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ENVIRONMENTAL

Proposed Construction of a pipeline for the conveyance of treated water from Tweefontein Wastewater Treatment Plant to Mbali Colliery

Flora and Wetland Specialist Report

Project Number:

HCI4929

Prepared for:

Mbali Coal (Pty) Ltd, a wholly owned subsidiary of HCI Coal (Pty) Ltd

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Project Name:	**Proposed Construction of a pipeline for the conveyance of treated water from Tweefontein Wastewater Treatment Plant to Mbali Colliery**
Project Code:	**HCI4929**

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EXECUTIVE SUMMARY

Digby Wells was commissioned by HCI Coal (Pty) Ltd (HCI Coal) to complete a Flora and Wetland Assessment for the proposed pipeline for the conveyance of treated water from the Tweefontein Water Reclamation Plant to the Mbali Colliery.

The majority of the study area has undergone transformation due to cultivation for maize and soya beans, as well as from existing mining activities and road construction which has resulted in historical disturbance of floral components and soil compaction in some areas. Livestock were also observed throughout most of the study area and evidence of overgrazing was recorded in grassland areas. A total of 42 plant species were recorded on site.

Multiple wetland systems, totalling 211.8 ha, fall within the 500m buffer of the proposed pipeline route. Four HGM Units were identified on site; a large un-channelled valley bottom wetland (HGM Unit 1) that drains into a channelled valley bottom system (HGM Unit 3), a seep (HGM Unit 4) and an isolated depression (HGM Unit 2).

Present Ecological State (PES)

The wetlands within the Project Area exhibit a variety of PES values, ranging from Moderately Modified (Category C) to Largely Modified (Category D).

Two Moderately Modified (Category C) wetlands were identified (HGM units 1 and 2). These wetlands were mainly impacted on by cultivation and/or grazing with few geomorphological impacts.

Two Largely Modified (Category D) wetlands are present in the Project Area (HGM Unit 3 and HGM Unit 4). The Largely Modified category is mainly attributed to habitat transformation and dams as in the case of HGM unit 3.

Ecological Importance and Sensitivity (EIS)

EIS scores for the wetlands ranged from Low (1) to High (2.5). The wetlands present provide High and Low hydrological importance services (ranging between 1 and 2), such as flood attenuation and assimilation of toxicants and nitrates. The Ecological Importance and Sensitivity category is ranging from Low (1) to High (2.5). Due to the largely transformed nature of HGM Unit 4, this wetland provides little habitat for fauna and flora, whilst HGM Units 1, 2 and 3 still have large areas of intact vegetation, where Red Data species were observed. In general, the values are Low for 'Direct Human Benefits' (aside from the channelled valley bottom) due to restricted access by the mine. Some agriculture does occur, however this is minimal when compared to the size of the HGM units.

Flora Sensitivity

Due to the transformed nature of most of the habitat types and the fact that the pipeline is placed in the road servitude, the sensitivities are not high. The cultivated fields, alien clumps, and disturbed areas are demarcated as low sensitivity within HGM Units 1, 3 and 4, while HGM Unit 2 is characterised as medium sensitivity.

Impact Assessment for proposed pipeline

The Project area (comprising the pipeline route and 500m buffer) affects four wetland HGM units of varying degrees of ecological integrity and flora habitats of medium and low sensitivities. The proposed project has the potential to result in a number impacts to the wetland and flora ecology of the proposed pipeline including, but not limited to:

- Minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with construction, pipeline maintenance and decommissioning activities;
- Compaction of soils;
- Potential loss of natural vegetation;
- Increased potential for alien invasive vegetation; and
- Increased potential for erosion and sedimentation.

Summary and Ecological Opinion

Based on the findings of the baseline and sensitivity mapping assessment, as well as that of the impact assessment, a number of impacts were identified in relation to the wetland systems and floral habitats present. These impacts are deemed minor and negligible with the implementation of the proposed management and mitigation measures as the pipeline is proposed to run within the existing road servitude. Further impacts to the ecology of the wetlands and flora are thus deemed likely to be negligible with strict environmental management and mitigation measures in place.

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GLOSSARY OF TERMS

Alien invasive vegetation	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome - usually international in origin.
Basal cover	The cross-sectional area of the plant that extends into the soil.
Base flow	Long-term flow in a river that continues after storm flow has passed.
Biodiversity	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Catchment	The area contributing to runoff at a particular point in a river feature.

Ecoregion	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Groundwater	Subsurface water in the saturated zone below the water table.
Intermittent flow	Flows only for short periods.
Indigenous vegetation	Vegetation occurring naturally within a defined area.
Perennial	Flows all year round.
Wetland	Defined according to the National Water Act, 1998 (Act No. 36 of 1998) (NWA) as: *"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."*

LIST OF ACRONYMS

AIP	Alien Invasive Plants
BRP	Bioregional Plan
CBA	Critical Biodiversity Areas
CMA	Catchment Management Agencies
DMR	Department of Mineral Resources
DWA	Department of Water Affairs (currently the Department of Water and Sanitation)
DWAF	Department of Water and Forestry (currently the Department of Water and Sanitation)
DWE	Digby Wells Environmental
DWS	Department of Water and Sanitation
EC	Ecological Class
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMF	Environmental Management Framework
EMO	Environmental Management Officer
ESA	Ecological Support Area
F	Facultative species
FD	Facultative dry-land species

FW	Facultative wetland species
GIS	Geographical Information System
Ha	Hectares
HGM	Hydro-geomorphic
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MRA	Mining Right Area
NEM:BA	National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFEPA	National Freshwater Ecosystems Priority Areas
NWA	National Water Act, 1998 (Act No. 36 of 1998)
ONA	Other Natural Area
OW	Obligate wetland species
PA	Protected Area
PES	Present Ecological State
REC	Recommended Ecological Category
RQIS	Resource Quality Information Services
SANBI	South African National Biodiversity Institute
SFI	Soil Form Indicator
SWI	Soil Wetness Indictor
TUI	Terrain Unit Indicator
WMA	Water Management Areas
WRC	Water Research Commission
WUL	Water Use Licence

1 Introduction

The Mbali Colliery is owned and operated by Mbali Coal, a wholly owned subsidiary of HCI Coal (Pty) Ltd (HCI Coal) and is situated approximately 10 km south of the town Ogies adjacent to the Ogies – Bethal Road in the Mpumalanga Province. The Mbali colliery is located on portions 16, 17, 20, 31 and the Remaining Extent (RE) of portion 9 of the farm Klippoortjie 32 IS.

The Mbali Colliery Mining Right (Reference No. MP 30/5/1/2/2 228 MR) was granted by the Department of Mineral Resources (DMR) in June 2008 and is valid until 25 June 2018. HCI Coal intends to apply for extension of validity of the Mining Right in due course and are investigating the option of continuing operations of their washing plant at Mbali through toll-washing agreements, after the Mbali reserves have been depleted.

Mbali Colliery began operating in October 2013 with an extraction rate of 150 000 tonnes per month. The coal is mined from the number 4 and 5 seams using standard opencast mining methods. Run-of-Mine (RoM) coal is extracted through truck and shovels methods and hauled to the coal washing plant located on the mine. The washed coal is stockpiled on site and then it is transported by road to the local market for metallurgical purposes, and/ or Eskom Power Stations for power generation. The total estimated ROM tonnage is 1 800 000 tonnes per year.

The coal washing plant obtains water through the pumping of water from its open pits and Pollution Control Dam (PCD). The colliery is currently experiencing water shortages due to regional drought and requires an additional source of process water to continue operating its washing plant. Therefore Mbali Colliery is proposing to source water from the Tweefontein Water Reclamation Plant at Goedgevonden Mine (GGV). Operational Management of Tweefontein Water Reclamation Plant at has been contracted to Glencore Operations South Africa (Pty) Ltd (Glencore).

The GGV Mine is situated approximately 3 km north of the Mbali Colliery. Glencore has agreed, in principle to supply water to the Mbali Colliery from the Tweefontein Water Reclamation Plant which is currently being discharged to the environment in accordance with their Water Use License (WUL). To facilitate the water supply, HCI Coal will have to construct (and licence) a pipeline for the conveyance of treated water from the Tweefontein Water Reclamation Plant to the Mbali Colliery.

The design capacity of the pipeline will be 2 Mℓ/day (2,000 m^3 per day at around 30 ℓ/s). The pipeline diameter will be around 250 mm (0.25 m) and the length is approximately 3.6 km. The proposed pipeline route is along the existing R545 Road and existing Mbali Colliery access road, crossing the Klippoortjiespruit just south of GGV.

It is proposed that once Mbali Colliery reaches LOM it will source coal from other operations and process coal in the existing plant at the Mbali Colliery. Therefore, the pipeline and coal washing plant will remain in operation even after ceasing mining operation activities and the mining area is rehabilitated.

Activities that are listed in terms of the Environmental Impact Assessment (EIA) Regulations[1] require environmental authorisation prior to commencing. The proposed pipeline as described above constitutes Listed Activities in terms of GN R 983 (Listing Notice 1) and GN R 985 (Listing Notice 3) as amended.

This specialist Flora and Wetlands Report has been compiled in terms of Appendix 6 of the NEMA EIA Regulations (as amended) in terms of the Basic Assessment process which is being followed in applying for Environmental Authorisation.

The requirements of Appendix 6 are presented in Table 1-1 and cross-referenced to the relevant sections of this Report.

Table 1-1: Structure of this report in accordance with the EIA Regulations

Regulatory Requirement for EIA Reports	Relevant Section of this report
1. (1) A specialist report prepared in terms of these Regulations must contain -	
(a) details of— (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Please refer to Section 2 and Appendix A of this Report
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Please refer to Section 2 of this report: Details of the Specialist
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Please see Section 3: Scope and Purpose of this Report
(c) an indication of the quality and age of base data used for the specialist report;	Please see Section 6
(c) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Please see Section 6: Existing Environment
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Please see Section 4.
(e) a description of the methodology adopted in preparing the report inclusive of equipment and modelling used;	Please see Section 5: Methodology
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site	Please see Section 6.1.4

[1] As published in Government Notices R982; 983; 984 and 985 on 4 December 2014, as Amended 7 April 2017.

alternatives;	
(g) an identification of any areas to be avoided, including buffers;	Please see Section 6.1.4
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Please see Section 6.1.4
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Please see Section 7: Assumptions, Limitations and Gaps in knowledge
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Please see Section 8: Impact Assessment
(k) any mitigation measures for inclusion in the EMPr;	Please see Section 9: Mitigation and Management Measures
(l) any conditions for inclusion in the environmental authorisation;	
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Please see Section 10: Monitoring Requirements
(n) a reasoned opinion— (i) whether the proposed activity, activities or portions thereof should be authorised; (i) (A) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Please see Section 12: Reasoned opinion of the specialist
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Please see Section 11
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q) any other information requested by the competent authority.	No additional information was requested.

2 Details of the Specialist

This Specialist Report has been compiled by the following specialists (CVs of the Project Team are included in Appendix A):

Table 2-1: Details of the Specialist(s) who prepared this Report

Responsibility	**Fieldwork, report writing and review**
Full Name of Specialist	Kieren Jayne Bremner
Highest Qualification	M.Sc Aquatic Health
Years of experience in specialist field	10
Responsibility	**Fieldwork and report writing**
Full Name of Specialist	Kathryn Roy
Highest Qualification	M.Sc Restoration Ecology
Years of experience in specialist field	2

2.1 Declaration of the Specialist

I **Kieren Bremner,** as the appointed specialist, hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

- in terms of the general requirement to be independent:
  - other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; ~~or~~
  - ~~am not independent, but another specialist that meets the general requirements set out in Regulation 13 have been appointed to review my work (Note: a declaration by the review specialist must be submitted);~~
- in terms of the remainder of the general requirements for a specialist, am fully aware of and meet all of the requirements and that failure to comply with any the requirements may result in disqualification;
- have disclosed/will disclose, to the applicant, the Department and interested and affected parties, all material information that have or may have the potential to

influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application;

- have ensured/will ensure that information containing all relevant facts in respect of the application was/will be distributed or was/will be made available to interested and affected parties and the public and that participation by interested and affected parties was/will be facilitated in such a manner that all interested and affected parties were/will be provided with a reasonable opportunity to participate and to provide comments;
- have ensured/will ensure that the comments of all interested and affected parties were/will be considered, recorded and submitted to the Department in respect of the application;
- have ensured/will ensure the inclusion of inputs and recommendations from the specialist reports in respect of the application, where relevant;
- have kept/will keep a register of all interested and affected parties that participate/d in the public participation process; and
- am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.

Signature of the specialist:

Kieren Jayne Bremner

Full Name and Surname of the specialist:

Digby Wells Environmental

Name of company:

12-01-2018

Date:

3 Scope and Purpose of this Report

Digby Wells was commissioned by HCI Coal to complete a Flora and Wetland Assessment for the proposed pipeline for the conveyance of treated water from the Tweefontein Water Reclamation Plant to the Mbali Colliery .The following actions are required for this Scope of Work:

- The identification and the delineation of wetlands within 500m of the proposed pipeline;
- A description and characterisation of the identified wetland areas;
- Determination of the wetland ecological health, importance and sensitivity;
- A floral assessment of the wetland vegetation present;
- Assessment of potential impacts to the wetlands from the activities; and
- Discussion of recommended mitigation measures to be taken into account.

4 Details of the site visit

The wet season survey took place on the 5th of December 2017. The survey was limited to one day. A wet season was preferred for plant identification purposes as this is when the majority of plant species flower in the region. A 500m study area on each side of the proposed pipeline was investigated. The locality can be seen in Figure 4-1.

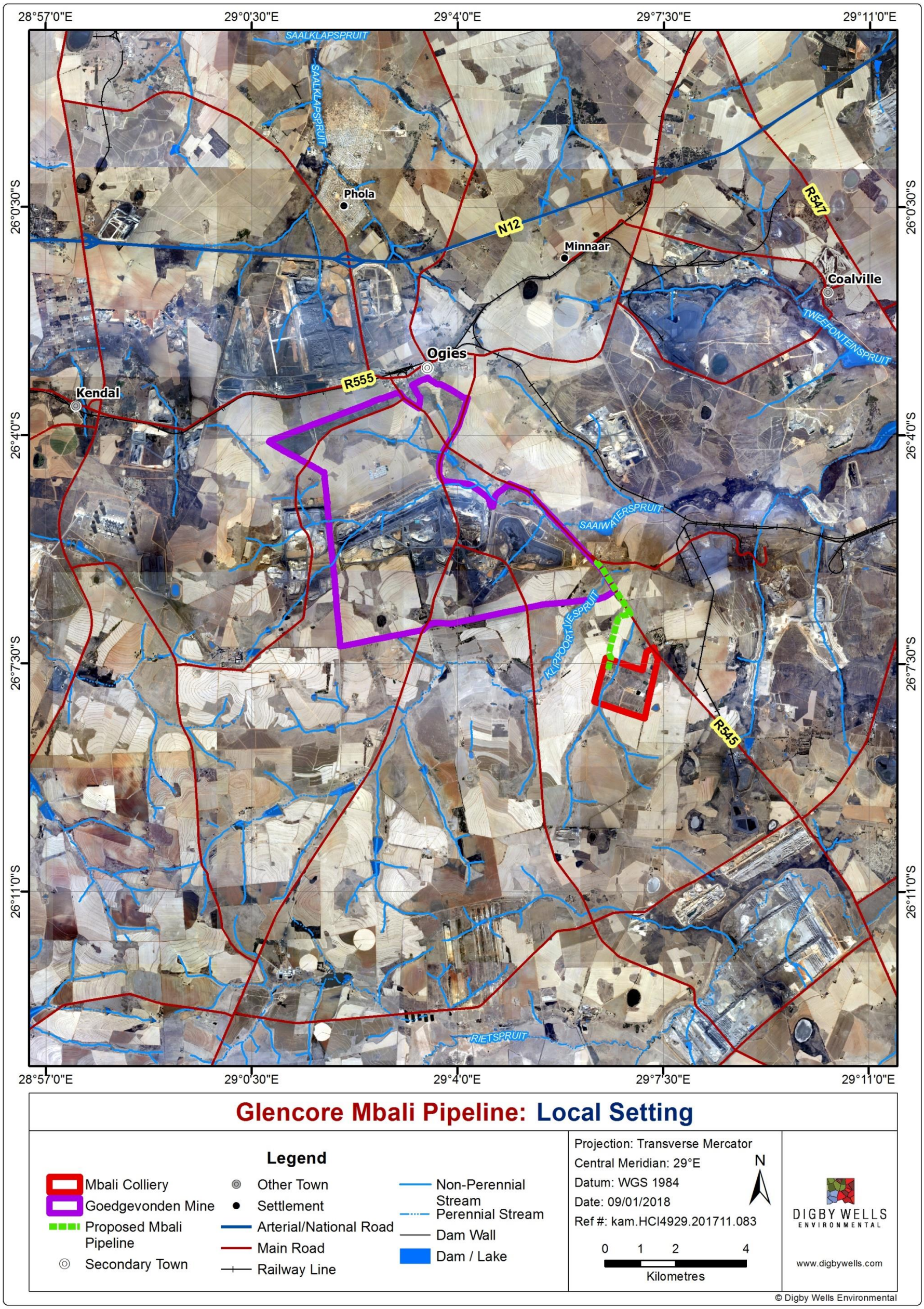

Figure 4-1: Locality

5 Methodology

5.1 Flora

5.1.1 Literature Review and Desktop Assessment

As the sampling of the entire study area is not possible, representative samples of the vegetation were assessed. Aerial imagery was utilized to identify and stratify homogenous vegetation units.

