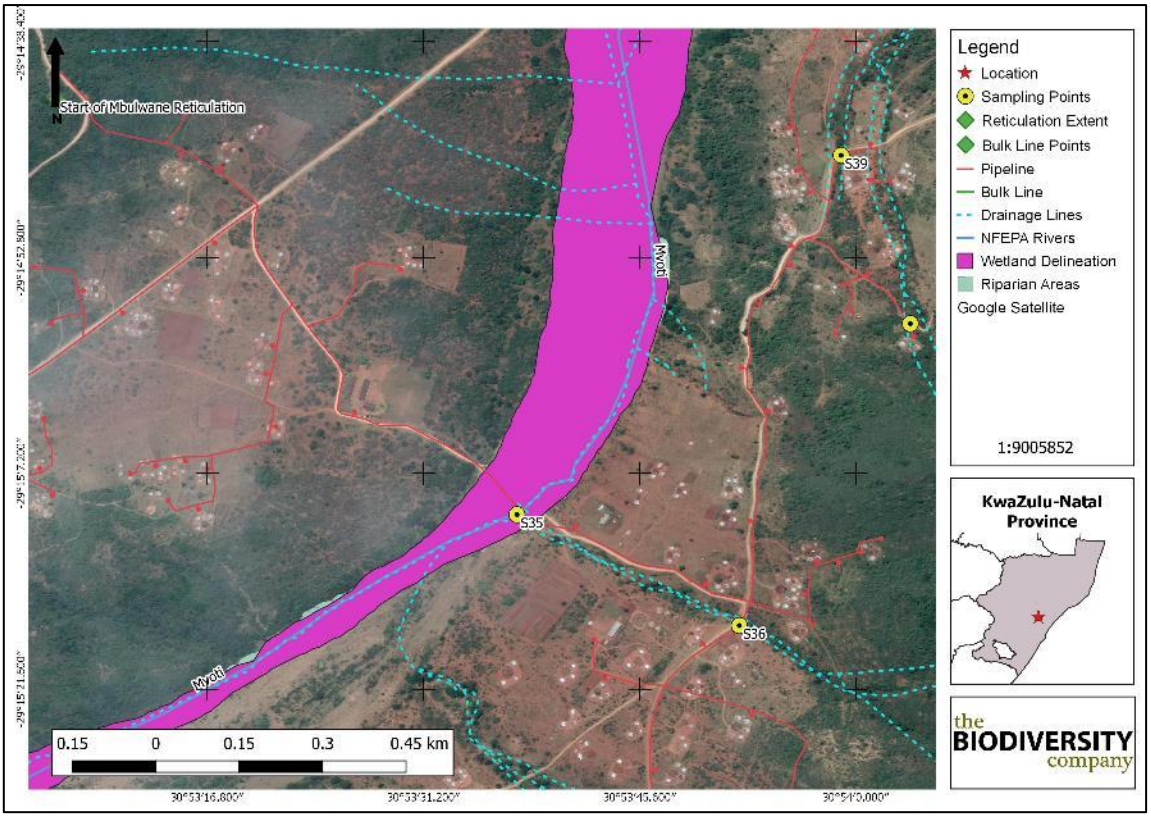


Figure 23: Riparian area delineation and buffer around Site S35 as well as accompanied drainage lines (November 2019)

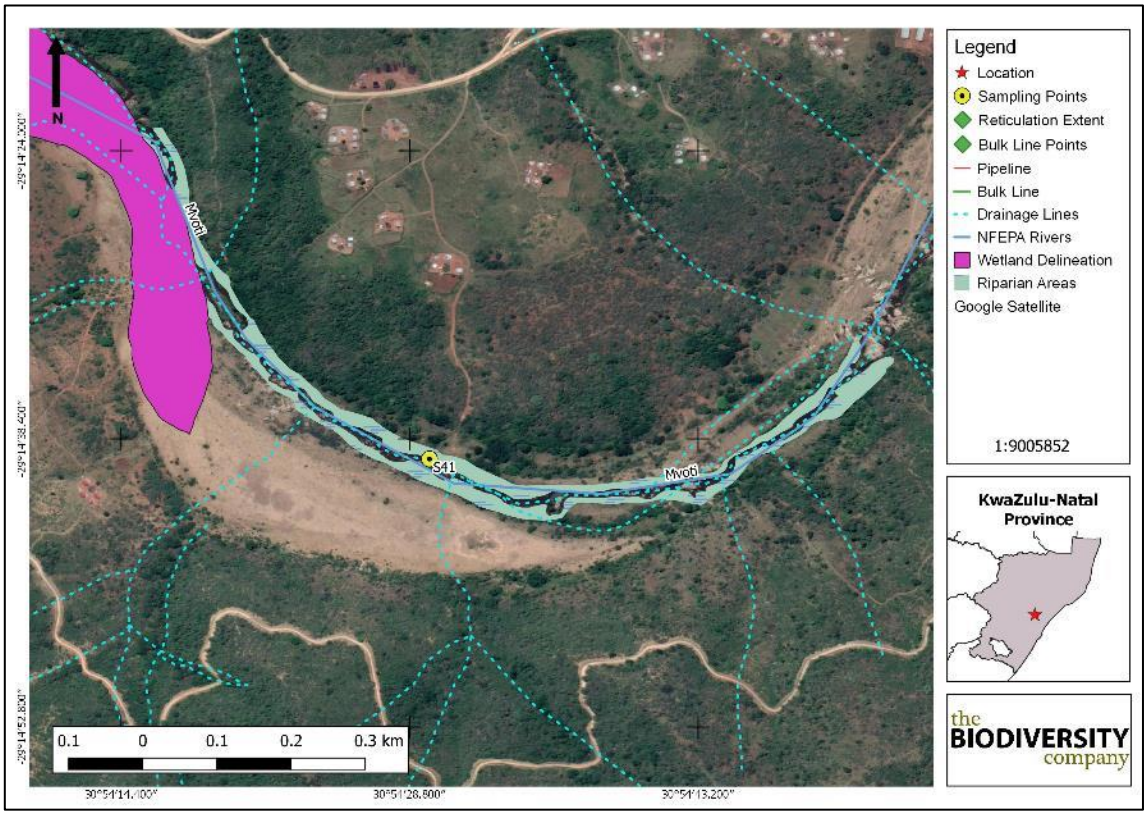


Figure 24: Riparian area delineation and buffer around Site S41 as well as accompanied drainage lines (November 2019)

8.2.3 Present Ecological State

The PES for the assessed HGM units are presented in Table 10 to Table 13. The overall wetland health for all HGM units were determined to be Moderately Modified (class C) systems. Although the wetlands are impacted upon, the wetlands maintained the habitat structure and functioning.

The impacts on the health of these wetlands are described in the tables below. The project area is located within a rural setting. The settlements are constructed on the crests of the landscape with subsistence livestock grazing the area. The overgrazed landscape reduces the surface roughness and in turn increases the runoff. The increased runoff has increased the erosion within the landscape. The eroded soil particles have settled within the channels (sedimentation) changing the geomorphology as well as the vegetation components. Portions of the pipeline sections have already been excavated. The existing crossing structures also impact on the wetland health (Figure 25).

Table 10: Summary of the scores for the wetland PES: HGM 1

Component	PES Rating	Description
Hydrology	C	**Moderately Modified**: The catchment has been overgrazed and the surface roughness reduced. This has increased runoff potential within the system altering the hydrological inputs. The current crossing structures also alter flows within the wetlands.
Geomorphology	C	**Moderately Modified**: severe erosion within the channel banks as well as the crossing structures have altered the geomorphology of the wetland.
Vegetation	D	**Largely Modified:** The wetland unit has been overgrazed and sedimentation has altered the vegetation component. Alien vegetation has become prevalent.
Overall	C	**Moderately Modified**. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.

Table 11: Summary of the scores for the wetland PES: HGM 2

Component	PES Rating	Description
Hydrology	C	**Moderately Modified**: The increased runoff from overgrazed areas has caused erosion as well as sedimentation altering the hydrological inputs. The alien vegetation also reduces some flows.
Geomorphology	C	**Moderately Modified**: The erosion in concentrated flow path areas has lowered the water table in some sections. The increased overland flow changes the hydrodynamics of the geomorphological setting.
Vegetation	C	**Moderately Modified:** Alien vegetation has become dominant with the wetland vegetation being overgrazed.
Overall	C	**Moderately Modified**. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.

Table 12: Summary of the scores for the wetland PES: HGM 3

Component	PES Rating	Description
Hydrology	D	**Largely Modified**: The catchment has been overgrazed and the surface roughness reduced. This has increased runoff potential within the system altering the hydrological inputs. The current crossing structures also alter flows within the wetlands.
Geomorphology	C	**Moderately Modified**: severe erosion within the channel banks as well as the crossing structures have altered the geomorphology of the wetland.
Vegetation	D	**Largely Modified:** The wetland unit has been overgrazed and sedimentation has altered the vegetation component. Alien vegetation has become prevalent.

Overall	C	**Moderately Modified**. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.

Table 13: Summary of the scores for the wetland PES: HGM 4

Component	PES Rating	Description
Hydrology	D	**Largely Modified**: The catchment is within a rural setting where livestock graze the landscape. This increases the impervious/bare area within the catchment and increases the runoff that enters the wetland systems. The increased runoff increases erosion at the high velocity inflow areas but increases sedimentation within the wetland systems further downstream. The alien vegetation also reduces daily low flows as these plants tend to utilize more water.
Geomorphology	C	**Moderately Modified**: The erosion in concentrated flow path areas has lowered the water table in some sections. The increased overland flow changes the hydrodynamics of the geomorphological setting.
Vegetation	C	**Moderately Modified:** Alien vegetation has become dominant with the wetland vegetation being overgrazed.
Overall	C	**Moderately Modified**. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.