5.1.2 Assessment

An extensive transect was walked through each habitat type. Vegetation was classified and the broad plant communities identified during the classification were then mapped to show their distribution. Species lists were compiled for each broad habitat type.

5.1.3 Species of Special Concern

From the overall species list, a list of Species of Conservation Concern (SSC) was compiled. A comprehensive SSC species list was compiled taking the following Red Data lists into consideration:

- International Union for the Conservation of Nature (IUCN) Red Data list (2015);
- The South African National Biodiversity Institute (SANBI) Red Data list version 2015.1;
- The National Environmental Biodiversity Act (NEMBA), 2004 (Act 10 of 2004); and
- The Convention on International Trade in Endangered Species of Flora and Fauna (CITES) list (2016).

An initial list of SSC expected to be found within the study area comprises PSSC (Possible Species of Special Concern). If any of these (and any additional species on the above lists) are recorded on site, they are ascribed the status Confirmed Species of Special Concern (CSSC).

The South African Red Data list uses the same criteria as that defined by the IUCN. According to the IUCN all species are classified in nine groups, set through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation (IUCN, 2010). The categories are described in Table 5-1 below.

Table 5-1: Red Data Categories (taken from SANBI 2012)

CATEGORY		DESCRIPTION
Extinct	(EX)	No known individuals remaining.
Extinct in the Wild	(EW)	Known only to survive in captivity.
Critically Endangered	(CR)	Extremely high risk of extinction in the wild.
Endangered	(EN)	High risk of extinction in the wild
Vulnerable	(VU)	High risk of endangerment in the wild.
Near Threatened	(NT)	Likely to become endangered in the near future.
Least Concern	(LC)	Lowest risk. Does not qualify for a more at risk category. Widespread and abundant taxa are included in this category.
Data Deficient	(DD)	Not enough data to make an assessment of its risk of extinction.
Not Evaluated	(NE)	Has not yet been evaluated against the criteria.
	Extinct	**Threatened species** are species that are facing a high risk of extinction. Any species classified in the IUCN categories **CR, EN** or **VU** is a threatened species. **Species of conservation concern** are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories**, NT, LC** and **DD**
	Threatened	
	Other categories of conservation concern	
	Other categories	

The online IUCN data base was referenced in order to identify Red Data species and their various threat status categorisations.

5.2 Wetlands

5.2.1 Literature Review and Desktop Assessment

For the purposes of this Project, wetland areas were identified and preliminary wetland boundaries were delineated at the desktop level using detailed aerial imagery (Southern Mapping, 2015) along with 5m contours. Baseline and background information was researched and used to understand the area on a desktop level prior to fieldwork; this included but was not limited to:

- NFEPA (Nel *et al*., 2011);
- Mining and Biodiversity Guidelines;
- Water Management Areas (WMA) and Quaternary Catchments; and
- Mpumalanga Biodiversity Sector Plan.

5.2.2 National Freshwater Ecosystem Priority Areas

The NFEPA project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel *et al.* 2011). The spatial layers (FEPA's) include the nationally delineated wetland areas that are classified into hydrogeomorphic (HGM) NFEPA project types and ranked in terms of their biodiversity importance. These layers were assessed to evaluate the importance of the wetland areas located within the Project area.

Whilst being an invaluable tool, it is important to note that the NFEPA's were delineated and studied at a desktop and low resolution level. Thus, the wetlands delineated via the ground-truthing work done through this study may differ from the NFEPA data layers. The NFEPA assessment does, however, hold significance from a national perspective. As mentioned above, the NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity and Table 5-2 below indicates the criteria considered.

Table 5-2: NFEPA Wetland Classification Ranking Criteria

Criteria	Rank
Wetlands that intersect with a RAMSAR site.	1
▪ Wetlands within 500 m of an IUCN threatened frog point locality; ▪ Wetlands within 500 m of a threatened water-bird point locality; ▪ Wetlands (excluding dams) with the majority of their area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes; ▪ Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented; and ▪ Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented.	3
Wetlands (excluding dams) in A or B condition (PES) AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition (PES) AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion).	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing Impacted Working for Wetland sites.	5
Any other wetland (excluding dams).	6

5.2.3 Mining and Biodiversity Guideline

The Mining and Biodiversity Guideline was developed collaboratively by the South African Biodiversity Institute (SANBI), the Department of Environmental Affairs (DEA), the Department of Mineral Resources (DMR), the Chamber of Mines and the South African Mining and Biodiversity Forum in 2013. The purpose of the guideline was to provide the mining sector with a manual to integrate biodiversity into the planning process thereby encouraging informed decision-making around mining development and environmental authorisations. The aim of the guideline is to explain the value for mining companies to consider biodiversity management throughout the planning process. The guideline highlights the importance of biodiversity in managing the social, economic and environmental risk of the proposed mining project. The country has been mapped into biodiversity priority areas including the four categories listed in Table 5-3 below, each with associated risks and implications.

Table 5-3: Mining and Biodiversity Guideline Categories (SANBI, 2013)

Category	Risk and Implications for Mining
Legally protected	Mining prohibited; unless authorised by ministers of both the DEA and DMR.
Highest Biodiversity Importance	Highest Risk for Mining: the EIA process must confirm significance of the biodiversity features that may be seen as a fatal flaw to the proposed project. Specialists must provide site-specific recommendations for the application of the mitigation hierarchy that informs the decision making processes of mining licences, water use licences and environmental authorisations. If granted, authorisations should set limits on allowed activities and specify biodiversity related management outcomes.
High Biodiversity Importance	High Risk for Mining: the EIA process must confirm the significance of the biodiversity features for the conservation of biodiversity priority areas. Significance of impacts must be discussed as mining options are possible but must be limited. Authorisations may set limits and specify biodiversity related management outcomes.
Moderate Biodiversity Importance	Moderate Risk for Mining: the EIA process must confirm the significance of the biodiversity features and the potential impacts as mining options must be limited but are possible. Authorisations may set limits and specify biodiversity related management outcomes.

5.2.4 Mpumalanga Biodiversity Sector Plan

The Mpumalanga Biodiversity Sector Plan (MBSP) is a spatial tool that forms part of the national biodiversity planning tools and initiatives that are provided for in national legislation and policy. The MBSP was published in 2014 by the Mpumalanga Tourism and Parks Agency (MTPA) and comprises a set of maps of biodiversity priority areas accompanied by contextual information and land-use guidelines for use in land-use and development planning, environmental assessment and regulation, and natural resource management. Strategically the MBSP enables the province to:

- Implement the NEM:BA, 2004 provincially, and comply with requirements of the National Biodiversity Framework, 2009 (NBF) and certain international conventions;
- Identify those areas of highest biodiversity that need to be considered in provincial planning initiatives, and
- Address threat of climate change (ecosystem-based adaptation).

The publication includes terrestrial and freshwater biodiversity areas that are mapped and classified in Protected Areas (PAs), Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs) or Other Natural Areas (ONAs). Wetlands in Mpumalanga Province have been extensively degraded and, in many cases, irreversibly modified and lost through a combination of inappropriate land-use practices, development and mining. Wetlands represent ecosystems of high value for delivering, managing and storing good quality water for human use, and they are vulnerable to harmful impacts. It is therefore in the interest of national water security that all wetlands are protected by law. The management objectives of these areas are summarised below.

Table 5-4: Mpumalanga Biodiversity Sector Plan Categories

Map category	Definition	Desired management objectives
PA	Those areas that are proclaimed as protected areas under national or provincial legislation, including gazetted protected environments.	Areas that are meeting biodiversity targets and therefore must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity.
CBAs	Areas that are required to meet biodiversity targets, for species, ecosystems or ecological processes. CBA Wetlands are those that have been identified as FEPA wetlands that are important for meeting biodiversity targets for freshwater ecosystems.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.
ESAs	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas or CBAs and for delivering ecosystem services. ESA Wetlands are those that are non-FEPA and ESA Wetland Clusters are clusters of wetlands embedded within a largely natural landscape that function as a unit, and allow for the migration of species such as frogs and insects between individual wetlands.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorisation process that ensures the underlying biodiversity objectives are not compromised.
ONAs	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.	An overall management objective should be to minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. These areas offer the greatest flexibility in terms of management objectives and permissible land-uses, but some authorisation may still be required for high-impact land-uses.

Map category	Definition	Desired management objectives
Heavily or Moderately Modified Areas	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritised for conservation action.	Such areas offer the most flexibility regarding potential land-uses, but these should be managed in a biodiversity-sensitive manner, aiming to maximise ecological functionality and authorisation is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilised and restored where possible, especially for soil carbon and water-related functionality.

5.2.5 Wetland Identification, Delineation and Classification

The wetland delineation procedure considers four attributes to determine the limitations of the wetland, in accordance with DWAF guidelines (now Department of Water and Sanitation (DWS) (2005)). The four attributes are:

- Terrain Unit Indicator – helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator – identifies the soil forms, which are associated with prolonged and frequent saturation;
- Soil Wetness Indicator – identifies the morphological “signatures” developed in the soil profile as a result of prolonged and frequent saturation; and
- Vegetation Indicator – identifies hydrophilic vegetation associated with frequently saturated soils.

5.2.6 Terrain Indicator

Terrain Unit Indicator (TUI) areas include depressions and channels where water would be most likely to accumulate. These areas are determined with the aid of topographical maps, aerial photographs and engineering and town planning diagrams (DWAF, 2005). The Hydro-geomorphic HGM Unit system of classification focuses on the hydro-geomorphic setting of wetlands which incorporates geomorphology; water movement into, through and out of the wetland; and landscape / topographic setting. Once wetlands have been identified, they are categorised into HGM Units as shown in Table 5-5.

Table 5-5: Description of the various HGM Units for Wetland Classification

Hydromorphic wetland type	Diagram	Description
Floodplain		Valley bottom areas with a well-defined stream channel, gently sloped and characterised by floodplain features such as oxbow depression and natural levees and the alluvial (by water) transport and deposition of sediment , usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom with a channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from the channel entering the wetland and also from adjacent slopes.
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterised by colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.
Isolated hillslope seepage		Slopes on hillsides that are characterised by colluvial transport (transported by gravity) movement of materials. Water inputs are from sub-surface flow and outflow either very limited or through diffuse sub-surface flow but with no direct link to a surface water channel.
Pan/Depression		A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. It is inward draining). It may also receive subsurface water. An outlet is usually absent and so this type of wetland is usually isolated from the stream network.

5.2.7 Soil Form Indicator

Hydromorphic soils are taken into account for the Soil Form Indicator (SFI) which will display unique characteristics resulting from prolonged and repeated water saturation (DWAF, 2005). The continued saturation of the soils results in the soils becoming anaerobic and thus resulting in a change of the chemical characteristics of the soil. Iron and manganese are two

soil components which are insoluble under aerobic conditions and become soluble when the soil becomes anaerobic and thus begin to leach out into the soil profile. Iron is one of the most abundant elements in soils and is responsible for the red and brown colours of many soils.

Resulting from the prolonged anaerobic conditions, iron is dissolved out of the soil, and the soil matrix is left a greying, greenish or bluish colour, and is said to be “gleyed”. Common in wetlands which are seasonally or temporarily saturated is a fluctuating water table, these results in alternation between aerobic and anaerobic conditions in the soil (DWAF, 2005). Iron will return to an insoluble state in aerobic conditions which will result in deposits in the form of patches or mottles within the soil. Recurrence of this cycle of wetting and drying over many decades concentrates these insoluble iron compounds. Thus, soil that is gleyed and has many mottles may be interpreted as indicating a zone that is seasonally or temporarily saturated (DWAF, 2005).

5.2.8 Soil Wetness Indicator

In practice, the Soil Wetness Indictor (SWI) is used as the primary indicator (DWAF, 2005). Hydromorphic soils are often identified by the colours of various soil components. The frequency and duration of the soil saturation periods strongly influences the colours of these components. Grey colours become more prominent in the soil matrix the higher the duration and frequency of saturation in a soil profile (DWAF, 2005). A feature of hydromorphic soils are coloured mottles which are usually absent in permanently saturated soils and are most prominent in seasonally saturated soils, and are less abundant in temporarily saturated soils (DWAF, 2005). The hydromorphic soils must display signs of wetness within 50cm of the soil surface, as this is necessary to support hydrophytic vegetation.

5.2.9 Vegetation Indicator

As one moves along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas plant communities undergo distinct changes in species composition. Valuable information for determining the wetland boundary and wetness zone is derived from the change in species composition. A supplementary method for employing vegetation as an indicator is to use the broad classification of the wetland plants according to their occurrence in the wetlands and wetness zones (Kotze and Marneweck, 1999; DWAF, 2005). This is summarised in Table 5-6 below. When using vegetation indicators for delineation, emphasis is placed on the group of species that dominate the plant community, rather than on individual indicator species (DWAF, 2005). Areas where soils are a poor indicator (black clay, vertic soils), vegetation (as well as topographical setting) is relied on to a greater extent and the use of the wetland species classification as per Table 5-6 becomes more important. If vegetation was to be used as a primary indicator, undisturbed conditions and expert knowledge are required (DWAF, 2005). Due to this uncertainty, greater emphasis is often placed on the SWI to delineate wetland areas. In this assessment, where possible, the SWI has been relied upon to delineate wetland areas due to the high level of anthropogenic impacts characterising the wetlands and freshwater resources of the general

area. The identification of indicator vegetation species and the use of plant community structures have been used to validate these boundaries.

Table 5-6: Classification of Plant Species According to Occurrence in Wetlands (DWAF, 2005)

Type	Description
Obligate Wetland species (OW)	Almost always grow in wetlands: >99% of occurrences.
Facultative Wetland species (FW)	Usually grow in wetlands but occasionally are found in non-wetland areas: 67 – 99 % of occurrences.
Facultative species (F)	Are equally likely to grow in wetlands and non-wetland areas: 34 – 66% of occurrences.
Facultative dry-land species (FD)	Usually grow in non-wetland areas but sometimes grow in wetlands: 1 – 34% of occurrences.

5.2.10 Wetland Ecological Health Assessment (WET-Health)

According to Macfarlane *et al*. (2009) the health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. A level 1 WET-Health assessment was done on the wetlands in accordance with the method described by Kotze *et al.* (2007) to determine the integrity (health) of the characterised HGM units for the Project area. A Present Ecological State (PES) analysis was conducted to establish baseline integrity (health) for the associated wetlands. The health assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules to attempt to estimate similarity to or deviation from natural conditions.

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described above.

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 State score. This takes the form of assessing the spatial *extent* of the impact of individual activities and then separately assessing the *intensity* of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall *magnitude* of impact. The impact scores and Present State categories are provided in Table 5-7.

Table 5-7: Impact Scores and Present Ecological State Categories used by WET-Health

Impact Category	Description	Combined Impact Score	PES Category
None	Unmodified, natural.	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota has taken place.	1-1.9	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.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable.	6-7.9	E
Critical	Modifications have reached a critical level and ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (Table 5-8).

Table 5-8: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓

Change Class	Description	HGM change score	Symbol
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

5.2.11 Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) tool was derived to assess the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term. The methodology outlined by DWAF (1999) and updated in Rountree and Kotze, (2012), in Rountree *et al.* (2012) was used for this study.

In this method there are three suites of importance criteria; namely:

- **Ecological Importance and Sensitivity:** incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWS and thus enabling consistent assessment approaches across water resource types;
- **Hydro-functional Importance:** which considers water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- **Importance in terms of Basic Human Benefits:** this suite of criteria considers the subsistence uses and cultural benefits of the wetland system.

These determinants are assessed for the wetlands on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. It is recommended that the highest of these three suites of scores be used to determine the overall Importance and Sensitivity category of the wetland system, as defined in Table 5-9.

Table 5-9: Interpretation of Overall EIS Scores for Biotic and Habitat Determinants

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

5.3 Determining the Baseline Environment

5.3.1 Drainage and Quaternary Catchment

The water resources of South Africa are divided into quaternary catchments, which are regarded as the principal water management units in the country (DWAF 2011). A quaternary catchment is a fourth order catchment in a hierarchical classification system in which the primary catchments are the major units. The primary drainages are further grouped into or fall under Water Management Areas (WMA) and Catchment Management Agencies (CMA). The Department of Water and Sanitation (DWS) has established nine WMAs and nine CMAs as contained in the National Water Resource Strategy 2 (2013) in terms of Section 5 subsection 5(1) of the National Water Act, 1998 (Act No. 36 of 1998). The establishment of these WMAs and CMAs is to improve water governance in different regions

of the country, to ensure a fair and equal distribution of the Nations water resources, while making sure that the resource quality is sustained.

Figure 5-1 indicates the water resource management classification associated with the Project area. The Project area falls within the Olifants River Catchment (WMA2), and it is associated with primary drainage B. The quaternary catchment is B11F.

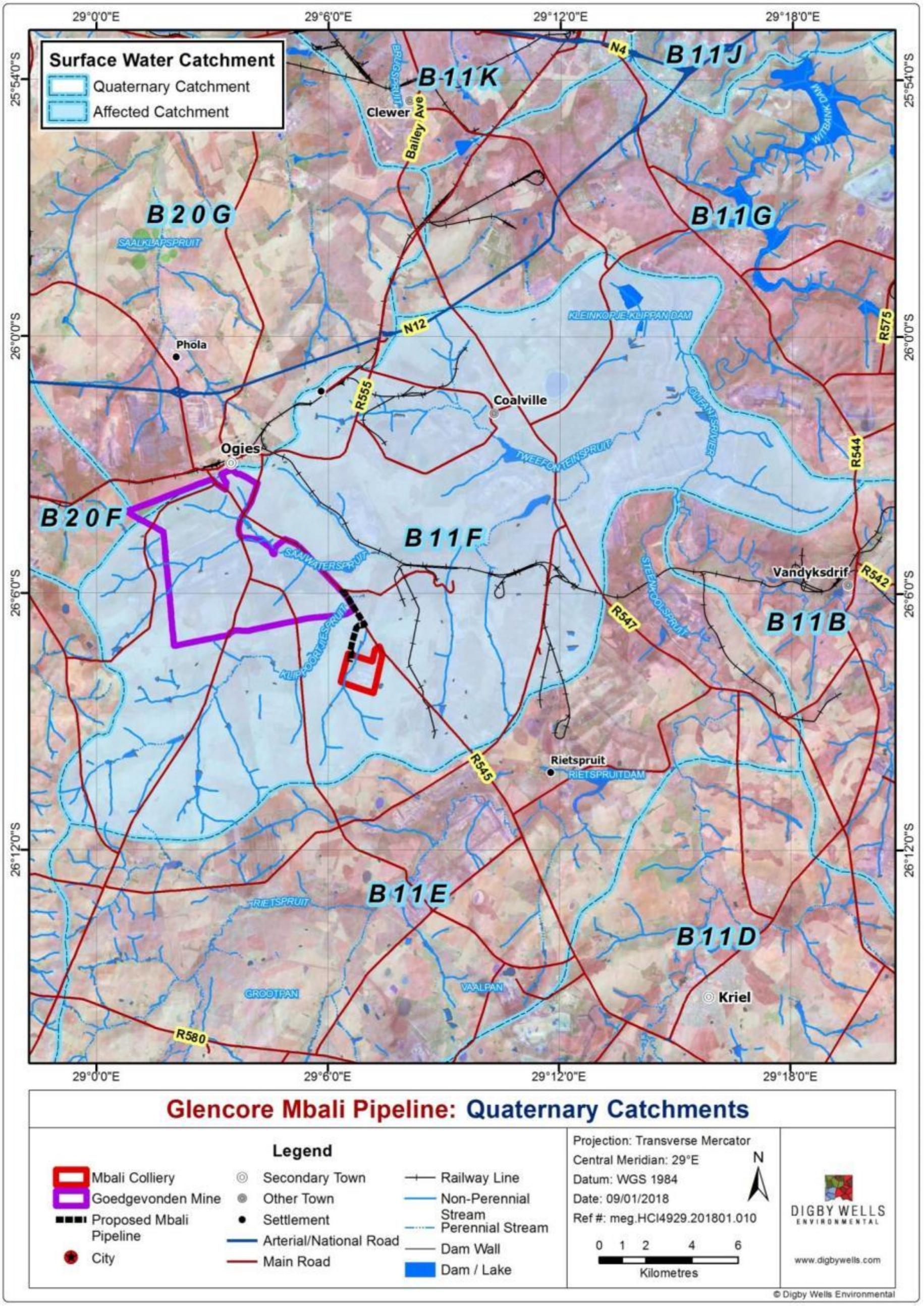

Figure 5-1: Quaternary Catchments

5.3.2 National Freshwater Ecosystem Priority Areas (NFEPA)

The NFEPA project provides information of wetland and river ecosystems for integrating into freshwater ecosystem and biodiversity planning and decision-making processes. The assessor considered the strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources contained therein to evaluate the importance of the wetland areas (Nel *et al.* 2011). Figure 5-2 demonstrates the distribution of NFEPA wetlands within the Project area. The wetland types that dominate the landscape are Valley Floor wetlands.

The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. The Project wetlands are mostly of Rank 2, 5 and 6. Rank 2 wetlands are important wetlands that fall within 500 m of an IUCN threatened frog point locality or threatened water-bird point locality. Alternatively they fall mostly within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes or has been identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented or as containing wetlands that are good, intact examples from which to choose.

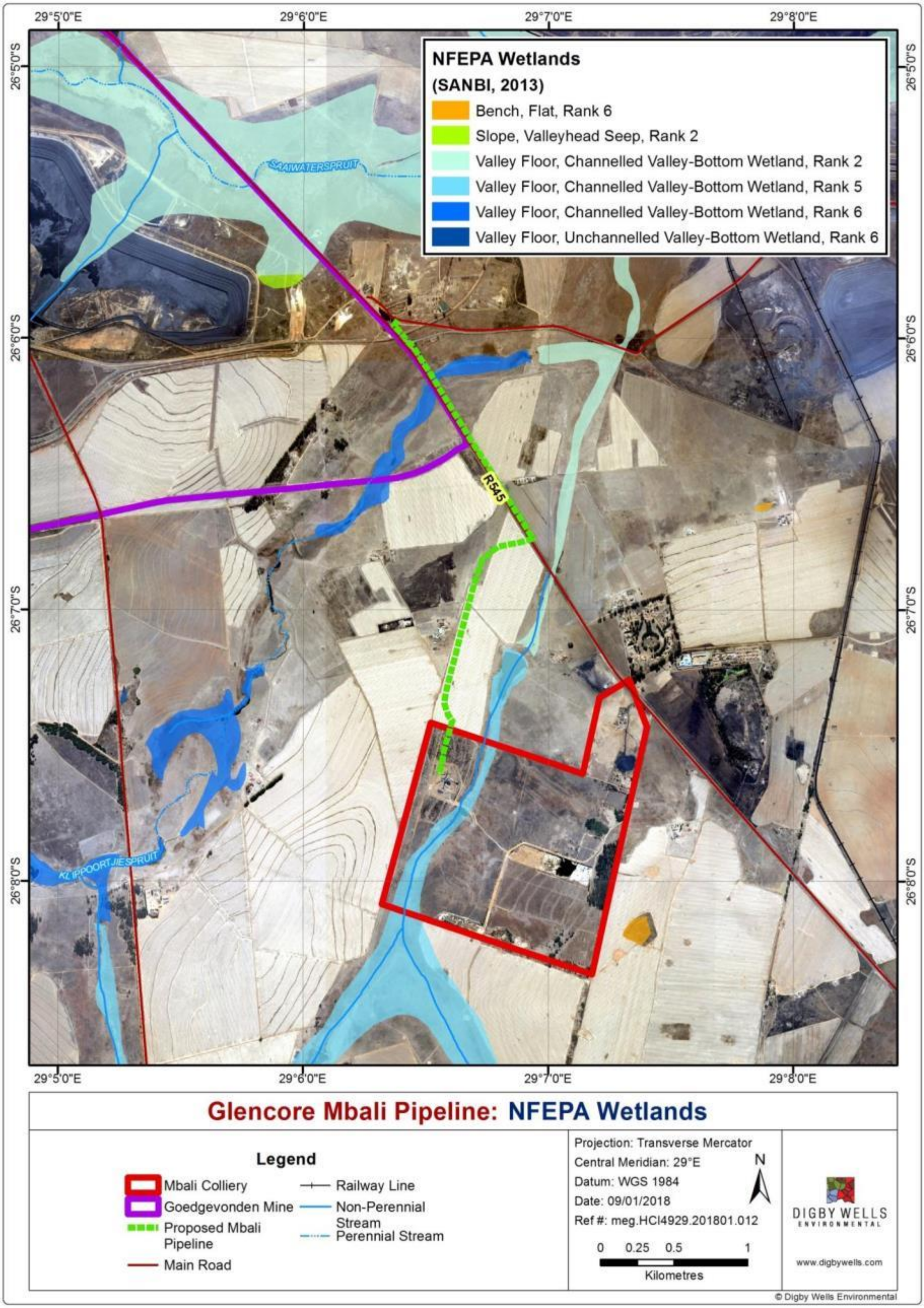

Figure 5-2: NFEPA Wetlands

5.3.3 Mining and Biodiversity Guidelines

The Mining and Biodiversity Guideline (2013) can be seen as a cumulative finding of all available biodiversity and ecological related information with a final mapped area. The assessment looks at NFEPA and regional biodiversity plans such as the MBSP. This is shown in Figure 5-3 below.

The entire proposed pipeline route is designated as ‘Highest Risk for Mining’.

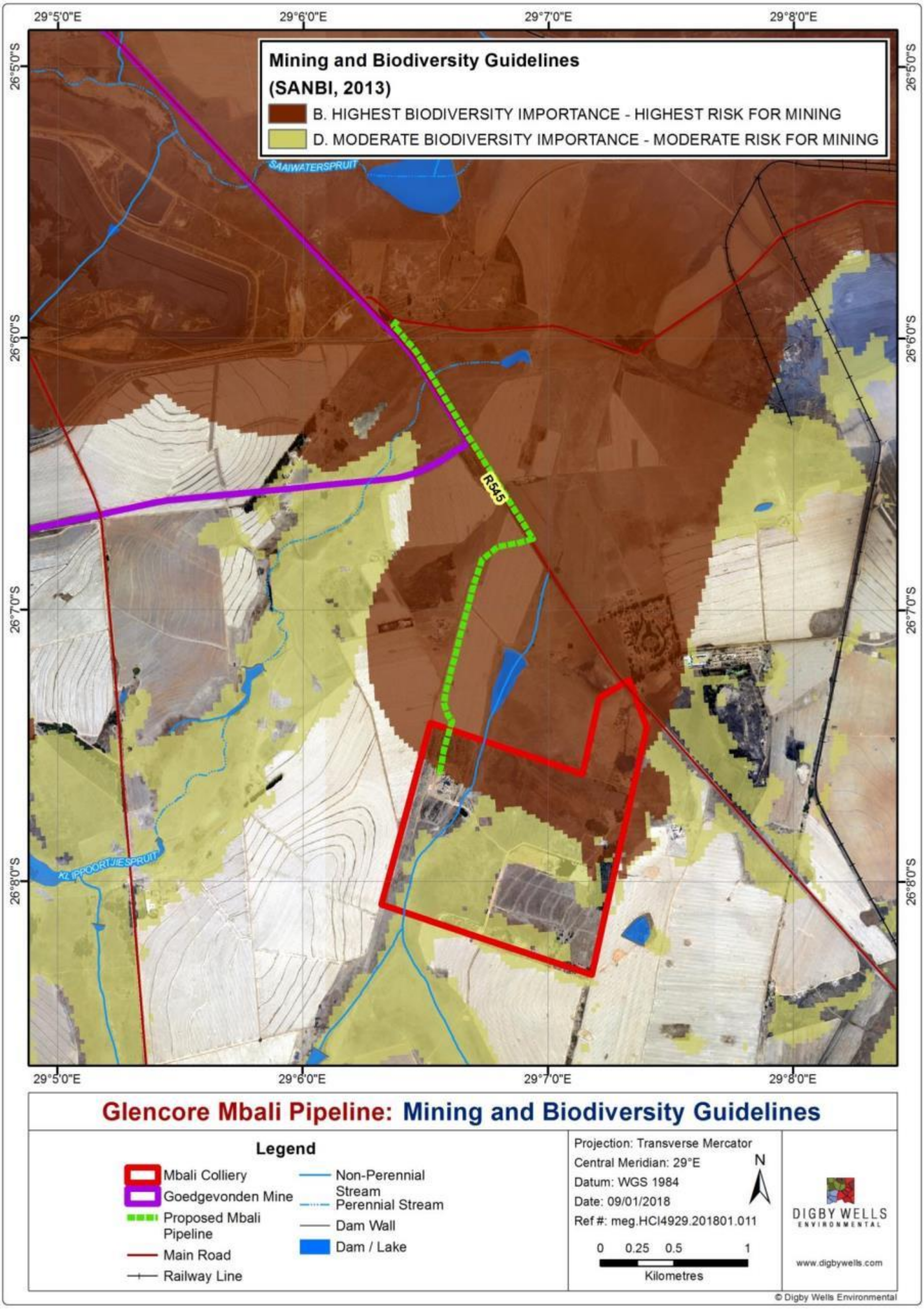

Figure 5-3: Mining and Biodiversity Guideline

5.3.4 Mpumalanga Biodiversity Sector Plan

The MBSP (2013) is a spatial tool that forms part of the national biodiversity planning. The proposed pipeline traverses only natural or modified areas. Although natural areas were not pristine as they are subject to grazing and / or grass bailing, these areas are mapped and regarded as natural habitat for naturally occurring fauna and flora species.

The proposed pipeline does not traverse ‘CBA Irreplaceable’ or ‘CBA Optimal’ areas. According to the guidelines from the MSBP, CBAs must be kept in a natural state with no further loss of habitat; where only low-impact, biodiversity-sensitive land-uses are appropriate.