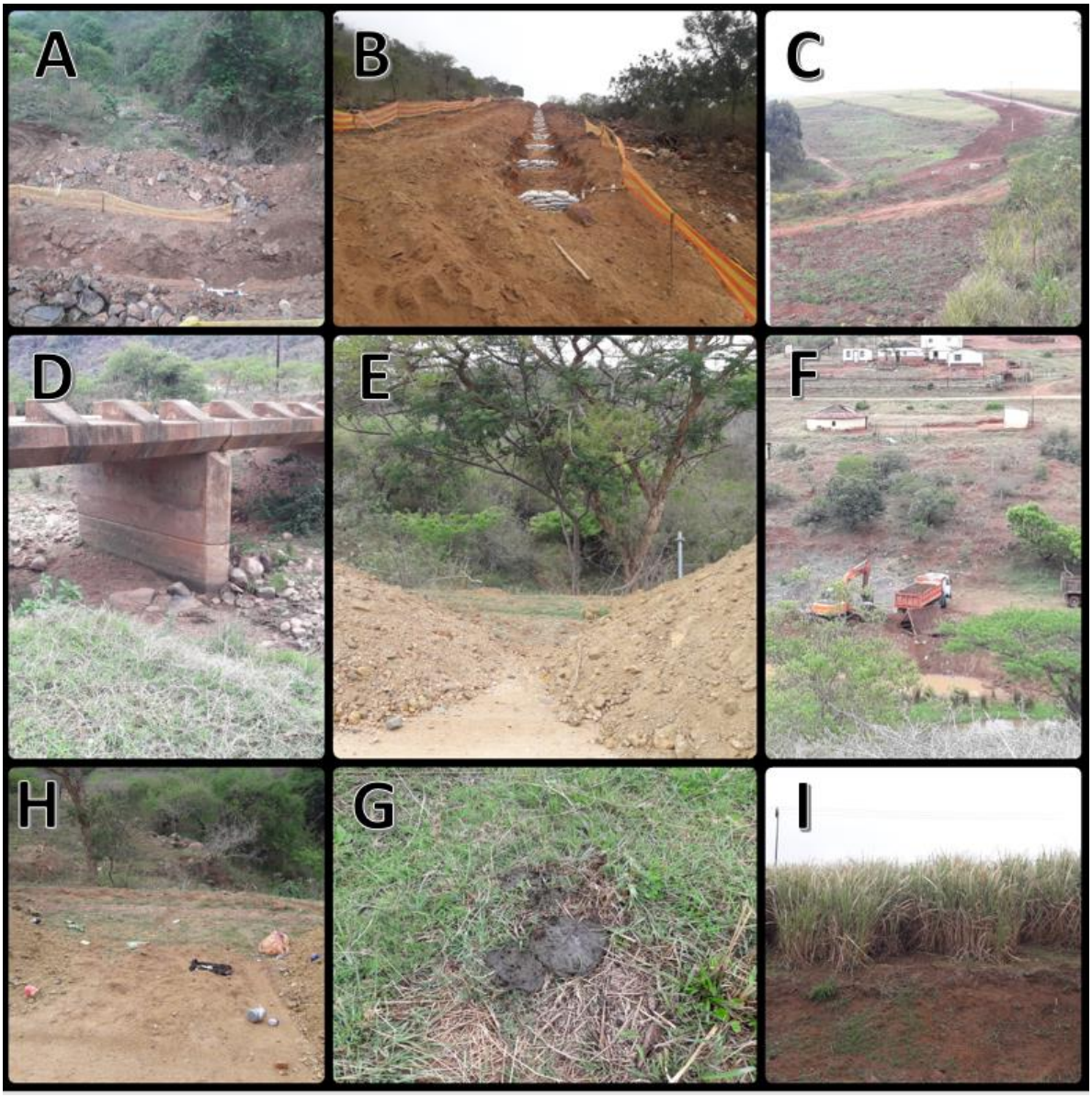


Figure 25: Impacts affecting the wetland health ratings. A, B & C) Existing pipeline trenches. D) Crossing structures. E) Sediment sources. F) Sand mining within channel. G) Livestock grazing. H) General waste. I) Sugarcane crops.

8.2.4 Ecosystem Services Assessment

The ecosystem services provided by the wetlands identified on site were assessed and rated using the WET-EcoServices method (Kotze *et al*. 2008).

The channelled valley bottoms had an overall Intermediate level of service. The direct benefits to the community was Moderately-Low due to the wetlands being able to provide harvestable resources in all HGM units. The indirect benefits that were rated as Moderately High included; Flood attenuation and sediment control in all HGM units. HGM 1 and HGM 3 provided additional benefits at a higher level, which included the assimilation of phosphates and toxins, as well as erosion control. The biodiversity maintenance was rated as Intermediate to Low due to the increased pressures of the developing area on the natural habitat.

Table 14: The ecosystem services being provided by the HGM units

Wetland Unit					HGM 1	HGM 2	HGM 3	HGM 4
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		2.3	2.3	2.3	2.4
			Streamflow regulation		1.7	1.2	1.7	1.2
			Water Quality enhancement benefits	Sediment trapping	2.7	2.1	2.7	2.1
				Phosphate assimilation	2.2	1.5	2.1	1.6
				Nitrate assimilation	1.7	1.0	1.6	1.1
				Toxicant assimilation	2.1	1.5	2.0	1.7
				Erosion control	2.1	2.0	2.1	2.3
			Carbon storage		1.7	1.7	2.0	1.7
	Direct Benefits	Biodiversity maintenance			1.6	1.1	1.6	1.1
		Provisioning benefits	Provisioning of water for human use		2.3	0.7	2.3	0.7
			Provisioning of harvestable resources		3.0	2.2	3.0	2.2
			Provisioning of cultivated foods		1.4	1.4	1.4	1.4
		Cultural benefits	Cultural heritage		1.0	1.0	1.0	1.0
			Tourism and recreation		0.9	0.0	0.9	0.0
			Education and research		0.8	0.8	0.8	0.8
Overall					27.2	20.3	27.2	21.0
Average					1.8	1.4	1.8	1.4

8.2.5 Ecological Importance & Sensitivity

The EIS assessment was applied to the HGM units described in the previous section in order to assess the levels of sensitivity and ecological importance of the wetland. The results of the assessment are shown in Table 15.

The EIS for HGM 1 and HGM 3 were calculated to have a High (class B) level of importance, whilst the EIS for HGM 2 and HGM 4 were calculated to have a Moderate (class C) level of importance. The EIS rating also took into account the wetland vegetation classification within this region being the Sub-Escarpment Savanna unit being listed as Endangered (NBA, 2011). No FEPA wetlands were identified within the 500m regulated area. The Hydrological/Functional Importance for all HGM units were rated as Moderate (class C) due to the ability of the wetland to enhance water quality and regulate streamflow. The Direct Human Benefits for both HGM units were rated as Low (class D).

Table 15: The EIS results for the delineated wetland

Wetland Importance and Sensitivity	HGM 1	HGM 2	HGM 3	HGM 4
Ecological Importance & Sensitivity	B	C	B	C
Hydrological/Functional Importance	C	C	C	C
Direct Human Benefits	D	D	D	D

8.3 Buffer Requirements

According to Ezemvelo KZN Wildlife (EKZNW, 2013) a minimum recommended buffer size of 30 m is required for wetlands within the province. The wetland buffer zone tool was used to calculate the appropriate buffer required for the construction and operation of the pipeline crossing.

The model shows that the largest risk (Moderate) posed by pipeline installation during the construction phase is that of “increased sediment inputs and turbidity” and this is rated as a medium risk. During the operational phase, only Low to Very Low risks are posed by the project, owing to the fact that the pipeline is used for water.

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 with the prescribed mitigation measures and therefore the recommended buffer was calculated to be 15 m (Table 16) for the construction and operational phases.

Table 16: 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.

The buffer zone will not be applicable for areas of the project that traverse wetland areas, however, for all secondary and supporting activities such as laydown yards, storage areas and camp sites, the buffer zone must be implemented.

Table 17: The risk results from the wetland buffer model for the proposed project

Threat Posed by the proposed land use / activity		Specialist Threat Rating	Description of any additional mitigation measures	Refined Threat Class
Construction Phase	1. Alteration to flow volumes	Very Low		Very Low
	2. Alteration of patterns of flows (increased flood peaks)	Very Low		Very Low
	3. Increase in sediment inputs & turbidity	Medium	There is an existing road over the wetland areas and the pipelines must be attached to the existing structures and therefor the proposed project will not introduce a new impact. Dry season construction, silt traps, managed stockpiles, storm water management will reduce the risk of sedimentation during the construction.	Medium
	4. Increased nutrient inputs	N/A		N/A
	5. Inputs of toxic organic contaminants	Medium	Provide ablution facilities for staff, and collect, separate and dispose of all on-site waste. Vehicles must be kept in a good condition with no oil leaks.	Low
	6. Inputs of toxic heavy metal contaminants	Low	Off-site equipment vehicle fuelling and maintenance, storage in bunded area, no on-site fabrication, oil spill kits, equipment & vehicle inspections.	Low
	7. Alteration of acidity (pH)	Very Low		Very 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	Low	The proposed pipeline will be underground and will not impact on the surface hydrology during the duration of its operation. The pipeline will be attached to existing infrastructure at crossing locations. Furthermore, the proposed pipeline is for the supply of clean potable water to residents in the area, the risk of organic compounds and nutrients will be limited. An infrastructure monitoring plan will be devised to regularly check for leaks and remedy these.	Low
	2. Alteration of patterns of flows (increased flood peaks)	Low		Low
	3. Increase in sediment inputs & turbidity	Very Low		Very Low
	4. Increased nutrient inputs	Low		Low
	5. Inputs of toxic organic contaminants	Low		Low
	6. Inputs of toxic heavy metal contaminants	Low		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)	Very Low		Very Low

8.4 Aquatic Assessment

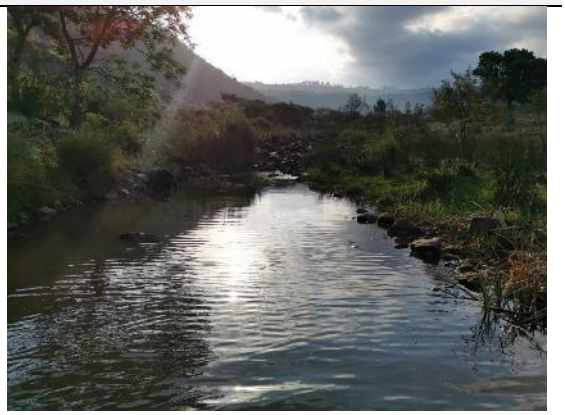
The sampling point for the study was selected to adequately assess the current state of the Mvoti River and all the associated tributaries to identify the potential risks that may result from constructing and operation of the Umshwati reticulation network.