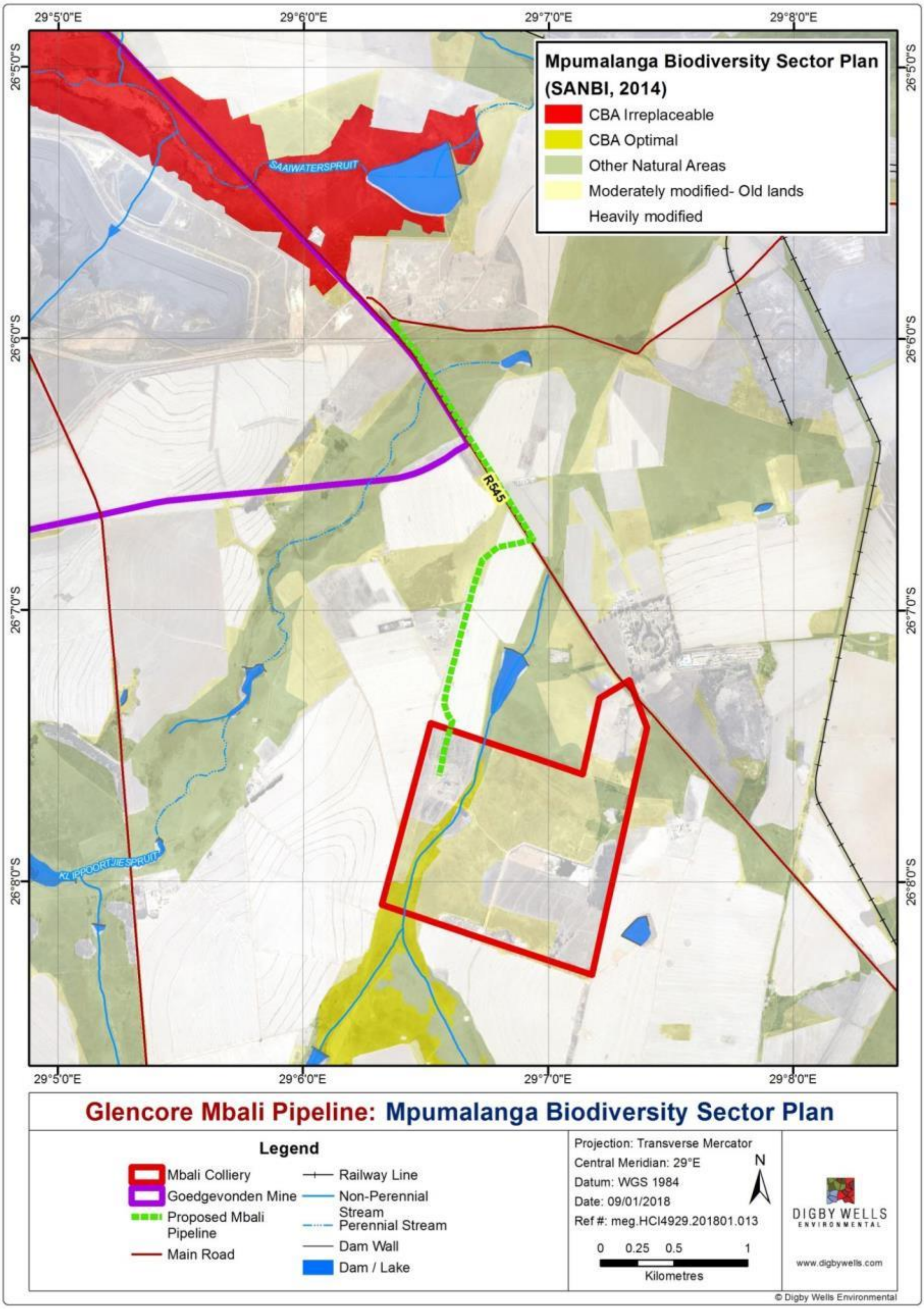

Figure 5-4: Mpumalanga Biodiversity Sector Plan

5.3.5 Regional Vegetation

The proposed pipeline falls within the Grassland Biome (Mucina and Rutherford, 2012), one of the nine South African plant Biomes and the second most bio-diverse biome in South Africa. The Grassland Biome is situated primarily on the central plateau of South Africa, and the inland areas of Kwa-Zulu-Natal and the Eastern Cape provinces. This biome is rich in flora and fauna diversity but is under threat due to rapid urbanisation and expansion of mining and industrial activities.

The Project area occurs in the Eastern Highveld Grassland regional vegetation type (Mucina and Rutherford, 2012) (Figure 5-5). It is an endangered vegetation type with a conservation target of 24%. Table 5-10 list the species characteristic of the Eastern Highveld Grassland.

Table 5-10: Plant Species Characteristic of the Eastern Highveld Grasslands

Plant Form	Species
Graminoids	*Aristida aequiglumis, A. congesta, A. junciformis subsp. galpinii, Brachiaria serrata, Cynodon dactylon, Digitaria monodactyla, D. tricholaenoides, Elionurus muticus, Eragrostis chloromelas, E. capensis, E. curvula, E. gummiflua, E. patentissima, E. plana, E. racemosa, E. sclerantha, Heteropogon contortus, Loudetia simplex, Microchloa caffra, Monocymbium ceresiiforme, Setaria sphacelata, Sporobolus africanus, S. pectinatus, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, T. rehmannii, Alloteropsis semialata subsp. eckloniana, Andropogon appendiculatus, A. schirensis, Bewsia biflora, Ctenium concinnum, Diheteropogon amplectens, Harpochloa falx, Panicum natalense, Rendlia altera, Schizachyrium sanguineum, Setaria nigrirostris, Urelytrum agropyroides*
Herbs	*Berkheya setifera, Haplocarpha scaposa, Justicia anagalloides, Pelargonium luridum, Acalypha angustata, Chamaecrista mimosoides, Dicoma anomala, Euryops gilfillanii, E. transvaalensis subsp. setilobus, Helichrysum aureonitens, H. caespititium, H. callicomum, H. oreophilum, H. rugulosum, Ipomoea crassipes, Pentanisia prunelloides subsp. latifolia, Selago densiflora, Senecio coronatus, Vernonia oligocephala, Wahlenbergia undulata.*
Geophytic herbs	*Gladiolus crassifolius, Haemanthus humilis subsp. hirsutus, Hypoxis rigidula var. pilosissima, Ledebouria ovatifolia*
Succulent Herbs	*Aloe ecklonis*

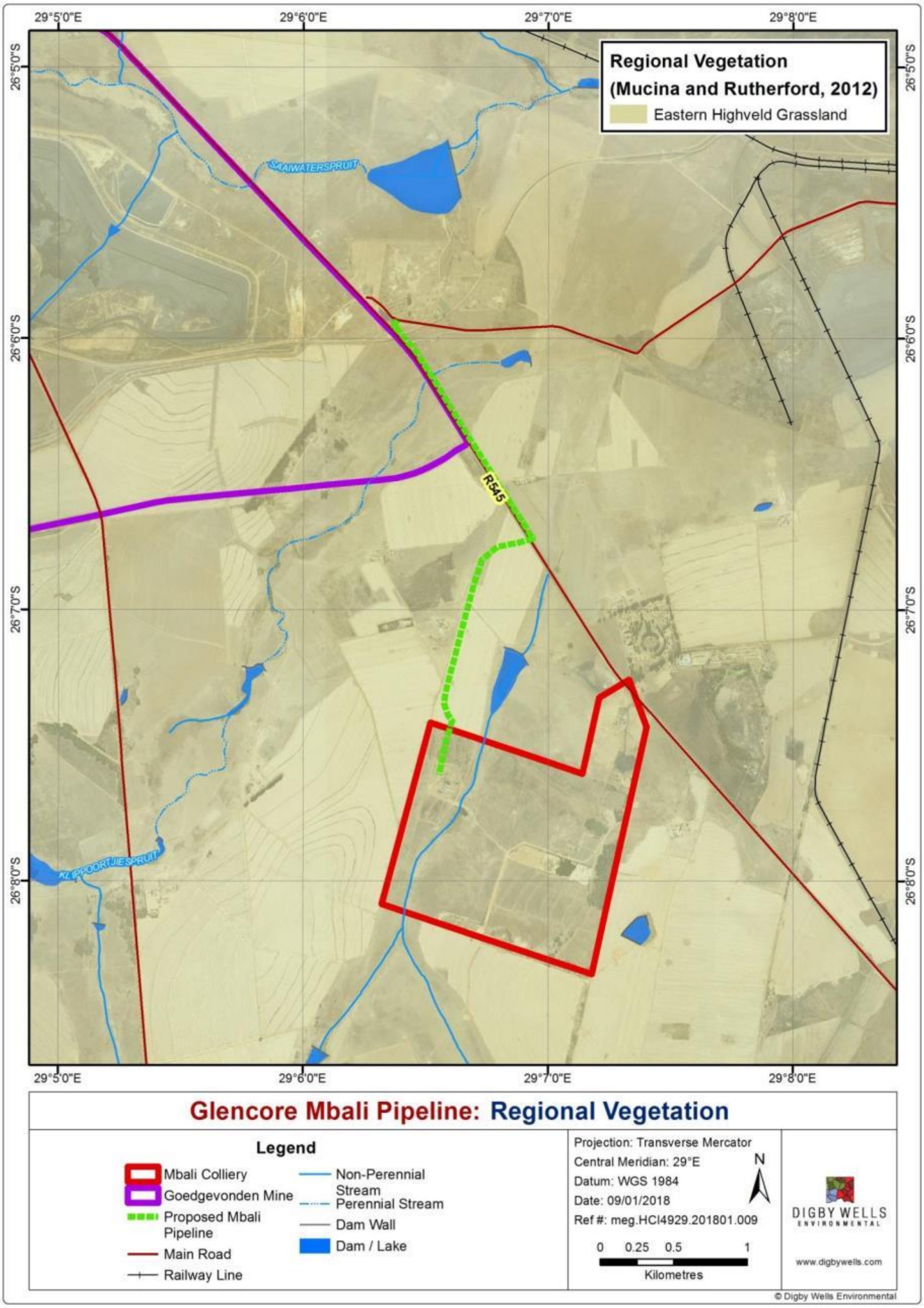

Figure 5-5: Regional Vegetation

5.4 Impact Assessment Methodology

Impacts and risks have been identified based on a description of the activities to be undertaken. Once impacts have been identified, a numerical environmental significance rating process will be undertaken that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a particular environmental impact.

The severity of an impact is determined by taking the spatial extent, the duration and the severity of the impacts into consideration. The probability of an impact is then determined by the frequency at which the activity takes place or is likely to take place and by how often the type of impact in question has taken place in similar circumstances.

Following the identification and significance ratings of potential impacts, mitigation and management measures will be incorporated into the EMP.

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact/risk assessment formula:

Significance = CONSEQUENCE X PROBABILITY X NATURE

Where

Consequence = intensity + extent + duration

And

Probability = likelihood of an impact occurring

And

Nature = positive (+1) or negative (-1) impact

The matrix calculates the rating out of 147, whereby intensity, extent, duration and probability are each rated out of seven as indicated in Table 5-12. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation has been applied; post-mitigation is referred to as the residual impact. The significance of an impact is determined and categorised into one of seven categories (The descriptions of the significance ratings are presented in Table 5-13).

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, (i.e., there may already be some mitigation included in the engineering design). If the specialist determines the potential impact is still too high, additional mitigation measures are proposed.

Table 5-11: Impact assessment parameter ratings

Rating	Intensity/ Irreplaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
7	Irreplaceable loss or damage to biological or physical resources or **highly** sensitive environments. Irreplaceable damage to **highly sensitive** cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or **moderate to highly** sensitive environments. Irreplaceable damage to cultural/social resources of **moderate to highly** sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur.>65 but <80% probability.

Rating	Intensity/ Irreplaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
5	Serious loss and/or damage to physical or biological resources or **highly** sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or **moderately** sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.

Rating	Intensity/ Irreplaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
3	Moderate loss and/or damage to biological or physical resources of **low to moderately** sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local including the site and its immediat surrounding area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	**Minor loss and/or effects** to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited extending only as far as the development site area.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

Rating	Intensity/ Irreplaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
1	**Minimal to no loss** and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site / Project Footprint.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 5-12: Probability/consequence matrix

Significance																																						
-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Consequence																																						

Table 5-13: Significance rating description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

6 Existing Environment

6.1 Wetland delineation and classification

Multiple wetland systems totalling 211.8 ha fall within the 500m buffer of the proposed pipeline route. Four HGM Units were identified on site; a large un-channelled valley bottom wetland that drains into a channelled valley bottom system, a seep and an isolated depression. The breakdown of the wetland types per area is detailed in Table 6-1 and illustrated in Figure 6-1.

Table 6-1: Wetland HGM Units

HGM Unit	HGM Unit Type	Area (ha)
1	Un-channelled Valley Bottom	69.4
2	Depression	9.8
3	Channelled Valley Bottom	103.5
4	Seep	29.2

The buffer zones relating to the wetlands are illustrated in Figure 6-2. Zones of Regulation of 100m around each wetland have been assigned according to the regulations on use of water for mining and related activities aimed at the protection of water resources (GN 704 in GG 20119 of 4 June 1999).

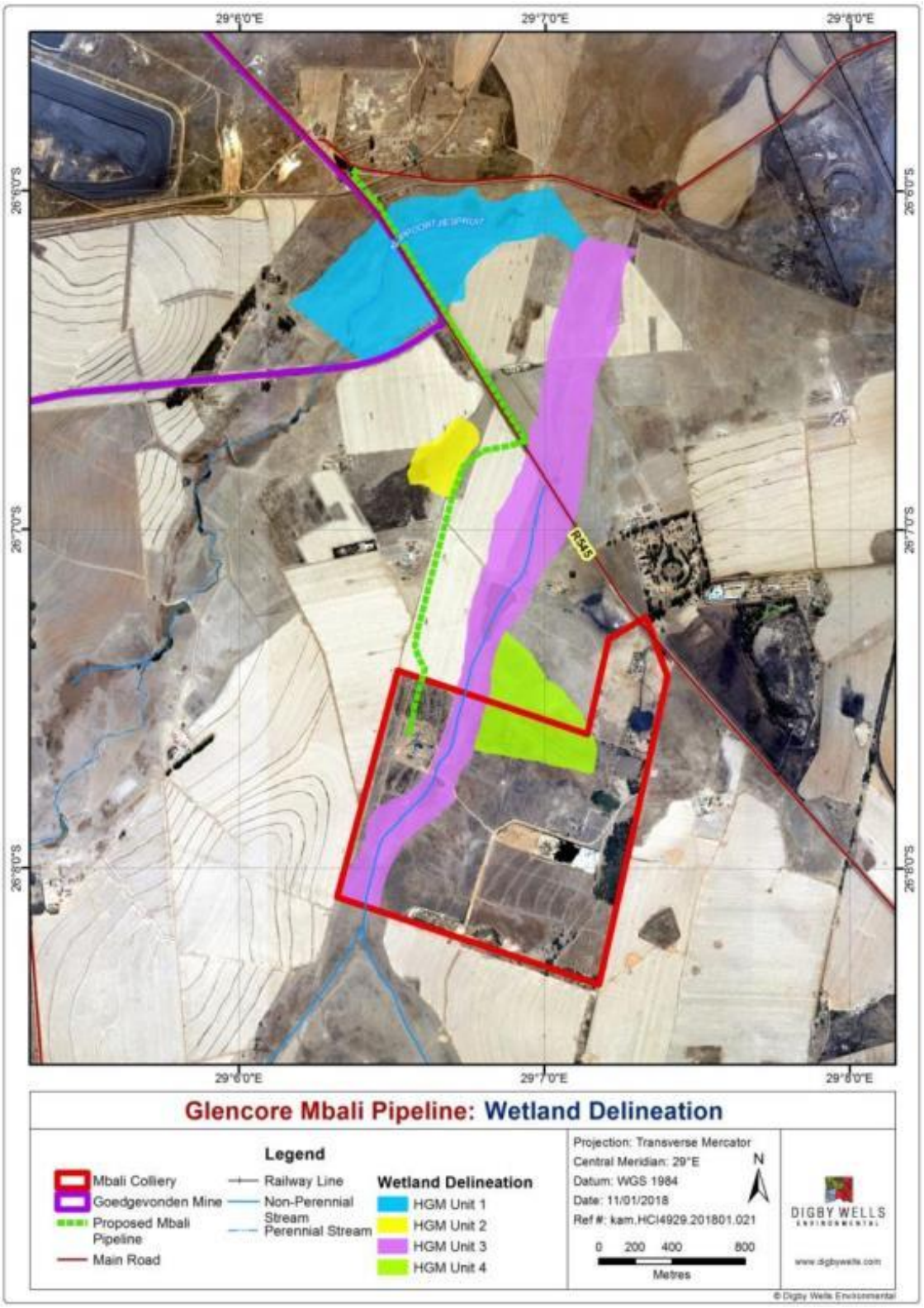

Figure 6-1: Wetland Delineation

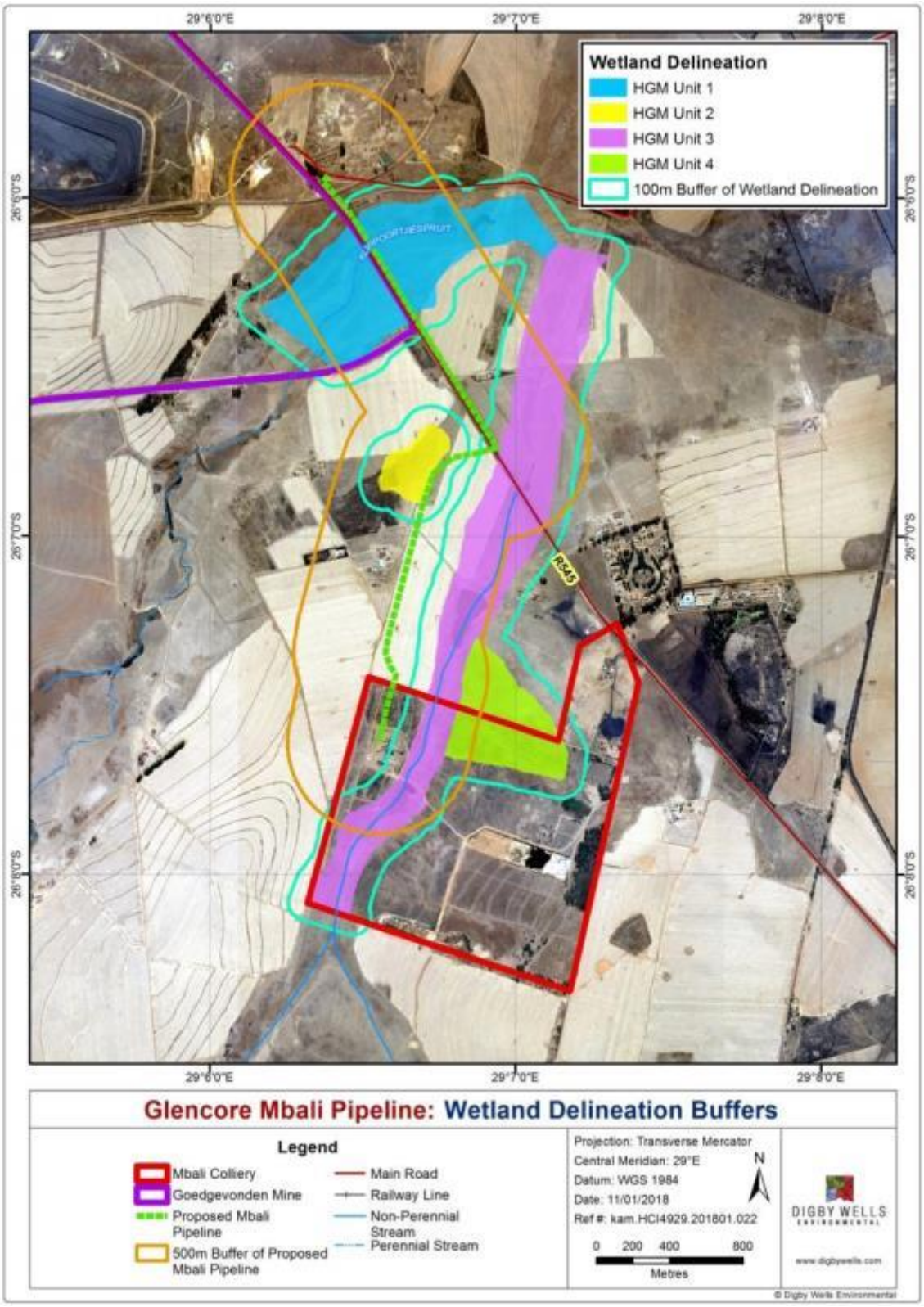

Figure 6-2: Wetland Regulation Zones

6.1.1 HGM Unit 1

HGM Unit 1 is an un-channelled valley bottom covering 69.4 ha (Figure 6-3). It has gentle slopes and is dominated by *Paspalum dilatatum* (Dallis Grass)*, Eragrostis curvula (*Weeping Lovegrass*)* and *Juncus effusus (*Common Rush*). Erythrina zeyheri* (Plough-breaker) and *Crinum bulbispermum* (Orange River Lily, protected species) which both favour wetland areas, were also observed.

Impacts to this wetland include agriculture and road crossings:

- The impact of the road crossings is diminished as large culverts are present which allow for the flow of water underneath the roads;
- Croplands have replaced some of the naturally occurring vegetation and this has impacted the ability of wetlands to maintain biodiversity;
- Cattle-grazing activities were noted in this HGM unit, which has resulted in overgrazing, trampling and erosion. In addition, this impact has resulted in impacts on water quality of the wetlands associated with the site. These activities cause increased sedimentation of the systems due to exposed substrate. Sedimentation alters the natural hydrological and geomorphological functioning of the wetlands and may have an impact on aquatic life. The impaired water quality may also result from additional loading of phosphates and nitrates; and
- Disturbance has also led to the establishment of alien and invasive plant species, further limiting the ability of the hydromorphic grasslands to function.

;

Figure 6-3: HGM unit 1

6.1.2 HGM Unit 2

HGM unit 2 is a depression wetland covering approximately 9.8 ha (Figure 6-4). The depression is inundated with water and displays vegetation that favours this environment. The wetland was mainly intact with the major impacts on the periphery of the wetland.

The major impacts are the following

- The powerlines and associated servitude within the depression wetland has resulted in disturbance to the system. Impacts such as removal of vegetation, compaction of soils and erosion will also pose a threat to avifauna. The decreases in ecological integrity of the wetlands are also likely to deter avifaunal populations;
- Croplands have replaced some of the naturally occurring vegetation and this has impacted the ability of wetlands to maintain biodiversity; and

- The depression is impacted on by a road, which has resulted in some fragmentation of the natural system, compaction of soils in some places and loss of vegetation.

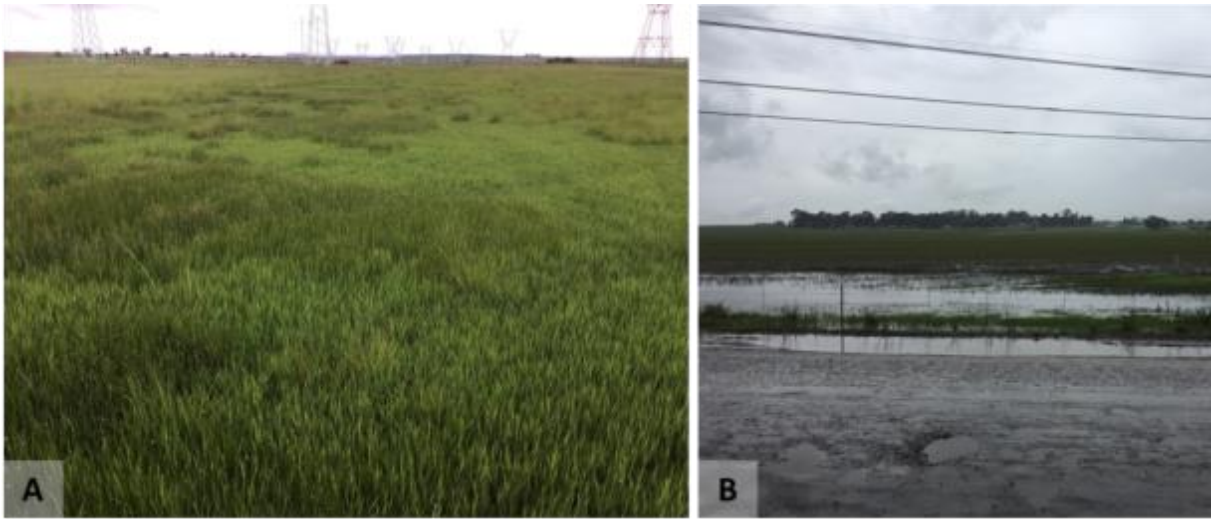

Figure 6-4: HGM unit 2

6.1.3 HGM Unit 3

HGM unit 3 is a channelled valley bottom that runs parallel to a section of the proposed pipeline and Mbali Access Road and covers 104 ha (Figure 6-5).

This wetland has been largely impacted as a result of the following:

- Dams were abundant and have impacted severely on the wetland integrity of the site, causing head-cut erosion upstream and in-stream erosion downstream;
- Edge effects related to mining activities have resulted in impacts to water quality of the wetland;
- The impact of the road crossings is large as culvert design is considered insufficient to allow for the flow of water underneath the roads; and
- Croplands along the edges of the wetland have replaced some of the naturally occurring vegetation.

Figure 6-5: HGM unit 3

6.1.4 HGM Unit 4

HGM unit 4 is a hillslope seep that feeds into and is connected to the channelled valley bottom wetland (HGM Unit 3) and covers 29.2 ha.

This wetland has been largely impacted as a result of the following:

- Edge effects related to mining activities have resulted in impacts to water quality of the wetland (the wetland falls partly within the approved Mbali Mining Right Area);
- Edge effects related to adjacent mining activities have resulted in loss of the wetland habitat and biodiversity;
- Croplands along the edges of the wetland have replaced some of the naturally occurring vegetation; and
- Cattle-grazing activities have resulted in the loss of wetland ecological integrity.

6.2 Flora

The majority of the study area had undergone transformation due to cultivation for maize and soya beans as well as mining activities and road construction which resulted in historical disturbance of floral components and soil compaction in some areas. Livestock were also observed throughout most of the site and evidence of overgrazing was recorded in grassland areas.

A total of 42 plant species were recorded on site. The natural areas associated with the project area are discussed in more detail in the sections that follow. The disturbed grassland, cultivated areas and alien bushclumps have also been discussed. The primary land uses and vegetation habitats identified in the vicinity of the proposed pipeline route are listed in Table 6-2 and illustrated in Figure 6-6.

Table 6-2: Vegetation Habitats (and other land use) and Approximate Areas

Vegetation Unit	Area (ha)	Proportion of total project area (%)
Depression	4.57	1.05%
Valley bottom wetlands	106.70	24.46%
Infrastructure	57.30	13.14%
Disturbed Grassland / mowed servitude	44.43	10.19%
Alien bushclumps	2.83	0.65%
Cultivation (maize and soybean)	213.81	49.02%
Total	429.64	98.5%*

*the remaining 1.5% are roads and railways

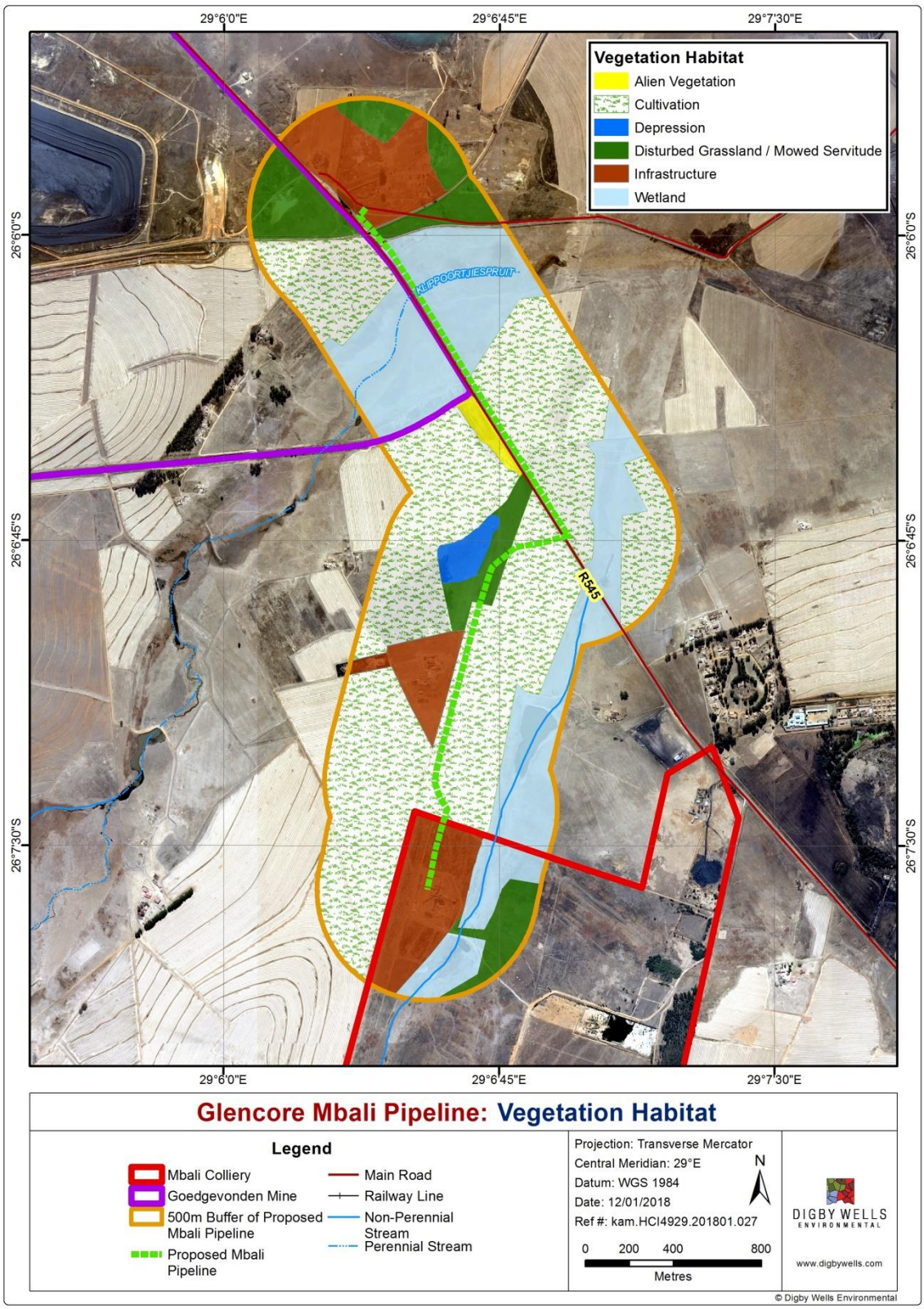

Figure 6-6: Flora habitats

6.2.1 Valley Bottom Wetland Habitat

This habitat is associated with the un-channelled and channelled valley bottom wetlands that run through the project area. These areas are gently sloping and comprise of hydromorphic grasslands. Where standing water was present; *Typha capensis* (Common Bulrush), *Imperata cylindrica* (Cottonwool Grass), *Cyperus fastigiatus* had colonised. The slopes were dominated by *Eragrostis species*, *Agrostis lacnantha, Paspalum dilatatum* and various herbs such as *Monopsis decipiens* and *Chlorophytum fasciculatum.*

Crinum bulbispermum (Orange River Lily), which is abundant in this vegetation unit, is provincially protected (according to Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998): Schedule 11).

Alien plant species that had colonised this vegetation unit included: *Acacia mearnsii* (Black Wattle) seedlings, and *Cirsium vulgare* (Scotch Thistle).

Species characteristic of this habitat can be seen in Table 6-3 and Figure 6-7.

Table 6-3: Species found in the wetland areas

Species name	Common name
Agrostis lacnantha	Bent Grass
*Acacia mearnsii*** (NEMBA:Category 1b)	Black Wattle
*Bidens pilosa**	Black Jack
Chlorophytum fasciculatum	-
*Cirsium vulgare***(NEMBA:Category 1b)	Scotch Thistle
*Cosmos bipinnatus**	Cosmos
Crinum bulbispermum	**Orange River Lily**
Cynodon dactylon	Couch Grass
Cyperus fastigiatus	-
Cyperus sp	-
Dipcadi viride	-
Eragrostis curvula	Weeping Lovegrass
Eragrostis sp.	-
Erythrina zeyheri	Plough-breaker
Euphorbia striata	-
Gomphocarpus physocarpus	Milkweed
Helichrysum aureonitens	-
Helichrysum rugulosum	-
Helychrysum sp.	-
Juncus effusus	Common Rush
Ledebouria sp.	-
Melinis repens	Natal Red-top
Monopsis decipiens	Wild Violet
*Oenothera rosea**	Rosy Evening Primrose
*Paspalum dilatatum**	Dallis Grass
*Pennisetum clandistenum*** (NEMBA Category 1b in protected areas and wetlands)	Kikuyu Grass
*Persicaria sp.**	Knotweed
Pycreus nitidus	-

Species name	Common name
Setaria sp.	-
Themeda triandra	Red Grass
Typha capensis	Bulrush
*Verbena bonariensis***(NEMBA: Category 1b)	Tall Verbena

* denotes alien species

** denotes invasive alien species categorised by NEMBA

Bold font denotes protected species

Figure 6-7: Valley Bottom Wetland Habitat

6.2.2 Depression

The depression habitat encountered was characterised by short sedges (e.g. *Eleocharis dregeana, Schoenoplectus decipiens*) that were inundated with water. Grass species such as *Leersia hexandra* were also found in the permanent wet zone with *Setaria sphacelata* in the temporary and seasonal zones. Herb species such as *Asclepias gibba* var *gibba* and *Kohautia amatymbica* were scattered throughout the depression.