As a result, each reach was assessed at the proposed location of a pipeline crossing with a watercourse to gain a holistic image of the system and which habitat may be affected. The selected sampling location and the location of the bridge can be seen in Table 18 as well as Figure 26, Figure 27 and Figure 28.

Table 18: Illustration of location of aquatic sites used to ascertain the state of the system at each crossing (November 2019).

	Upstream	**Downstream**
S0		
GPS	29°12'51.63"S 30°46'10.51"E	
	Upstream	Downstream
S1		
GPS	29°13'38.86"S 30°45'38.69"E	
	Upstream	Downstream

S2		
GPS	29°14'10.36"S 30°46'6.85"E	
	Upstream	Downstream
S3		
GPS	29°13'12.30"S 30°46'38.06"E	
	Upstream	Downstream
S4		
GPS	29°13'18.66"S 30°46'48.02"E	
	Upstream	Downstream

S5		
GPS	29°13'27.51"S 30°46'58.64"E	
	Upstream	Downstream
S6		
GPS	29°14'1.53"S 30°47'2.60"E	
	Upstream	Downstream
S7		
GPS	29°14'10.90"S 30°47'24.80"E	
	Upstream	Downstream

S8		
GPS	29°14'10.70"S 30°47'33.46"E	
	Upstream	Downstream
S9		
GPS	29°14'41.13"S 30°47'13.07"E	
	Upstream	Downstream
S10		
GPS	29°14'22.85"S 30°47'53.77"E	
	Upstream	Downstream

S11		
GPS	29°14'11.93"S 30°47'49.17"E	
	Upstream	Downstream
S12		
GPS	29°14'11.70"S 30°48'10.01"E	
	Upstream	Downstream
S13		
GPS	29°14'11.77"S 30°48'9.32"E	
	Upstream	Downstream

S14		
GPS	29°14'8.46"S 30°48'10.95"E	
	Upstream	Downstream
S15		
GPS	29°13'57.01"S 30°48'7.95"E	
	Upstream	Downstream
S16		
GPS	29°17'12.50"S 30°47'38.73"E	
	Upstream	Downstream

S17		
GPS	29°16'18.05"S 30°47'33.26"E	
	Upstream	Downstream
S18		
GPS	29°15'8.69"S 30°50'41.94"E	
	Upstream	Downstream
S19		No access
GPS	29°15'5.28"S 30°51'0.23"E	
	Upstream	Downstream

S20		
GPS	29°14'22.58"S 30°51'48.75"E	
	Upstream	Downstream
S21		
GPS	29°14'37.92"S 30°51'51.12"E	
	Upstream	Downstream
S22		
GPS	29°14'46.96"S 30°52'2.46"E	
	Upstream	Downstream

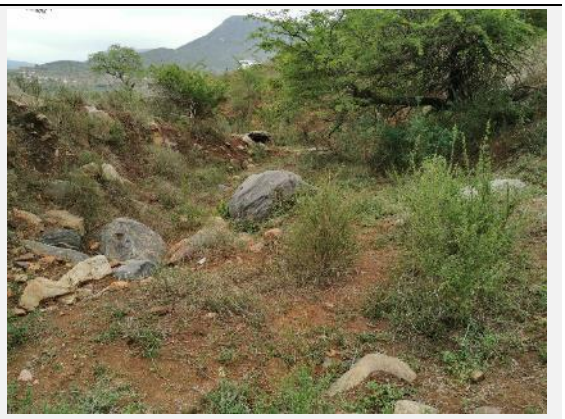
S23		
GPS	29°14'44.22"S 30°51'49.00"E	
	Upstream	Downstream
S24		
GPS	29°14'44.81"S 30°51'49.47"E	

	Upstream	**Downstream**
S25		
GPS	29°14'38.08"S 30°52'31.54"E	
	Upstream	Downstream

S26		
GPS	29°14'28.37"S 30°52'29.69"E	
	Upstream	Downstream
S27		
GPS	29°14'23.83"S 30°52'42.16"E	
	Upstream	Downstream
S28		
GPS	29°14'1.85"S 30°52'39.51"E	
	Upstream	Downstream

S29		
GPS	29°13'52.13"S 30°52'33.00"E	
	Upstream	Downstream
S30		
GPS	29°14'58.60"S 30°52'47.22"E	
	Upstream	Downstream
S31		
GPS	29°14'59.62"S 30°52'36.57"E	
	Upstream	Downstream

S32		
GPS	29°15'24.26"S 30°52'33.29"	
	Upstream	Downstream
S33		
GPS	29°15'26.32"S 30°52'37.25"E	
	Upstream	Downstream
S34		
GPS	29°15'28.61"S 30°52'36.21"E	
	Upstream	Downstream

S35		
GPS	29°15'9.54"S 30°53'37.06"E	
	Upstream	Downstream
S36		
GPS	29°15'17.36"S 30°53'52.23"E	
	Upstream	Downstream
S37		
GPS	29°15'33.24"S 30°53'49.96"E	
	Upstream	Downstream

S38		
GPS	29°15'41.99"S 30°53'55.70"E	
	Upstream	Downstream
S39		
GPS	29°14'45.98"S 30°53'59.01"E	
	Upstream	Downstream
S40		
GPS	29°14'57.21"S 30°54'3.62"E	
	Upstream	Downstream

S41		
GPS	29°14'39.40"S 30°54'29.79"E	

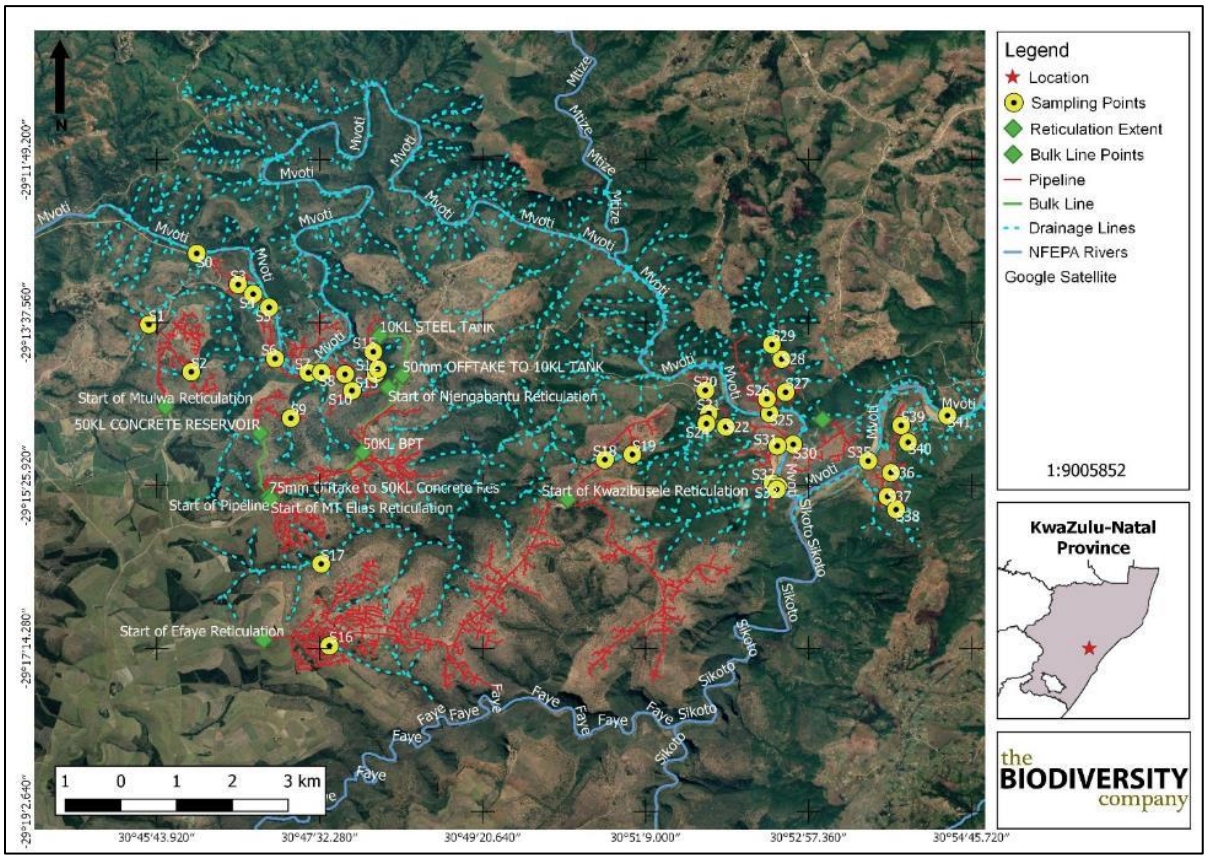


Figure 26:Locality map representing sampled aquatic monitoring points for the project area (November 2019)

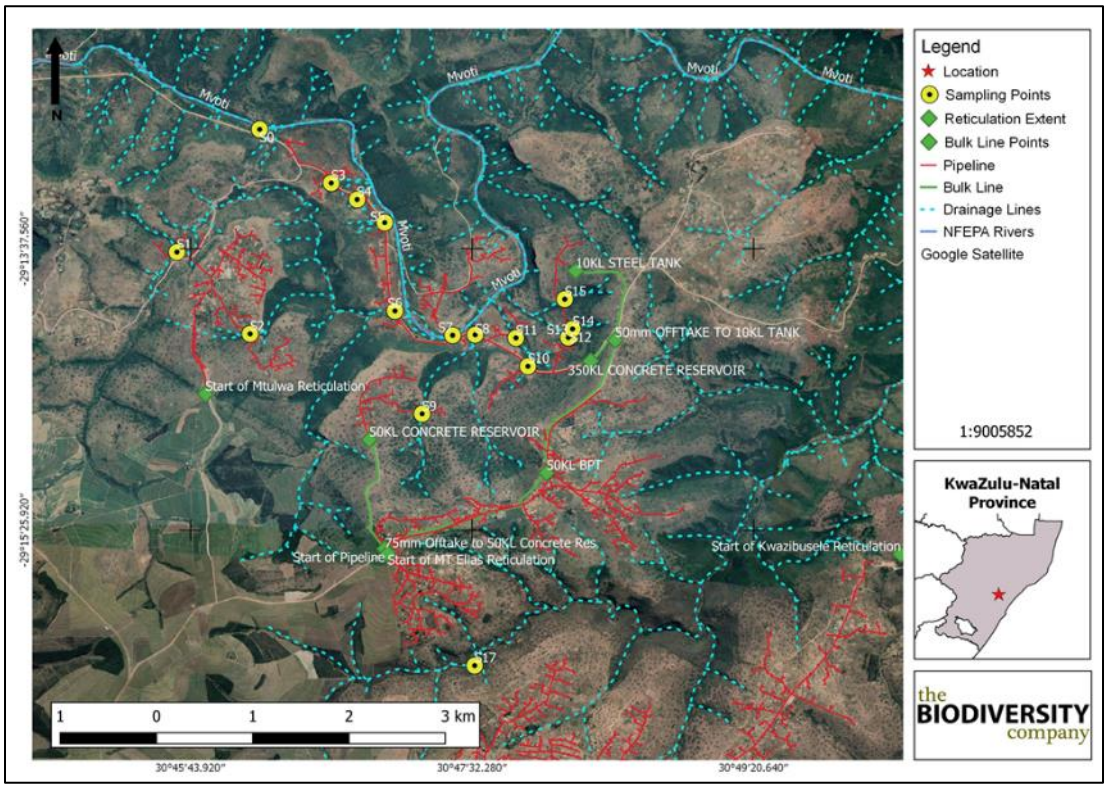


Figure 27: Locality map representing sampled aquatic monitoring points on left limb of the project area (November 2019)

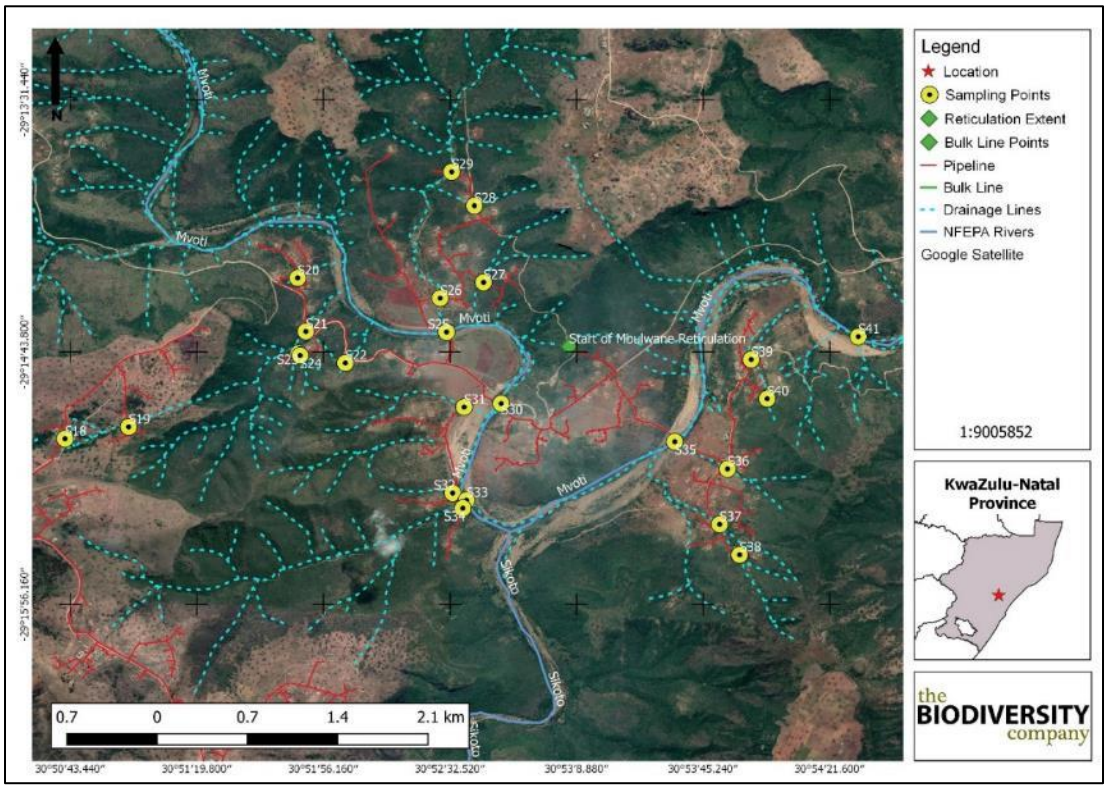


Figure 28: Locality map representing sampled aquatic monitoring points on right limb of the project area (November 2019)

8.4.1 *In situ* Water Quality

In situ water quality analysis was conducted during the study at each pipeline crossing which contained water. Results have been compared to limits stipulated in the Target Water Quality Range (TWQR) for aquatic ecosystems (DWS, 1996a). The results of the November 2019 assessment are presented in Table 19.

Table 19: In situ surface water quality results (November 2019)

Site	pH	Dissolved Oxygen (mg/l)	Temperature (°C)
TWQR*	**6.5-9***	**>5.00***	**5-30***
S0	8.1	6.7	22.7
S1	7.71	6.96	25.2
S7	8.28	7.38	25.5
S11	8.32	6.21	28.6
S17	8.49	7.58	24.6
S25	7.76	7.95	20.3
S26	8.16	7.57	21.3
S29	7.22	7.92	20.3
S35	8.09	8.40	20.7
S41	8.28	7.97	20.3

*TWQR – Target Water Quality Range; Levels exceeding guideline levels are indicated in red

In situ water quality for the Mvoti River as well as its associated tributary indicate natural conditions as they confirm with Target Water Quality Ranges (TWQR). The parameters indicate water quality which is would not be a limiting factor to local aquatic biota. The construction of the reticulation network is not considered to modify the water quality of these systems significantly if appropriate mitigation measures prescribed in the risk assessment are followed.

8.4.2 Habitat Integrity Assessment

The IHIA was completed for the Mvoti River as described in the IHIA methodology component of this study. The special framework of which constitutes a 5km reach above and below the proposed Umshwati pipeline system. The results thereof are shown in Table 20.

Table 20: Intermediate Habitat Integrity Assessment for the Mvoti River reach

Criterion	Impact Score	Weighted Score
	Instream	
Water abstraction	**8**	**4.5**
Flow modification	**13**	**6.8**
Bed modification	**16**	**8.3**
Channel modification	**15**	**7.8**
Water quality	**4**	**2.2**

Inundation	**2**	**0.8**
Exotic macrophytes	**0**	**0.0**
Exotic fauna	**0**	**0.0**
Solid waste disposal	**4**	**1.0**
Total Instream Score		**68.64**
Instream Category		**C**
Riparian		
Indigenous vegetation removal	**5**	**2.6**
Exotic vegetation encroachment	**8**	**3.8**
Bank erosion	**6**	**3.1**
Channel modification	**12**	**7.2**
Water abstraction	**4**	**2.1**
Inundation	**2**	**0.9**
Flow modification	**15**	**7.8**
Water quality	**5**	**2.6**
Total Riparian Score		**69.88**
Riparian Category		**C**

The results of the instream and riparian habitat assessment in the associated Mvoti River indicates a moderately modified state (class C) in the riparian habitat and in the instream habitat. This indicates a loss and change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged. There were instances of modification observed however their impacts, significance and extent were considered across the whole system and assessed for IHIA. The largest causes of modification within the system are channel (Figure 29), bed (e.g. sedimentation), flow modification (Figure 30) and bank erosion (Figure 31) within the riparian and instream habitat as well as water extraction by local communities and agriculture. This was followed by modification from alien invasive (Figure 32) and water quality (Figure 33) in the riparian areas. The last cause of modification is from solid waste disposal within the watercourses (Figure 34).

Figure 29: Excavation and earth works within the river channel and drainage lines respectively (November 2019)

Figure 30: Livestock found in the riparian areas of the Mvoti River and associated tributaries (November 2019)

Figure 31: Examples of erosion seen within drainage lines (November 2019)

Figure 32: Senna didymobotrya an alien invasive in the riparian area (November 2019).

Figure 33: Washing baskets of local communities which use the river for washing (November 2019)

Figure 34: Refuse found within watercourses of the project area (November 2019).

8.4.3 Aquatic Macroinvertebrate Assessment

8.4.3.1 Macroinvertebrate Habitat

Biological assessments were completed at representative site in the considered river reach. The invertebrate habitat at the site was assessed using the South African Scoring System version 5 (SASS5) biotope rating assessment as applied in Tate and Husted (2015). The results of the biotope assessment are provided below (Table 21). A rating system of 0 to 5 was applied, 0 being not available. The weightings for upper foothills rivers (slope class D) were used to categorize biotope ratings (Rowntree *et al.* 2000; Rowntree & Ziervogel, 1999).