Very few alien plant species had colonised this vegetation unit aside from *Verbena bonariensis.* Species characteristic of this habitat can be seen in Table 6-4 and Figure 6-8.

Table 6-4: Species found in the depression areas

Species name	Common name
Asclepias gibba var gibba	-
Eleocharis dregeana	Finger sedge
Fuirena pubescens	-
Helichrysum aureonitens	Golden Everlasting
Helichrysum rugulosum	Felted Everlasting
Kohautia amatymbica	-
Leersia hexandra	Rice Grass
Schoenoplectus decipiens	-
Selago densiflora	-
Setaria sphacelata	Bristle Grass
*Verbena bonariensis*** (NEMBA: Category 1b)	Tall Verbena

* denotes alien species

** denotes invasive alien species categorised by NEMBA

Figure 6-8: Depression Habitat

6.2.3 Disturbed Grassland / mowed servitude

This habitat has been mowed and therefore species identification was not possible. These areas were located where powerlines were present.

6.2.4 Alien Bushclumps

Small alien bushclumps colonised road reserves. These included *Bidens pilosa* (Black Jack), *Conyza albida* (Fleabane) and *Cosmos bipinnatus* (Garden Cosmos).

6.2.5 Cultivated areas

This habitat was completely transformed by maize and soya bean farming.

6.3 Sensitivity of the Site

6.3.1 Present Ecological State

Table 6-5 indicates the PES scores for the various HGM Units.

The wetlands within the Project Area exhibit a variety of PES values, ranging from *Moderately Modified* (Category C) to *Largely Modified* (Category D) (Table 6-5).

Two *Moderately Modified* (Category C) wetlands were identified (HGM units 1 and 2). These wetlands were mainly impacted on by cultivation and/or grazing with few geomorphological impacts.

Two *Largely Modified (*Category D*)* wetlands are present in the Project Area (HGM Unit 3 and HGM Unit 4). The *Largely Modified* category is mainly attributed to habitat transformation and dams in the case of HGM unit 3.

Table 6-5: Present Ecological Health Scores

HGM Unit	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Final Ecological Health Score	PES Score
1	3	0.3	7.4	3.5	C
2	2	0.3	5.3	2.4	C
3	6	1.1	7.8	5.1	D
4	3.5	0.9	9.2	4.4	D

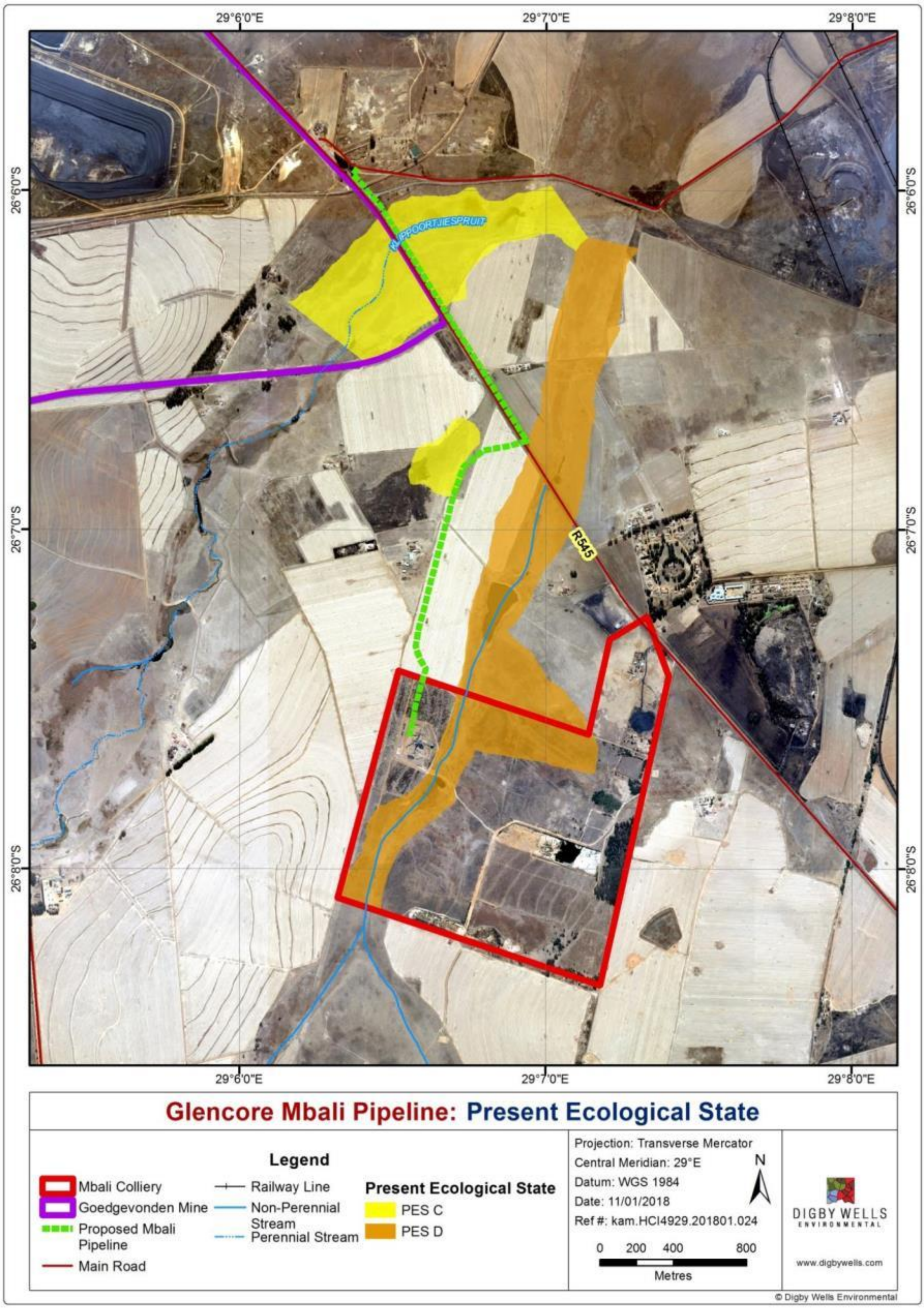

Figure 6-9: Present Ecological State

6.3.2 Ecological Importance and Sensitivity

Table 6-6 indicates the EIS scores for the various HGM Units with the final EIS score for the wetlands ranging from *Low* (1) to *High* (2.5).

Although the wetlands are modified, they do still provide predominantly *High* to *Low* hydrological importance services (ranging between 1 and 2), such as flood attenuation and assimilation of toxicants and nitrates.

The Ecological Importance and Sensitivity category is ranging from *Low* (1) to *High* (2.5). Due to the largely transformed nature of HGM Unit 4, this wetland provides little habitat for fauna and flora, whilst HGM Units 1, 2 and 3 still have large areas of intact vegetation where red data species were observed.

In general, the values are *Low* for 'Direct Human Benefits' (aside from the channelled valley bottom) due to restricted access by the mine. Some agriculture does occur, however this is minimal when compared to the size of the HGM units.

Table 6-6: EIS Scores

HGM Unit	Ecological Importance & Sensitivity	Hydrological/Functional Importance	Direct Human Benefits	Final EIS Score	Final EIS Category
1	2.5	2	1	2.5	B
2	1.8	1.1	0.8	1.8	C
3	1.4	1.6	1.7	1.7	C
4	1	1	0.3	1	D

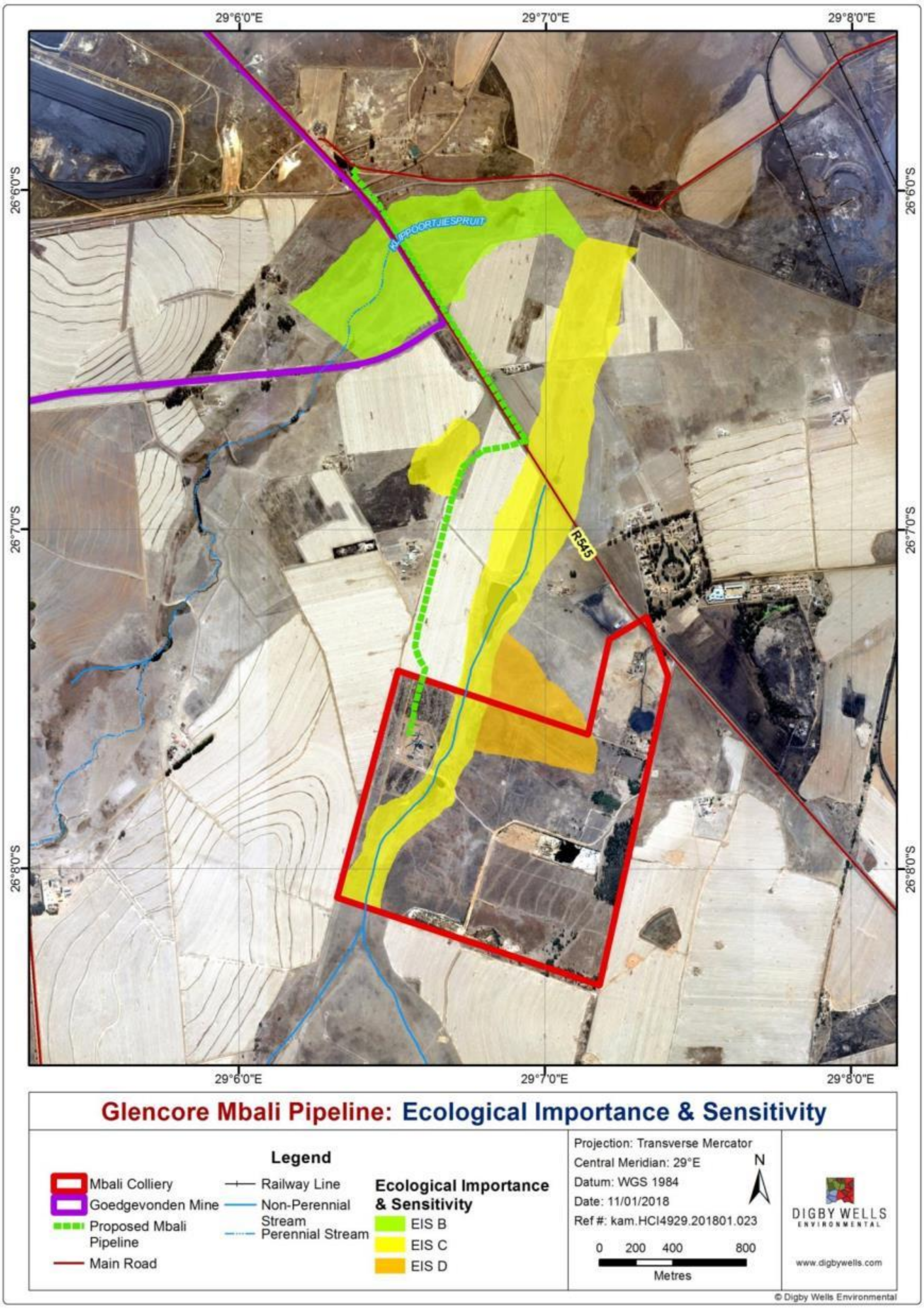

Figure 6-10: Ecological Importance and Sensitivity

6.3.3 Flora Sensitivity

Due to the transformed nature of most of the habitat types and the fact that the pipeline is placed in the road servitude, the sensitivities are not high.

The cultivated fields, alien clumps, and disturbed areas are demarcated as low sensitivity with the wetland areas and depression characterised as medium sensitivity (Figure 6-11). The protected species, *Crinum bulbispermum,* was identified on site in the wetland areas.

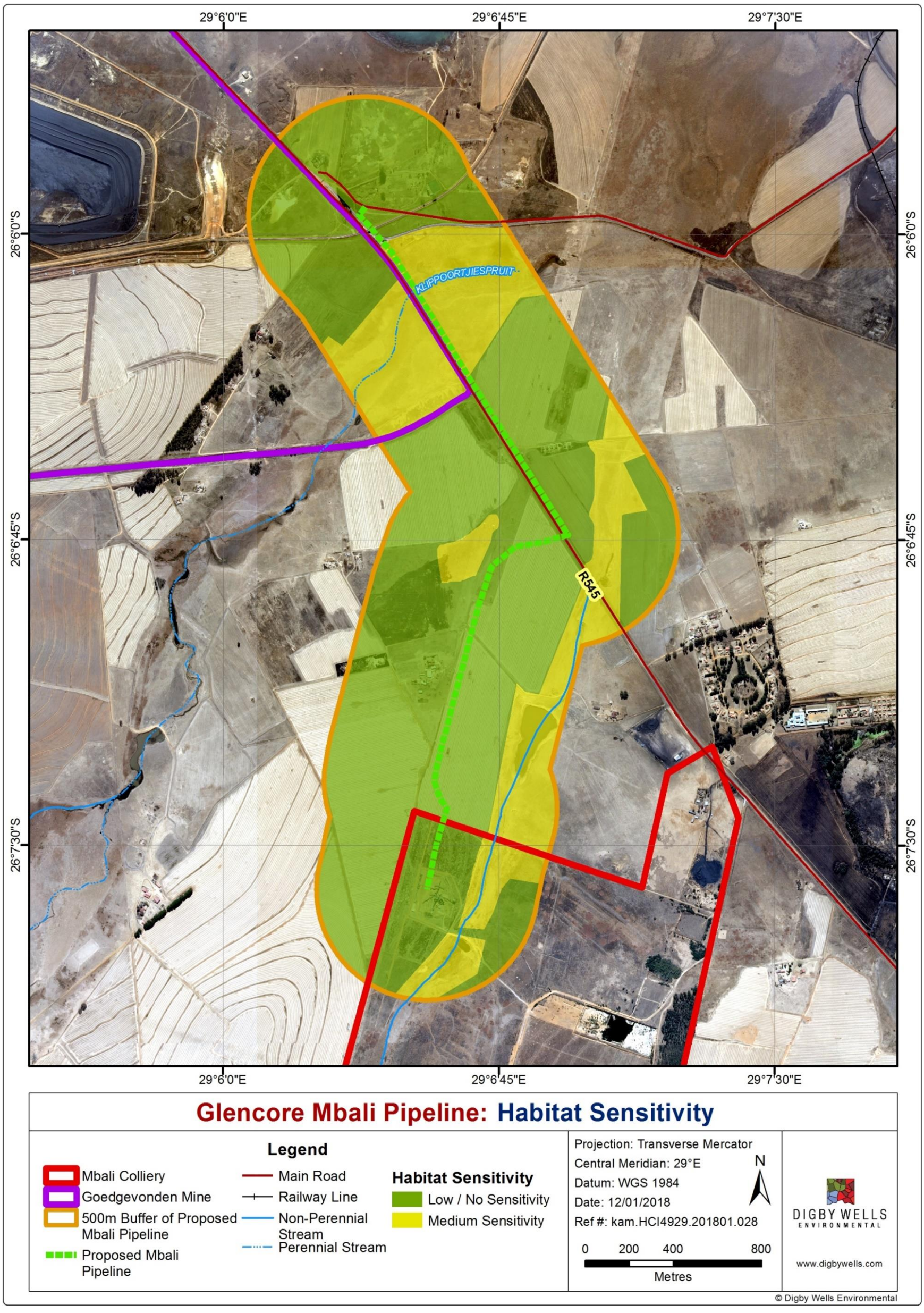

Figure 6-11: Flora Sensitivity

7 Assumptions, Limitations and Gaps in knowledge

The following limitations were encountered during this study:

- Wetlands have been delineated only within the 500m area of the proposed pipeline route;
- Overgrazing, trampling, and cultivation in some areas made identification of species impossible. As a result, the species richness will be underestimated;
- The composition of the flora and freshwater resources in the Project area prior to major disturbance is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available; and
- With ecology being dynamic and complex, certain aspects, some of which may be important, may have been overlooked. However, wherever possible, it is expected that the Project area has been accurately assessed and considered, based on the field observations undertaken and the consideration of historical and existing studies and the desktop data available.