Table 21: Biotope availability at the sites (Rating 0-5)

Biotope	Weighting (Upper Foothills)	S0	S1	S7	S25	S26	S29	S35	S41
Stones in current	20	3	2	2	3	1	2.5	3	2
Stones out of current	10	3	2	2	2.5	0.5	1	2	3
Bedrock	5	2	1	1	0	2.5	1	2	1
Aquatic Vegetation	0.5	0	0	0	0	0.5	0	0	1
Marginal Vegetation In Current	2	4	2	2	1	1.5	2	2	4

Marginal Vegetation Out Of Current	2	3	2.5	2.5	2	1	1.5	2.5	3
Gravel	3.5	2	1	1	3	1	2	1	3
Sand	1	2	2	2	2	1	2	1	2
Mud	0.5	1	2	2	1	1	0	0	0
Biotope Score		55	36	36	46	21	36	46	45
Weighted Biotope Score (%)		20	14.5	14.5	14.5	10	12	13.5	19
Biotope Category (Tate and Husted, 2015)		**C**	**E**	**E**	**D**	**F**	**E**	**D**	**D**

The habitat availability within the Mvoti River ranges considerably from S7 which is an E(S7), a D (S25, S35, S41) to a C (S0) which represents a poor to fair habitat conditions within the reach. The tributaries of the Mvoti River represent poor habitat (S1, S26, S29). The watercourses which were assessed represented a reasonable distribution of biotopes however found in only fair amounts with stones out of current an example of a heavily weighted biotope. Although there was lack of aquatic vegetation and mud, the class is a weighted score and these biotopes are less significant due to the number of taxa which inhabit them. The biotope results within the reach indicate that the habitat availability would not be limiting factor for the macroinvertebrate communities within the Mvoti River. Missing or poorly represented biotopes within the tributaries of the Mvoti River are however expected to influence and limit macroinvertebrate community presence.

8.4.3.2 South African Scoring System

The aquatic macroinvertebrate results for the survey are presented in Table 22.

Table 22: Macroinvertebrate assessment results recorded during the survey (August 2019)

Site	SASS Score	No. of Taxa	ASPT*	Category (Dallas, 2007)**
S0	160	29	5.51	**A**
S1	146	18	8.11	**A**
S7	198	34	5.82	**A**
S25	282	36	7.83	**A**
S26	87	19	4,58	**C**
S29	161	29	5.55	**A**
S35	196	31	6.32	**A**
S41	204	33	6.18	**A**

*ASPT: Average score per taxon; ** North Eastern Coastal Belt lower ecoregion

The SASS5 assessment results generated SASS scores that are categorised as a class A for all but one site (S26) assessed (Dallas, 2007) which indicates natural conditions within the reach. The high number of taxa sampled during the survey are a clear indication that the sampled reach is in a natural condition, with 18 (S1) to 36 (S25) taxa found within the system. This high number of taxa increases the SASS Score which is one axis used to find the Dallas bands. This is considered significant as the reach is classed an A based on SASS score, but a D/C based on ASPT. Both are considered for Dallas bands in an attempt to remove bias from highly intolerant and highly tolerant species in systems with low numbers of taxa. An example of this is seen at S1 which has the highest ASPT but lowest no. of taxa due to the lack of some intolerant taxa (e.g. Potamonautidae, Belostomatidae, Phycidae). The average score per taxon (ASPT) indicated that not only tolerant taxa but also intolerant macroinvertebrates were collected during this survey. The tolerant macroinvertebrates include Oligochaeta (earthworms), Chironomidae (Blood worms) and Muscidae (House flies) with some of the intolerant macroinvertebrates including 3sp of Baetidae, Perlidae, Heptageniidae (Flathead mayflies), Chlorocyphidae (Jewels), Philopotamidae, Psephenidae (water pennies) and Athericidae (Snipe flies) to mention a few. The presence and wide distribution of specialist taxa across the biotopes along with high diversity of species indicates the current health of the system from a geomorphological, biological and chemical stance.

8.4.4 Fish Communities

The results of the qualitative fish community assessment are provided in Table 23 with photos of sampled fish for the survey in Table 24. Eight fish species fish were observed during the survey. The most common species observed was *Enteromius trimaculatus* and *Enteromius viviparus* which were present throughout the survey. While there were 3 species which were not sampled it is assumed that with increased efforts that these fish would be sampled due to presence of habitat required by these specialists. This includes the only VU species identified species within the system (*Enteromius gurneyi*).

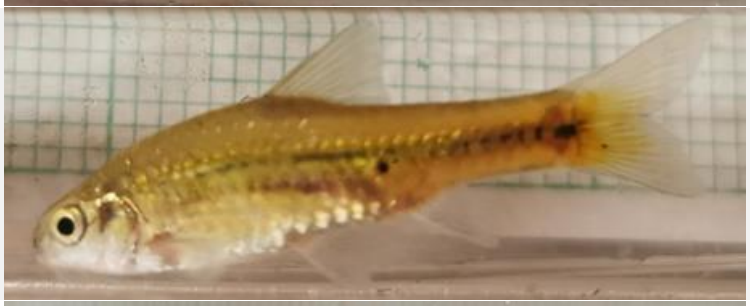
The reach should be avoided when at all possible and all pipeline crossings which do cross any drainage lines, tributaries or the Mvoti River need to make allowance for flow as well as fish migrations in the system. Bridges are the advised means for crossings which should have minimal piers and should be placed on bedrock where possible, to avoid artificial flows.

Table 23: Fish community assessment for November 2019 (iThalu System)

Survey	**November 2019**				
Species/Site	**S0**	**S7**	**S25**	**S35**	**S41**
Amphilius natalensis	0	0	0	0	0
Anguilla mossambica	2	1	2	8	4
Awaous aeneofuscus	0	0	0	0	0
Clarias gariepinus	1	4	15	2	3
Enteromius gurneyi	0	0	0	0	0
Enteromius paludinosus	3	4	10	30	15
Enteromius trimaculatus	15	25	70	40	33
Enteromius viviparus	38	3	55	50	23
Labeobarbus natalensis	1	3	12	12	11
Oreochromis mossambicus	0	4	1	10	6
Tilapia sparrmanii	17	15	5	2	8
Total Native Species	**7**	**8**	**8**	**8**	**8**
Total Expected Native Species	**11**	**11**	**11**	**11**	**11**
% Fish Community Sampled	**63**	**72**	**72**	**72**	**72**

0 = Absent; 1 = Present

Table 24: Sampled Fish species for the survey

Species/Site	Photograph
Anguilla mossambica	
Clarias gariepinus	
Enteromius paludinosus	
Enteromius trimaculatus	
Enteromius viviparus	
Labeobarbus natalensis	

Oreochromis mossambicus	
Tilapia sparrmanii	

9 Risk Assessment

The project is for the construction of the proposed Umshwati water supply scheme, that will traverse several watercourses. The existing wetland crossings consist of tarred and gravel road crossings in the form of bridges, culverts and concrete pipe crossings. The pipelines cross predominantly drainage lines as well as the Mvoti River. The majority of the proposed pipeline is aligned with existing road and infrastructure servitudes with existing areas of impact. As this project is for the installation of a buried water pipeline, impacts associated with the area are potentially moderate to low. Modifications to wetlands are likely to occur during construction. The project will entail the clearing of moderate amounts of vegetation and levelling of areas for the construction activities. This has the potential to increase erosion and sedimentation of downstream habitats due to surface runoff during the wet season. Furthermore, due to the proximity of the construction to the water resources, direct impacts to the wetland zones and rivers are likely. Some of the more notable impacts identified during the site visit and that will be considered for the risk assessment include the following:

- Portions of the pipeline traversing wetland areas, rivers and drainage lines; and
- Potential for inadequate measures to dissipate flows and prevent erosion resulting in the scouring of channels and incisions in the receiving systems.

Soluble construction materials have the potential to dissolve in runoff of the area. This can result in the increase of dissolved solids in downstream waterbodies resulting in a water quality impact. Further to this, suspended materials emanating from the construction area may alter the physical water parameters and result in the sedimentation of downstream areas which will have negative effects to local aquatic ecology. This impact will only occur during the construction phase as no anticipated further impacts are foreseen beyond the construction phase.

The impact assessment considered both direct and indirect impacts to the water resources. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the study (Figure 35).

In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts. Findings from the DWS aspect and impact register / risk assessment are provided in Table 25,Table 26 and Table 27.

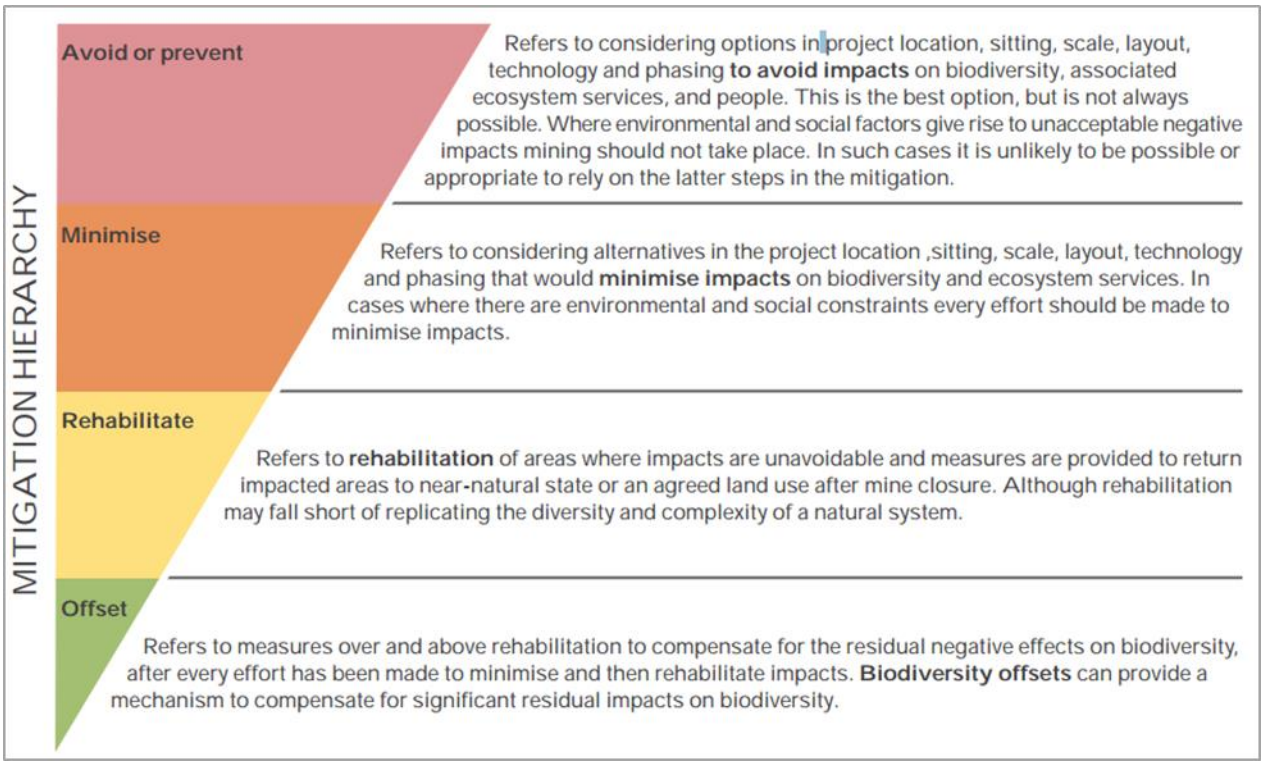


Figure 35: The mitigation hierarchy as described by the DEA (2013)