8 Impact Assessment

8.1 Discussion of Potential Impacts

The activities assessed for the wetlands impact assessment are listed in Table 8-1. This section includes an impact assessment for activities associated with the proposed pipeline for the conveyance of treated water. The Project area (comprising the pipeline route and 500m buffer) affects four wetland HGM units of varying degrees of ecological integrity and some flora of medium and low sensitivity.

Figure 6-1 provides an indication of the locality of the various wetland features in relation to the project area whilst Figure 6-6.

Table 8-1: Project Activities

Activity	Phase of Project
Infrastructure layout planning	Planning and pre-construction phase
Construction of infrastructure associated with the proposed pipeline	Construction phase
Operational and Maintenance activities associated with the proposed pipeline	Operational phase
Decommissioning of infrastructure	Decommissioning
Rehabilitation of decommissioned infrastructure	Rehabilitation/Closure
Monitoring and maintenance of decommissioned and rehabilitated areas	Post-closure

8.1.1 Planning and Pre-Construction Phase

8.1.1.1 Project Activities Assessed

Project activities and associated impacts for the proposed planning and pre-construction phase are listed in Table 8-2 and Table 8-3.

Table 8-2: Interactions for the planning and pre-construction phase

Interaction		Impact
1	Proposed pipeline route and design	Potential loss of biodiversity, potential impacts to stream connectivity.

8.1.1.2 Impact Description

The location of pipeline infrastructure occurs either within the delineated freshwater feature areas or within the 32m or 100m zones of regulation according to NEMA and Regulation GN704 of the NWA.

8.1.1.3 Management Objectives

The objectives for management measures for the planning and pre-construction phase are to preserve wetland functionality and integrity prior to any disturbances or impacts associated with the proposed project through optimal site selection of the proposed infrastructure.

The following management and mitigation measures are prescribed for the planning and pre-construction phase:

- Ensure that as far as possible all infrastructures result in the least disturbance to delineated freshwater features present;
- Ensure that sound environmental management is in place during the planning phase;
- Design of infrastructure should be environmentally and structurally sound and all possible precautions taken to prevent spillage to the surface water resources present;
- Impacts to surface wetlands are reduced as the proposed pipeline remains within the road reserves, thus minimizing fragmentation of the systems.

8.1.1.4 Management Actions and Targets

The Impact Ratings are indicated in the table below.

Table 8-3: Potential Impacts of the Planning and Pre-Construction Phase

Dimension	Rating	Motivation	Significance
Activity and Interactions: Proposed pipeline route and design			
Prior to Mitigation/Management			
Duration	Project life (5)	The impact will cease after the operational life span of the project.	Minor (negative) – 52
Extent	Greater municipal area (4)	Loss of stream connectivity and fragmentation of wetland systems will result in loss of catchment yield to systems further downstream	
Intensity x type of impact	Serious medium term environmental effects (4)	Due to the partially transformed nature of the systems present, should no management or mitigation measures be employed, activities could result in serious medium term impacts.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.	
Nature	Negative		
Post-Mitigation			
Duration	Short term (2)	The impact will be minimised to short term impacts based on project management and mitigation of potential impacts	Negligible (negative) - 14

Dimension	Rating	Motivation	Significance
Extent	Limited (2)	Impacts will be limited only to the project footprint area and will be rehabilitated accordingly on completion of the project.	
Intensity x type of impact	Limited (2)	Due to the sensitivity of wetland systems in general and the already degraded nature of the systems present, should management or mitigation measures be employed, activities are unlikely to result in significant impacts	
Probability	Unlikely(3)	Should the proposed management and mitigation measures be implemented, probability of impacts are deemed unlikely	
Nature	Negative		

8.1.2 Construction Phase

8.1.2.1 Project Activities Assessed

Project activities and associated impacts for the proposed construction phase are listed in Table 8-4 and Table 8-5.

Table 8-4: Interactions for the Construction Phase

Interaction		Impact (without mitigation)
1	Site clearing and access and creation of berms	Increased vehicular movement along river crossings and within wetland/riparian zones, resulting in: ▪ Vegetation clearing and disruption of soil profile ▪ Potential contamination of soils as a result of the ingress of hydrocarbons; ▪ Compaction of soils; ▪ Loss of natural vegetation; ▪ Increased sedimentation; and ▪ Increased potential for onset of erosion.

8.1.2.2 Impact Description

Among the impacts associated with the proposed construction phase are minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons.

Larger impacts include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the vicinity of any areas cleared for stockpiles and resulting in impacts further downstream.

Removal of vegetation and disturbance of soils in the vicinity of the construction footprint is likely to give rise to an increased potential for encroachment by robust pioneer species and alien invasive vegetation species, further altering the natural vegetation profiles of the wetlands encountered in the vicinity of the project footprint.

8.1.2.3 Management Actions and Targets

The following mitigation and management measures have been prescribed for the construction phase:

- *Crinum bulbispermum* plants should be removed from the construction footprint and relocated to a suitable location;
- Ensure soil management programme is implemented and maintained to minimise erosion and sedimentation;
- During the operational phase, erosion berms should be installed on roadways and downstream of stockpiles to prevent gully formation and siltation of the freshwater resources. The following points should serve to guide the placement of erosion berms:
  - Where the track has slope of less than 2%, berms every 50m should be installed;
  - Where the track slopes between 2% and 10%, berms every 25m should be installed;
  - Where the track slopes between 10%-15%, berms every 20m should be installed; and
  - Where the track has slope greater than 15%, berms every 10m should be installed.
- Active rehabilitation, re-sloping, and re-vegetation of disturbed areas immediately after construction;
- Implement and maintain alien vegetation management programme;
- Limit the footprint area of the construction activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas);
- If it is absolutely unavoidable that any of the wetland areas present will be affected, disturbance must be minimised and suitably rehabilitated;
- Ensure that no incision and canalisation of the wetland features present takes place;
- All erosion noted within the construction footprint should be remedied immediately and included as part of an ongoing rehabilitation plan;

- All soils compacted as a result of construction activities should be ripped/scarified (<300mm) and profiled;
- A suitable Alien Invasive Plant (AIP) control programme must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones;
- Permit only essential personnel within the 32 or 100m zones of regulation for all freshwater features identified;
- No unnecessary crossing of the wetland features and their associated buffers should take place and the substrate conditions of the wetlands and downstream stream connectivity must be maintained;
- No material may be dumped or stockpiled within any rivers, tributaries or drainage lines in the vicinity of the proposed pipeline;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the construction footprint;
- All vehicles must be regularly inspected for leaks;
- Re-fueling must take place at the Mbali diesel facility, on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into topsoil;
- All spills should be immediately cleaned up and treated accordingly;
- Wetlands should be monitored monthly during construction; and
- Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate waste facility.

8.1.2.4 Impact Ratings

Impact ratings for the construction phase are provided in the tables below.

Table 8-5: Potential Impacts of the Construction Phase

Dimension	Rating	Motivation	Significance
Activity and Interactions: Site access and disturbance			
Prior to Mitigation/Management			
Duration	Project life (5)	The impact will cease after the life of the project has been completed	Minor (negative) – 52
Extent	Greater municipal area (4)	General scouring from sedimentation, as well as degraded habitat due to water quality deterioration will affect entire watercourse and river reaches.	

Dimension	Rating	Motivation	Significance
Intensity x type of impact	Serious medium term environmental effects (4)	Due to the already degraded nature of the systems present, should no management or mitigation measures be employed, activities could result in serious medium term impacts.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands and flora present are considered probable.	
Nature	Negative		
Post-Mitigation			
Duration	Project life (5)	The impact will cease after the project has been completed.	Negligible (negative) - 27
Extent	Limited (2)	Impacts will be limited only to the project footprint area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity x type of impact	Minor effects on the biological or physical environment (2)	Due to the impacted nature of the systems present, should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the wetland systems present	
Probability	Unlikely (3)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are considered unlikely.	
Nature	Negative		

8.1.3 Operational Phase

8.1.3.1 Project Activities Assessed

Project activities and associated impacts for the operational phase are listed in Table 8-6 and Table 8-7.

Table 8-6: Interactions for the Operational Phase

Interaction		Impact
1	Potential spills or leaks from pipeline infrastructure	Water and soil quality deterioration
2	Maintenance and inspection of the pipeline	Water quality deterioration and soil compaction

8.1.3.2 Impact Description

Among the impacts associated with the proposed project are potential impacts to soil and water quality as a result of the ingress of spills associated with the pipeline.

8.1.3.3 Management Actions and Targets

The following mitigation and management measures have been prescribed for the construction phase:

- Leak detection will be necessary. Flow meters can be fitted at the start and end of the pipeline to detect if there are any water losses;
- All erosion noted within the operational footprint as a result of surface activities should be remedied immediately and included as part of the ongoing rehabilitation plan;
- Maintenance of erosion berms;
- A suitable AIP control programme must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones;
- Permit only essential personnel within the 32 or 100m zones of regulation for all wetland features identified;
- No unnecessary crossing of the wetland features and their associated buffers should take place and the substrate conditions of the wetlands and downstream stream connectivity must be maintained;
- No material may be dumped or stockpiled within any rivers, tributaries or drainage lines in the vicinity of the proposed operational footprint;
- The servitude should be reseeded with indigenous grass species during the rehabilitation process;
- All spills from maintenance vehicles or leaks from the pipeline should be immediately cleaned up and treated accordingly; and
- Monitor all systems for erosion and incision.

8.1.3.4 Impact Ratings

Table 8-7 represents the impact ratings for the operational phase.

Table 8-7: Potential Impacts of the Operational Phase

Dimension	Rating	Motivation	Significance
Activity and Interactions: Site access and roads			
Prior to Mitigation/Management			
Duration	Project life (5)	The impact will cease after the life of the project has been completed.	Minor (negative) – 52
Extent	Greater municipal area (4)	Spills as well as degraded habitat due to water quality deterioration will affect entire watercourses and river reaches.	
Intensity x type of impact	Serious medium term environmental effects (4)	Due to the already degraded nature of the systems present, should no management or mitigation measures be employed, activities could result in serious medium term impacts.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.	
Nature	Negative		
Post-Mitigation			
Duration	Project life (5)	The impact will cease after the project has been completed and the pipeline decommissioned.	Negligible (negative) – 18
Extent	Limited (2)	Impacts will be limited only to the project footprint area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity x type of impact	Minor effects on the biological or physical environment (2)	Due to the impacted nature of the systems present, should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the flora and wetland systems present	

Dimension	Rating	Motivation	Significance
Probability	Improbable (2)	Should the proposed project proceed, impacts to the ecological integrity of the systems present are considered unlikely.	
Nature	Negative		

8.1.4 Decommissioning Phase

8.1.4.1 Project Activities Assessed

Project activities and associated impacts for the decommissioning phase are listed in Table 8-8.

Table 8-8: Interactions for the Decommissioning Phase

Interaction		Impact (without mitigation)
1	Site access roads and pipeline crossing wetlands	Increased vehicular movement along river crossings and within wetland/riparian zones, resulting in: ▪ Potential contamination of soils as a result of the ingress of hydrocarbons; ▪ Compaction of soils; ▪ Loss of natural vegetation; ▪ Increased sedimentation; and ▪ Increased potential for onset of erosion
2	Removal of infrastructure	Potential dumping of decommissioned infrastructure in wetland/riparian areas; Potential incomplete removal of infrastructure; Disturbance of natural vegetation structures

Interaction		Impact (without mitigation)
	▪ Rehabilitation of historical impacts to the wetlands in the vicinity of the proposed decommissioning footprint; ▪ Removal of AIPs and implementation of an alien vegetation management plan; ▪ Clean-up of any waste or hazardous materials in the vicinity of the proposed decommissioning footprint, both in and in the vicinity of wetland areas; ▪ Ripping and re-profiling of slopes and natural terrain profiles in the vicinity of the decommissioned area, subsidence areas and associated historically eroded areas; and ▪ Re-seeding of disturbed or cleared areas. Re-seeding of re-profiled areas.	Disturbance of natural vegetation structures Spread of AIPs, increased soil compaction, wetland fragmentation and loss of biodiversity, erosion and subsequent sedimentation into the wetland ecosystems.

8.1.4.2 Impact Description

Among the impacts associated with the decommissioning, closure and rehabilitation phase are minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for the decommissioning activities.

Larger impacts include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas and resulting in impacts further downstream.

Any temporary storage or dumping of decommissioned infrastructure within wetland areas, has the potential to result in loss of stream connectivity, loss of refuge areas, alterations to the terrain profiles of the areas and the creation of preferential flow paths, which may result in sedimentation, alterations to the vegetation structure of the area, encourage alien vegetation encroachment and result in increased erosion and sedimentation potentials.

Removal of vegetation and disturbance of soils in the vicinity of the decommissioning footprint is likely to give rise to an increased potential for encroachment by robust pioneer species and alien invasive vegetation species, further altering the natural vegetation profiles of the wetlands encountered in the vicinity of the decommissioning footprint.

8.1.4.3 Management Actions and Targets

The following mitigation and management measures have been prescribed for the decommissioning phase:

- Ensure that sound environmental management is in place during the proposed decommissioning phase;
- Limit the footprint area of the decommissioning and rehabilitation activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas);
- All erosion noted within the decommissioning area footprint should be remedied immediately and included as part of the ongoing rehabilitation plan;
- All soils compacted as a result of decommissioning activities should be ripped/scarified (<300mm) and profiled;
- Permit only essential personnel within the zones of regulation for all freshwater features identified;
- Wherever possible, restrict decommissioning activities to the drier winter months to avoid sedimentation of the freshwater resources further downstream;
- No material may be dumped or stockpiled within any wetland areas (or the buffers) in the vicinity of the proposed decommissioning footprint;
- Wetlands and their associated zones of regulation are to be clearly demarcated and avoided wherever possible;
- An AIP management plan to be implemented and managed for the life of the proposed decommissioning, rehabilitation, closure and post-closure phases;
- As much vegetation growth as possible should be promoted within the proposed development area during all phases. In order to protect soils, vegetation clearance should be kept to a minimum;
- Monitor all systems for erosion and incision;
- All areas where active erosion is observed should be ripped, re-profiled and seeded with indigenous grasses;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the project area footprint;
- Compacted soils should be ripped, re-profiled and re-seeded;
- All vehicles must be regularly inspected for leaks;
- Re-fueling must take place at the Mbali diesel facility on a sealed and bunded surface area away from wetlands to prevent ingress of hydrocarbons into topsoil;
- All existing litter, debris should be removed from the wetland areas and littering should be prohibited on an ongoing basis;
- All spills from machinery should be immediately cleaned up and treated accordingly;

- Appropriate sanitary facilities must be provided for the duration of the rehabilitation activities and all waste must be removed to an appropriate waste facility; and
- Wetland monitoring should be carried out monthly during decommissioning and annually during rehabilitation;
- Ongoing wetland rehabilitation is necessary both within and in the vicinity of the proposed decommissioning footprint and appropriate wetland monitoring techniques must take place on an annual basis during the summer/wet season in order to identify any emerging issues, trends or improvements in the receiving environment.

8.1.4.4 Impact Ratings

The majority of wetlands that are at risk of negative impacts during the decommissioning phase have been identified as largely modified to seriously modified and further impacts related to sedimentation and habitat degradation may result in a further drop in ecological state of the freshwater systems present. Table 8-9 represents the impact ratings for the decommissioning phase.

Table 8-9: Potential Impacts of the Decommissioning, Closure and Rehabilitation Phase

Dimension	Rating	Motivation	Significance
Activity and Interactions: Decommissioning of all infrastructure			
Prior to Mitigation/Management			
Duration	Project life (5)	The impact will cease after the decommissioning, rehabilitation and closure phases of the project have been completed.	Minor (negative) – 52
Extent	Greater municipal area (4)	General scouring from sedimentation, as well as degraded habitat due to water quality deterioration will affect entire watercourse and river reaches.	
Intensity x type of impact	Serious medium term environmental effects (4)	Due to the sensitivity of wetland systems in general and the already degraded nature of the systems present, should no management or mitigation measures be employed, activities could result in serious medium term impacts.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the flora and wetlands present are considered probable.	