Table 25: Potential impacts associated with the project

Wayne Jackson	**Cert Sci Nat**	**119037**
Activity	**Aspect**	**Impacts**
Construction of Pipeline	• Potential temporary damming (inundation) of upstream areas • Temporary channel diversion • Removal of embankment vegetation areas • Cutting/reshaping of embankments • Operation of equipment and machinery in riparian areas. • Soil and building material stockpile management • Domestic and industrial waste • Storage of chemicals, mixes and fuel • Final landscaping and post-construction rehabilitation	• Impeding the flow of water. • Loss of embankments. • Siltation of watercourse. • Erosion of watercourse. • Increase in sediment inputs & turbidity • Vegetation removal • Loss of seepage areas • Inundation of aquatic habitat • Alteration to flow volumes • Increase in sediment inputs & turbidity • Water quality impairment

Operation of Pipeline	• Alteration of surface drainage and runoff • Storm water management • Establishment of alien plants on disturbed areas • Conducting maintenance	• Alteration to flow volumes (impediment) • Alteration of patterns of flows (increased flood peaks) • Solid waste

9.1 Risk Significance

A variety of risks have been identified for the proposed project. The construction of the water pipeline will entail the clearing of areas and digging of trenches, laying of pipeline and attachment of the pipeline to the existing crossing structures which will pose risks to the identified watercourses, with the level of risk determined to vary from low to moderate.

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 as the soils in the area are susceptible to dispersion and the impairment of water quality during the attachment of the pipeline to existing crossing structures.

The operation of the pipeline does pose a risk to the identified water resources, with the level of risk determined to be low. The low risks are largely attributed to the study being for a water reticulation project.

Taking into consideration that the project is for water reticulation, and that pipelines are generally aligned in road reserves and then branch up to the existing homesteads, the risks posed to wetlands is considered to be negligible. This is supported by the fact that the proposed pipeline will also tie into existing structures, indicating the area to already be disturbed.

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

Table 26: DWS Risk Impact Matrix for the proposed project

Aspect	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase								
Removal of embankment vegetation areas	2	1	3	1	1.75	2	2	5.75
Cutting/reshaping of embankments	3	1	2	1	1.75	2	2	5.75
Temporary channel diversion	3	2	2	1	2	2	2	6
Operation of equipment and machinery in riparian areas	2	2	2	1	1.75	2	2	5.75
Soil and building material stockpile management	1	2	1	1	1.25	1	2	4.25
Domestic and industrial waste	1	2	1	1	1.25	3	2	6.25
Storage of chemicals, mixes and fuel	1	2	2	1	1.5	1	2	4.5
Final landscaping and post-construction rehabilitation	1	1	2	1	1.25	2	3	6.25
Operational Phase								
Alteration of surface drainage and runoff	1	1	2	1	1.25	2	4	7.25
Storm water management	1	2	1	1	1.25	3	4	8.25
Establishment of alien plants on disturbed areas	1	2	1	1	1.25	2	3	6.25
Conducting maintenance	2	2	2	1	1.75	2	4	7.75

Table 27: 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								
Removal of embankment vegetation areas	1	3	5	2	11	57.75	**Moderate***	**Low**
Cutting/reshaping of embankments	1	2	5	2	10	57.75	**Moderate***	**Low**
Temporary channel diversion	1	3	5	1	10	60	**Moderate***	**Low**
Operation of equipment and machinery in riparian areas.	1	3	1	1	6	34.5	**Low**	**Low**
Soil and building material stockpile management	1	1	1	1	4	17	**Low**	**Low**
Domestic and industrial waste	4	1	1	2	8	50	**Low**	**Low**
Storage of chemicals, mixes and fuel	1	1	1	2	5	22.5	**Low**	**Low**
Final landscaping and post-construction rehabilitation	1	1	1	1	4	25	**Low**	**Low**
Operational Phase								
Alteration of surface drainage and runoff	3	2	5	1	11	79.75	**Moderate***	**Low**
Storm water management	2	2	1	1	6	49.5	**Low**	**Low**
Establishment of alien plants on disturbed areas	2	2	1	2	7	43.75	**Low**	**Low**
Conducting maintenance	1	1	1	1	4	31	**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.”

9.2 Mitigation Measures

The prescribed mitigation measures for the project include the following:

9.2.1.1 Water pipeline installation specific mitigation measures

- The footprint area of the pipeline must be kept a minimum. The footprint area must be clearly demarcated to avoid unnecessary disturbances to adjacent areas;
- The footprint area must be aligned in existing road reserves wherever possible. Disturbed areas should be sought as the preferred alignment area;
- The pipeline must be aligned as close to the road as possible;
- Pipeline trenches and sandy bedding material may produce preferential flow paths for water across the project area perpendicular to the general direction of flow instead of angle. This risk can be reduced by installing clay plugs at intervals down the length of the trench to force water out of the trench and down the natural topographical gradient;
- Pipelines crossing drainage areas, should preferably span the drainage lines above ground. This prevents disruptions to sub surface flow dynamics and allows the pipeline to be monitored for leaks. Pipelines buried underground should be buried at a sufficient depth below ground level such that the pipelines do not interfere with surface water movement or create obstructions, where flows can cause erosion;
- When a pipeline spans a river, drainage line or wetland, it should be attached to any existing crossing or bridge structures. This will limit the need to disturb new areas of the river system with the construction of new structures;
- The pipeline must be attached to existing infrastructure at all crossing structures;
- If pier support structures are needed for the pipeline to span a wide drainage line or river, then piers should be placed outside of preferential flow paths with the least number of pier structures used as possible;
- Contamination of aquatic systems with unset cement or cement powder should be negated as it is detrimental to aquatic biota. Pre-cast structures should be made use of (where possible) to avoid the mixing of these materials on site, reducing the likelihood of cement in the river system;
- During the excavation of trenches, flows should be diverted around active work areas where required. Water diversion must be temporary and re-directed flow must not be diverted towards any stream banks that could cause erosion; and
- The pipeline should be regularly inspected (quarterly) for any signs of failure, damage or leaks. Adequate maintenance measures need to be implemented upon finding pipeline issues and failures.

9.2.1.2 General mitigation measures

The following general mitigation measures are provided:

- The wetland areas outside of the specific project site area must be avoided where possible;

- 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 aquatic areas. Where possible, the construction of the pipeline and crossings must take place from the existing road servitudes and not from within the aquatic systems;
- 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;
- It is preferable that construction takes place during the dry season to reduce the erosion potential of the exposed surfaces;
- Temporary storm water channels and preferential flow paths should be filled with aggregate and/or logs (branches included) to dissipate and slow flows limiting erosion;
- Prevent uncontrolled access of vehicles through the river and 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;
- Quarterly vegetation rehabilitation surveys need to be conducted of the vegetation within the project footprint for a period of at least a year after construction has been completed to assess vegetation regrowth and recovery; and
- 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.

9.2.2 Recommendations

The following are recommendations made in support of the water resource assessment:

- A soil management strategy must be compiled and implemented for the excavation and back-filling of trenches. A proposed soil handling sequence is presented in Figure 36.
- An infrastructure monitoring and service plan must be compiled and implemented during the operational phase.
- An Environmental Control Officer (ECO) must oversee the construction phase of the project, with wetland areas as a priority.

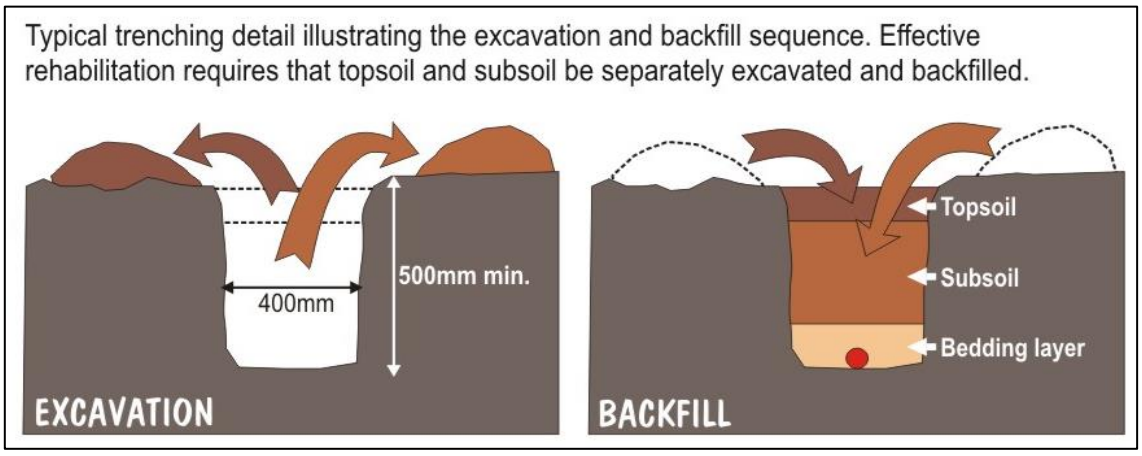


Figure 36: The proposed excavation and back-filling handling of soil

10 Conclusion

10.1 Wetlands

One wetland type was identified; namely the channelled valley bottom systems. These comprised of four (4) HGM units, which were identified and delineated for this assessment.

The **bulk water pipeline** does not cross any drainage lines and there are no wetlands within the 500m regulated area. Therefor no impacts are anticipated on the wetlands for this portion of the project.

The **reticulation pipeline** crosses several drainage lines as well as crosses the four wetland HGM units.

The overall wetland health for all HGM units were determined to be Moderately Modified (class C) systems. Although the wetlands are impacted upon, the wetlands maintained the habitat structure and functioning. The channelled valley bottoms had an overall Intermediate level of service. The direct benefits to the community was Moderately-Low due to the wetlands being able to provide harvestable resources in all HGM units. The indirect benefits that were rated as Moderately High included; Flood attenuation and sediment control in all HGM units. HGM 1 and HGM 3 provided additional benefits at a higher level, which included the assimilation of phosphates and toxins, as well as erosion control. The biodiversity maintenance was rated as Intermediate to Low due to the increased pressures of the developing area on the natural habitat. The EIS for HGM 1 and HGM 3 were calculated to have a High (class B) level of importance, whilst the EIS for HGM 2 and HGM 4 were calculated to have a Moderate (class C) level of importance. The EIS rating also took into account the wetland vegetation classification within this region being the Sub-Escarpment Savanna unit being listed as Endangered (NBA, 2011). No FEPA wetlands were identified within the 500m regulated area. The Hydrological/Functional Importance for all HGM units were rated as Moderate (class C) due to the ability of the wetland to enhance water quality and regulate streamflow. The Direct Human Benefits for both HGM units were rated as Low (class D).

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.

10.2 Aquatics

The Mvoti River (U40D-03957 and U40D-03967 SQR's) across which the proposed reticulation network will be constructed is considered to be largely natural (B) at desktop level (PES). The reach has a very high to high Ecological Importance and very high Ecological Sensitivity. This was confirmed through the baseline survey where water quality indicated natural conditions. Aquatic macroinvertebrate species were found to be both abundant and diverse. With a total number of taxa of ranging from 18 to 36 species found at S1 and S25 respectively with multiple intolerant species. An ASPT range of between 4.58 and 8.11 was achieved, putting the reach in an A class with one exception (S26, a tributary of the Mvoti River), representing natural conditions for the region. A total of 11 indigenous fish species are expected within the reach, with one near threatened species (*Oreochromis mossambicus*) and one vulnerable species (*Enteromius gurneyi*). Eight of the 11 species were sampled during the survey with *E. gurneyi* not found in the reach. The sub-quaternary catchment is however not considered a river FEPA or Fish Sanctuary but is upstream of wetland FEPA's and

therefore care must be taken during construction. In order to minimize effects on these species, fish ways (pathways through infrastructure used) must be considered along with minimizing the number of piers used in the river of expected bridges used to support the pipeline. The available habitat within the reach was in a moderately modified state in both the riparian and instream areas. The largest modifiers were to flow, channel and bed modification. The riparian areas are well established but contain large degraded patches from anthropogenic influence.

10.3 Risk Assessment

A variety of risks have been identified for the proposed project. The construction of the water pipeline will entail the clearing of areas and digging of trenches, laying of pipeline and attachment of the pipeline to the existing crossing structures which will pose risks to the identified watercourses, with the level of risk determined to vary from low to moderate.

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 as the soils in the area are susceptible to dispersion and the impairment of water quality during the attachment of the pipeline to existing crossing structures.

The operation of the pipeline does pose a risk to the identified water resources, with the level of risk determined to be low. The low risks are largely attributed to the study being for a water reticulation project.

Taking into consideration that the project is for water reticulation, and that pipelines are generally aligned in road reserves and then branch up to the existing homesteads, the risks posed to wetlands is considered to be negligible. This is supported by the fact that the proposed pipeline will also tie into existing structures, indicating the area to already be disturbed.

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

10.4 Impact Statement

It is the opinion of the specialists that the project be favourably considered and allow for the proposed Umshwati pipeline to proceed as no fatal flaws were identified, but all prescribed mitigation measures and recommendations must be implemented. Based on GN 509 it is the specialist opinion that a GA is permissible.

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CULTURAL HERITAGE IMPACT ASSESSMENT OF THE PROPOSED GREATER EFAYE PIPELINE AND RESERVOIRS UMSHWATHI LOCAL MUNICIPALITY, KWAZULU-NATAL

For: EnviroPro

ACTIVE HERITAGE cc.

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28 March 2017

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LIST OF ABBREVIATIONS AND ACRONYMS

EIA	Early Iron Age
ESA	Early Stone Age
HISTORIC PERIOD	Since the arrival of the white settlers - c. AD 1820 in this part of the country
IRON AGE	Early Iron Age AD 200 - AD 1000 Late Iron Age AD 1000 - AD 1830
LIA	Late Iron Age
LSA	Late Stone Age
MSA	Middle Stone Age
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998 and associated regulations (2006).
NHRA	National Heritage Resources Act, 1999 (Act No. 25 of 1999) and associated regulations (2000)
SAHRA	South African Heritage Resources Agency
STONE AGE	Early Stone Age 2 000 000 - 250 000 BP Middle Stone Age 250 000 - 25 000 BP Late Stone Age 30 000 - until c. AD 200

EXECUTIVE SUMMARY

A cultural heritage survey of the proposed establishment of the Greater Efaye Pipeline Pipeline, Umshwathi Local Municipality, KwaZulu-Natal identified no heritage sites or features on the footprint. The area is also not part of any known cultural landscape. There is no archaeological reason why the proposed development may not proceed as planned. However, attention is drawn to the South African Heritage Resources Act, 1999 (Act No. 25 of 1999) and the KwaZulu-Natal Heritage Act (Act no 4 of 2008) which, requires that operations that expose archaeological or historical remains should cease immediately, pending evaluation by the provincial heritage agency.

1 BACKGROUND INFORMATION ON THE PROJECT

Table 1. Background information

Consultant:	Frans Prins (Active Heritage) for EnviroPro
Type of development:	Pipeline and Reservoir at Efaye. The pipeline runs for the most part in previously disturbed road reserves. The pipeline covers a length of approximately 30 km.
Rezoning or subdivision:	n.a
Terms of reference	To carry out a Heritage Impact Assessment
Legislative requirements:	The Heritage Impact Assessment was carried out in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and following the requirements of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) and the KwaZulu-Natal Heritage Act, 1997 (Act No. 4 of 2008)

1.1. Details of the area surveyed:

The project area is situated approximately 23km to the south of Greytown and 13km to the north of Dalton in the KZN Midlands (Figs 1 & 2). The western section of the proposed pipeline trajectory runs through commercial farms and areas dominated by commercial woody plantations and grasslands (Fig 3). The eastern section of the proposed pipeline runs through a rural area with Zulu homesteads dotted over the landscape. The pipeline trajectory then descends into the Mvoti River Valley (Fig 4). The GPS coordinates for the proposed pipeline are:

START: 29° 14’ 26.99” S 30° 44’ 15.80” E

MIDDLE: 29° 17’ 14.79” S 30° 48’ 58.31” E

END: 29° 14’ 40.55” S 30° 53’ 05.80” E

BACKGROUND TO ARCHAEOLOGICAL HISTORY OF AREA

Portions of the greater New Hanover and Dalton areas have been relatively well surveyed for archaeological heritage sites by the KwaZulu-Natal Museum, post-graduate students from the Universities of Cape Town and the Witwatersrand, and subsequently by private heritage consultants in the last few years. However, the project area has not been covered in these surveys.

The available evidence, as captured in the Amafa and the KwaZulu-Natal Museum heritage site inventories, indicates that this area contains a wide spectrum of archaeological sites covering different time-periods and cultural traditions. These range from Early Stone Age, Middle Stone Age, and Later Stone Age to Early Iron Age, Middle and Later Iron Age sites as well as historical sites relating to the rise of the Zulu Kingdom and the subsequent colonial period. There are four Middle Stone Age sites, four later Stone Age sites, two San rock art sites, seven Later Iron Age sites and two recorded historical period sites in the greater New Hanover area.

The San were the owners of the land for almost 30 000 years but the local demography started to change soon after 2000 years ago when the first Bantu-speaking farmers crossed the Limpopo River and arrived in South Africa. Around 800 years ago, if not earlier, Bantu-speaking farmers also settled in the greater New Hanover area. Although some of the sites constructed by these African farmers consisted of stone walling not all of them were made from stone. Sites located elsewhere in the KwaZulu-Natal Midlands show that many settlements just consisted of wattle and daub structures. These Later Iron Age sites were most probably inhabited by Nguni-speaking groups such as the Wushe, Zondo and related groups (Bryant 1965). These groups were known to be excellent metal workers and it is not surprising that some archaeological evidence for early metal working has been found near Wartburg. However, by 1820 the original African farmers were dispersed from this area due to the expansionistic policies of the Zulu Kingdom of King Shaka. African refugee groups and individuals were given permission to settle in the area by the British colonial authorities after 1845 where most of them became farm labourers. After the Anglo-Zulu war of 1879 and the Bambatha Rebellion of 1911 many of the African people in the study area adopted a Zulu ethnic identity.

European settlement of the area started soon after 1838 when the first Voortrekker settlers marked out large farms in the area. However, most of these farms were abandoned in the 1840's when Natal became a British colony only to be reoccupied again by British immigrants. The greater New Hanover area, however, was settled in the 1850s by German families (Derwent 2006). Many of the people living here today are fourth generation Germans, with their language, customs, schooling and worship a legacy from the immigrant farmers and missionaries who arrived in the colony in the mid 19th century. It was in 1850 that cotton planter families founded New Hanover, followed in 1854 by members of the Hermannsburg Mission who settled in what became known as Hermannsburg. More German immigrants, mostly from the Hanover district, followed. As new settlements arose, steeped in the Lutheran faith, churches and schools were built. The Wartburg crest depicts the arrival of the immigrants by sailing vessels; the heraldry of Wartburg castle in Eisenach where Dr Martin Luther translated the bible into German; the 'Luther Rose': and the watchword 'Pray and Work'. These words are also inscribed on the church bell of Kirschdorf, near Wartburg, and reflect the industry of the local community to this day.

2 BACKGROUND INFORMATION OF THE SURVEY

2.1 Methodology

A desktop study was conducted of the archaeological databases housed in the KwaZulu-Natal Museum. The SAHRIS website was consulted. In addition, the available archaeological literature covering the Umgungundlovu District Municipality was also consulted.

A ground survey, following standard and accepted archaeological procedures, was conducted on 12 March 2017.

2.2 Restrictions encountered during the survey

2.2.1 Visibility

Dense mist in the Mvoti River Valley may have compromised site visibility in some areas.

2.2.2 Disturbance

No disturbance of any potential heritage features was noted.

2.3 Details of equipment used in the survey

GPS: Garmin Etrek
Digital cameras: Canon Powershot A460
All readings were taken using the GPS. Accuracy was to a level of 5 m.

3 DESCRIPTION OF SITES AND MATERIAL OBSERVED

3.1 Locational data

Province: KwaZulu-Natal
Municipality: Umgungundlovu District Municipality
Towns: New Hanover, Dalton, Greytown

3.2 Description of the general area surveyed

Although the area is potentially rich in Iron Age and Stone Age sites no heritage sites or features were observed on the footprint. Graves occurred in the eastern section of the greater project area in association with contemporary Zulu homesteads (Figs 5 & 6) but none were observed closer than 50m from the proposed pipeline trajectory. The area is also not part of any known cultural landscape. The absence of any heritage sites on the footprint is most probably also related to the fact that the proposed pipeline development follows the existing road reserve for most of the way.

3.3 Heritage sites identified

None

4 STATEMENT OF SIGNIFICANCE (HERITAGE VALUE)

Not applicable as no heritage sites were identified (Table 2).

Table 2. Evaluation and statement of significance.

Significance criteria in terms of Section 3(3) of the NHRA		
	Significance	**Rating**
1.	**Historic and political significance -** The importance of the cultural heritage in the community or pattern of South Africa's history.	None.
2.	**Scientific significance** – Possession of uncommon, rare or endangered aspects of South Africa's cultural heritage.	None.
3.	**Research/scientific significance** – Potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.	None.
4.	**Scientific significance** – Importance in demonstrating the principal characteristics of a particular class of South Africa's cultural places/objects.	None.
5.	**Aesthetic significance** – Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.	None.
6.	**Scientific significance** – Importance in demonstrating a high degree of creative or technical achievement at a particular period.	None.
7.	**Social significance** – Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.	None
8.	**Historic significance** – Strong or special association with the life and work of a person, group or organization of importance in the history of South Africa.	None.
9.	The significance of the site relating to the history of slavery in South Africa.	None.

4.1 Field Rating

Not applicable as no heritage sites were identified.

Table 3. Field rating and recommended grading of sites (SAHRA 2005)

Level	Details	Action
National (Grade I)	The site is considered to be of National Significance	Nominated to be declared by SAHRA
Provincial (Grade II)	This site is considered to be of Provincial significance	Nominated to be declared by Provincial Heritage Authority
Local Grade IIIA	This site is considered to be of HIGH significance locally	The site should be retained as a heritage site
Local Grade IIIB	This site is considered to be of HIGH significance locally	The site should be mitigated, and part retained as a heritage site
Generally Protected A	High to medium significance	Mitigation necessary before destruction
Generally Protected B	Medium significance	The site needs to be recorded before destruction
Generally Protected C	Low significance	No further recording is required before destruction

5 RECOMMENDATIONS

The proposed pipeline development may proceed from an archaeological point of view as no heritage sites or features are in danger of being destroyed or altered. It should, however, be pointed out that the KwaZulu-Natal Heritage Act requires that operations exposing archaeological and historical residues should cease immediately pending an evaluation by the heritage authorities.

6 MAPS AND FIGURES

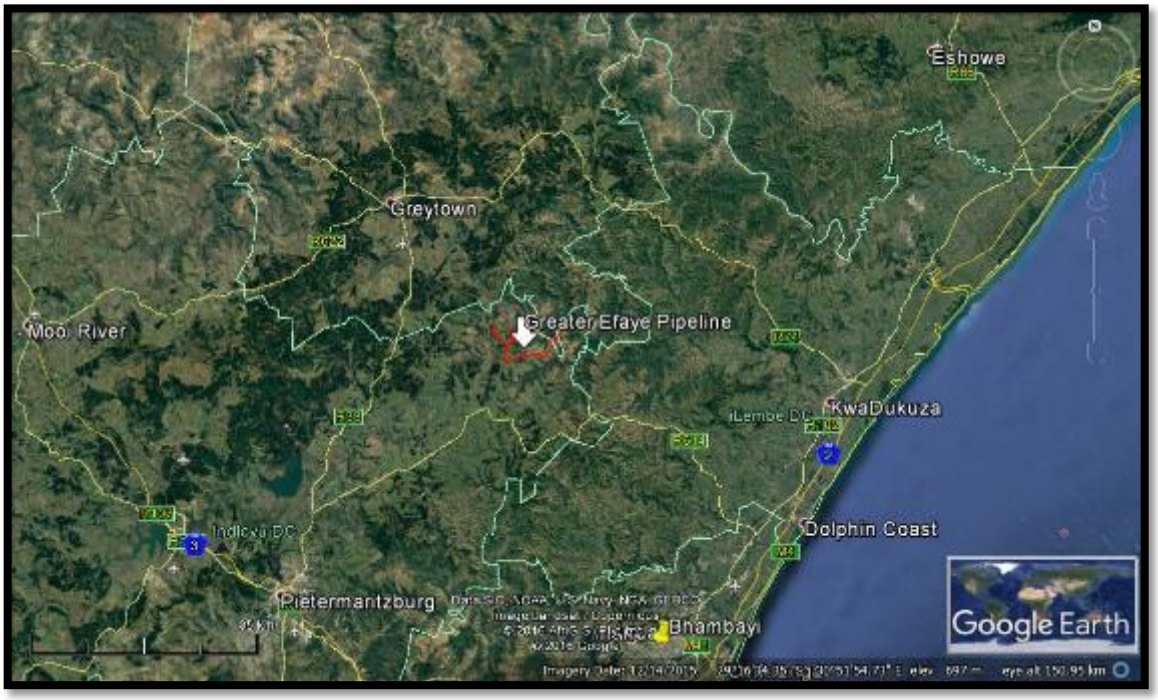

Figure 1. Google Earth aerial imagery showing the locality of the proposed Greater Efaye pipeline development near New Hanover, Umshwathi Local Municipality.

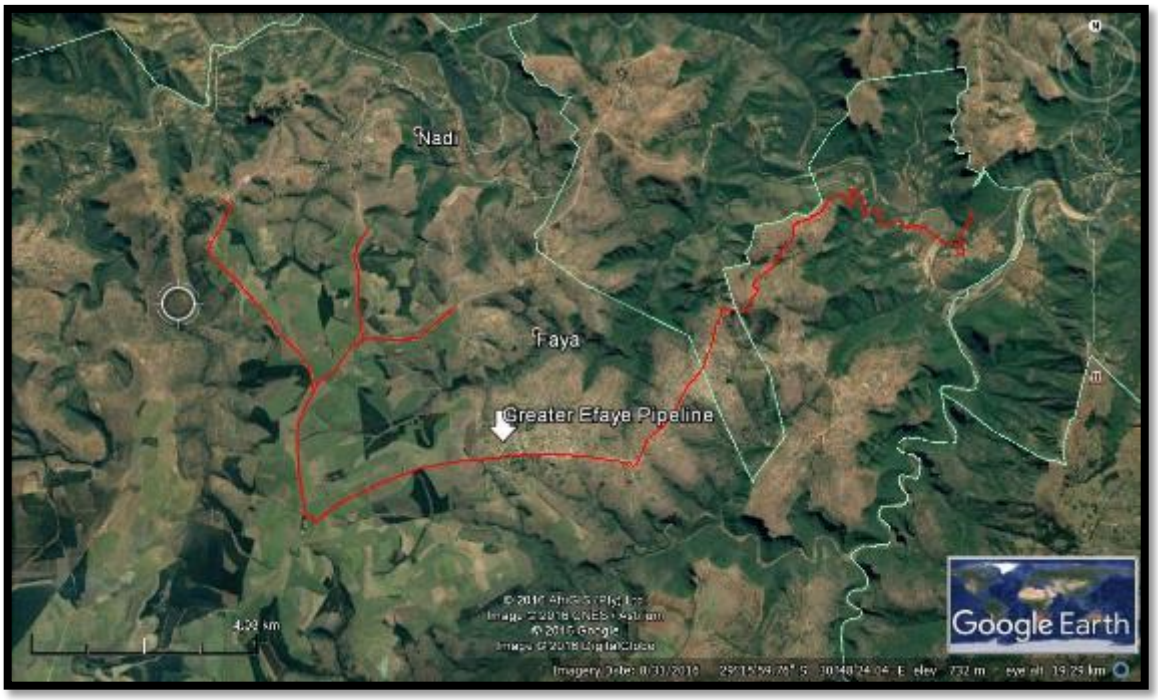

Figure 2. Google Earth aerial imagery showing the length and context of the proposed Greater Efaye Pipeline.

Figure 3. The beginning of the proposed pipeline trajectory in the western section of the study area. The pipeline follows the existing road reserve for most of the way.

Figure 4. Descent into the Mvoti River Valley. No heritage sites occur along the proposed pipeline trajectory.

Figure 5. Although rural homesteads occur along sections of the proposed pipeline trajectory no graves were observed within 50m from the footprint.

Figure 6. Some rural homesteads are situated within the former road reserve but no graves or heritage features occur in these locales.

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