Dimension	Rating	Motivation	Significance
Nature	Negative		
Post-Mitigation			
Duration	Project life (5)	The impact will cease after the decommissioning, rehabilitation and closure phases of the project have been completed.	Negligible (negative) – 27
Extent	Limited (2)	Impacts will be limited only to the project footprint area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity x type of impact	Minor effects on the biological or physical environment (2)	Due to the impacted nature of the systems present, should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the flora and wetland systems present	
Probability	Unlikely (3)	Should the proposed project proceed, and the appropriate management and mitigation measures be implemented, impacts are considered unlikely.	
Nature	Negative		
Activity and Interactions: Rehabilitation measures			
Prior to Mitigation/Management			
Duration	Project life (5)	The impact will cease after the rehabilitation of the project has been completed.	Minor (negative) – 52
Extent	Greater municipal area (4)	General scouring from sedimentation, as well as degraded habitat due to water quality deterioration will affect entire watercourse and river reaches.	
Intensity x type of impact	Serious medium term environmental effects (4)	Due to the sensitivity of the flora wetland systems in general and the already degraded nature of the systems present, should no management or mitigation measures be employed, activities could result in serious medium term impacts.	

Dimension	Rating	Motivation	Significance
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the flora and wetlands present are considered probable.	
Nature	Negative		
Post-Mitigation			
Duration	Project life (5)	The impact will cease after the rehabilitation and closure phases of the project have been completed.	Negligible (negative) – 27
Extent	Limited (2)	Impacts will be limited only to the project footprint area and will be rehabilitated accordingly on completion of the decommissioning phase.	
Intensity x type of impact	Minor effects on the biological or physical environment (2)	Due to the impacted nature of the systems present, should the appropriate precautions and management or mitigation measures be employed, the project could result in only a minor ecological impact to the flora and wetland systems present	
Probability	Unlikely (3)	Should the proposed project proceed, and the appropriate management and mitigation measures be implemented, impacts are considered unlikely.	
Nature	Negative		

8.1.5 Cumulative Impacts

The flora and freshwater resources in this area are currently heavily impacted as a result of various cumulative impacts from extensive mining activities in the area. In addition, other impacts to the flora and freshwater resources present in the vicinity of the proposed project include agricultural cultivation, road construction, powerline construction and associate servitudes and grazing activities.

9 Mitigation and Management Measures

See previous section for mitigation and management measures.

10 Monitoring Requirements

The flora and wetland systems should be monitored monthly during construction and for 3 years after the construction phase has been completed. During decommissioning and rehabilitation, the systems should be monitored monthly. Post-closure and rehabilitation, wetlands should be monitored annually for a period of 3 years.

11 Public Participation

The Public Participation (PP) Process will be followed. Should Interested and Affected Parties (I&APs) raise specific queries regarding wetlands/flora, the comments will be addressed in the CRR and updated submission to authorities.

12 Reasoned opinion of the specialist

It is the opinion of the ecologist that should the proposed pipeline project proceed, impacts to the wetland systems present are deemed limited with the implementation of the proposed management and mitigation measures. Further impacts to the ecology of the wetlands and flora are thus deemed likely to be limited with strict environmental management and mitigation measures in place.

13 Conclusion

Digby Wells was commissioned by HCI Coal to complete a Flora and Wetland Assessment for the proposed pipeline for the conveyance of treated water from the Tweefontein Water Reclamation Plant to the Mbali Colliery.

The majority of the study area had undergone transformation due to cultivation for maize and soy beans, as well as mining activities and road construction which resulted in historical disturbance of floral components and soil compaction in some areas. Livestock were also observed throughout most of the site and evidence of overgrazing was recorded in grassland areas.

A total of 42 plant species were recorded on site. Multiple wetland systems, totalling 211.8 ha, fall within the 500m buffer of the proposed pipeline route. Four HGM Units were

identified on site; a large un-channelled valley bottom wetland that drains into a channelled valley bottom system, a seep and an isolated depression. Impacts to the ecology of the wetlands and flora are deemed likely to be limited with strict environmental management and mitigation measures in place.

14 References

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Kotze, D.C., Marneweck, G.C., Batchelor, A.L., Lindley, D.C., and Collins, N.B. 2007. A Technique for rapidly assessing ecosystem services supplied by wetlands. Mondi Wetland Project.

Macfarlane, D., Kotze, D., Ellery, W., Walters, D., Koopman, V., Goodman, P., et al. 2009. A technique for rapidly assessing wetland health: Wet-Health. Water Research Commission.

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Rountree, M.W., H. Malan and B. Weston (editors). 2012. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). Joint Department of Water Affairs/Water Research Commission Study.

Rutherford MC, Mucina L. Introduction. In: Mucina L, Rutherford MC,editors. The vegetation of South Africa, Lesotho and Swaziland. Pretoria: South African National Biodiversity Institute, 2006; p. 384–385

Swanepoel, C.M., Barnard, R.O., 2007. Discussion Paper: Wetland in agriculture. Water

Appendix A: CVs of the Project Team

DANIEL JAKOBUS OTTO

Mr Daniel Otto

Director

Natural Sciences Department

Digby Wells Environmental

1 EDUCATION

- M.Sc (Geography & Environmental Management), University of Johannesburg (UJ), South Africa, 1997.
- B.Sc (Hons) (Geography/Botany), UJ, 1992: Environmental Management and Geomorphology;
- Water Management and GIS.
- B.Sc (Geography/Botany): UJ, South Africa, 1991.

2 TRAINING

- ISO14001 International Auditors course
- University of Pretoria Wetland Identification and Rehabilitation Course
- Carrying capacity and grass identification course
- GIS
- Management Skills
- Golder Global Leadership Development

3 EMPLOYMENT

- 2011 - Current Digby Wells & Associates Director: Natural Sciences Departments
  - Bio-geomorphologist: Wetland and Rehabilitation Scientist.
  - Environmental permitting processes, environmental and compliance audits, rehabilitation and specialist studies for mines.
  - Manage Biophysical (Fauna & Flora, Soils, Rehabilitation, Aquatics/Wetland and Rehabilitation Units), Surface Water, Groundwater and Air Quality Departments with the various Department and Unit Managers.

- 2005 – 2011 Golder Associates Africa (Pty) Ltd Associate
  - Manager: Florida Ecology Office - Bio-geomorphologist: Wetland and Rehabilitation Scientist.
  - Undertaking Environmental Assessments and compiling Environmental, Water & Waste Management Plans focussing on the mining industry.
  - Integrated Pollution Control development via phytoremediation and wetland assessments. Construction of wetlands for passive water treatment purposes. Underlying this is the goal and function of river and wetland rehabilitation with the emphasis on geomorphological aspects. Manager of Ecology Division and office of 20 staff.
- 2003 - 2005 GCS (Pty) Ltd Director
  - Managed personnel, budget and projects of the Environmental, Water Use and GIS Units undertaking environmental assessments, water licence applications etc
- 1998 - 2003 Digby Wells & Associates (Pty) Ltd Director
  - Managed projects, budgets and teams of various multidisciplinary projects. Work mostly mining related.
- 1995 - 1998 Pulles Howard & De Lange (PHD) Inc. Environmental Scientist
  - Managed projects, budgets and teams of various multidisciplinary environmental and water projects and assisted in research such as passive treatment wetland projects and A Manual on Mine Water Management and Treatment Practices in South Africa.
- 1994 Vista University Junior Lecturer
  - Lectured Geomorphology and Environmental Management and undertook research on desert vegetation cover.
- 1993 - 1994 CSIR Contract Researcher
  - Undertook research on A manual to Assess and Manage the Impact of Gold Mining Operations on the Surface Water Environment – on CSIR contract.
- 1991 - 1992 RAU (University of Johannesburg) Technical Assistant
  - General laboratory assistant and soil laboratory assistant for research on tailings sediment and dune sands.

4 EXPERIENCE

Countries worked in:

Botswana, South Africa, Lesotho, Zimbabwe, Mozambique, Mali, CAR, Sierra Leone.

5 PROJECT EXPERIENCE

5.1 ENVIRONMENTAL IMPACT ASSESSMENTS AND MANAGEMENT PLANS

- Rio Tinto – Mali Green gold mine, Kwekwe, Zimbabwe: EIA to World Bank Standards.
- Nevsun-Tabakoto gold mine, Mali: Ecological survey to IFC/World Bank standards.
- Impala Platinum: 16, 17 and 20 Shaft EMPRs.
- De Beers Finsch Diamond Mine: Fines Residue Deposit EMPR.
- Anglo Coal - Mafube Coal Mine: EMPR and project team member.
- Samancor: Eastern Chrome Mines: Project Manager - EMPRs, IWWMPs, Closure Plans.
- Highveld Steel and Vanadium: Transalloys Tiaco process EIA.
- Anglo Platinum Process Plant (ACP): Waterval Smelter EIA including river diversion.
- TEM: Proposed Wild Coast Heavy Minerals Mining – Environmental Scan of Ecological Aspects.
- South Eastern District Council Landfill, Gaborone, Botswana: Landfill and Hazardous Waste Site EMP.
- Eskom/Amplats, Polokwane: Powerline to platinum processing plant – Ecology.
- Strategic Fuel Fund-Tavistock: Wetland and pan assessments.
- Anglovaal-Dorstfontein Coal Plant: Vegetation, wetland and land assessment.
- Total Coal Holdings: Springbok siding scoping report specialist input.
- Kriel TLC: Kriel powerline and pipeline to Dorstfontein – EIA.
- Paulpietersburg siding: Scoping report specialist input (Paulpietersburg).
- Consolidated Modderfontein Mines Environmental: Johannesburg - South Africa Liability assessment review.
- Foskor phosphate mine: EMP for re-mining tailings and new tailings dam facility.
- Palabora Mining Company: Water Management Plan, IWULA, EIAs, Closure Plan.
- Xstrata – Spitzkop Mine and Plant: Coal mine EMP amendments.
- Xstrata Coal: Tselentis waste disposal facility EMP amendments.
- Xstrata Coal: Beesting mine vegetation and wetland survey.
- JCI Coal: Caroline opencast mine, plant and waste facilities.
- Pafuri Metals: Vegetation survey for Madimbu corridor.
- Bushveld Mines: Klipwal gold mine, plant and waste facilities.
- Crown Gold Recoveries:

- Meretsel Silts – Wetland alteration and rehabilitation EMP.
- Fleurhof Dam – Wetland alteration and rehabilitation for dredge mining EMP.
- Anker/Gholfview: Ermelo Coal Rail Siding EIA.
- Gibb Africa/Dept. of Transport: Mojadji development – road and quarries EMP.
- Etruscan Diamonds: Scoping vegetation survey for diamond mining.
- Dullstroom water purification plant: Ecological survey.
- Xstrata Coal –Tavistock: Water Management Plan specialist input.
- Kalgold (Harmony): Rock dump EMPR.
- Metorex - Bankfontein Colliery: EMPR Ecological Aspects.
- Metorex - Kleinfontein Colliery: EMPR Ecological Aspects.
- Kao Diamond Mine and Road, Lesotho: EMP & EMPR, Ecological Aspects.
- Samancor - Western Chrome: Mooinooi Operations – Project Manager & EMPR Ecological. Aspects. Millsell Operations – Project manager & EMPR Ecological Aspects.
- Bakouma Uranium Mine, Central African Republic: Ecological aspects of EIA.
- Tanguma Environmental Baseline study, Sierra Leone: Project Manager.
- Benga EIA, Mozambique: Ecology and wetland aspects.
- Moatize Biomonitoring, Mozambique: Project Manager.
- Matla: River diversion EIA, WULA, Audits, long term monitoring, Wetland Management Plan. Project Manager.
- Thuni Dam, Selebi Pikwe, Botswana: EIA scoping report.
- Hazardous Waste Site, Lobatse area, Botswana: Environmental Audit and EIA input.
- Protea Hotels (African Pride): EIA for Jackalberry Camp to Lodge and Concession in the Kruger National Park. Jakkalsbessie/Tinga KNP Concession Area – EIA & EMP.
- Glenburn Lodge: Specialist ecology studies for EIA for expansion.
- Bronberg Nature Reserve: Scoping ecological report – property sub-division.
- Rand Uranium: EIA/EMP for Cooke Plant optimisation, tailings dam, pipelines and pit deposition (Project Sponsor).

5.2 ENVIRONMENTAL REHABILITATION

- **Pomfret Asbestos Mine:** Input into management plan and impact assessment from sources, pathways and rehabilitation point of view.
- **Iscor Steel Works (Vanderbijlpark):** Management plan for waste discard and slag pollution control measures, rehabilitation and vegetation programme.

- **Pering Lead Mine – BHP-Billliton:** Closure plan. Rehabilitation aspects.
- **ERPM Gold Mine:** Tailings facility rehabilitation management and vegetation survey (Germiston).
- **Foskor Phosphate Mine:** Rehabilitation consultation, EIA, EMP, Integrated Water Licence application.
- **Durnacol Coal Mine:** Durnacol rehabilitation and closure risk assessment plan inputs.
- **Northern Metropolitan Local Council Randburg:** Rehabilitation Plan input - Pipeline and watercourses for Cosmo City, co-manage implementation of EMP review and Audits.
- **Highveld Technopark Wetland:** Review wetland and waste facility rehabilitation and environmental management plans of Centurion Council.
- **Hartebeesfontein:** Tailings facility rehabilitation plan and on site implementation review.
- **CMR Golfcourse wetland:** Concept design team for wetland for seepage treatment (Maraisburg).
- **WAGM Arnot Colliery and VCC Colliery wetlands:** Input into concept design and construction consultation on pilot scale passive treatment wetland systems.
- **Pidwa Game Ranch:** Vegetation rehabilitation.
- **Kangala Cola Mine, Universal Coal:** Rehabilitation plan.

5.3 AUDITS, CLOSURES PLANING, LIABILITY ASSESSMENTS AND ENVIRONMENTAL MANAGEMENT PLAN IMPLEMENTATIONS

- Various mining operations in South Africa.
- **Hewlett Packard – Techink:** Due diligence on digital ink manufacturing and milling facilities.
- **Target Gold Mine:** SHE Audit, sustainability reporting, Performance Assessment audit.
- **Assmang Chrome Smelter:** SHE Audit, sustainability reporting.
- **Assmang Manganese Smelter:** SHE Audit, sustainability reporting.
- **Black Rock Manganese Mines:** SHE Audit, sustainability reporting, Performance Assessment audit.
- **Beeshoek Iron Ore Mine:** SHE Audit, sustainability reporting, Performance Assessment audit.
- **Dwarsrivier Chrome Mine:** SHE Audit, sustainability reporting, Performance Assessment audit.
- **Nkomati Base Metals Mine:** SHE Audit, sustainability reporting, Performance Assessment audit.

- **Crown Mines:** Environmental audits for C-Dump, C-west, 3/L/13, Rosherville Dam, Valley Silts operations.
- **Bushveld Mines:** Klipwal gold mine, water management plan for plant and waste facilities inputs.
- **Xstrata Coal:** Spitzkop Mine and Plant specialist input.
- **Lepele Water:** Phalaborwa Pipeline construction EMP audit.
- **Rand Water:** Kroondal Pipeline construction EMP audit.
- **Total Coal Holdings:** Forzando field condition audit.
- **Crocodile River Platinum Mine:** State of Environment and investigation into potential effects on tree species.
- **Black Rock Manganese:** Detailed closure costing.
- **Chemwes Gold Mine:** Quarterly Environmental Audits 2000-2005.
- **Mamre Gold Mine:** Closure Cost and Liability Assessment.
- **Wonderstone:** Pyrophyllite mine, Environmental Audit.
- **Rustenburg Minerals Development:** Environmental Audit of Chrome Mine.
- **Simmer & Jack, DRD:** NW Operation (Buffelsfontein & Hartbeesfontein) liability assessment.
- **Simmer & Jack Management Committee, TGME:** Pilgrims Rest Mines, EMP audits (part of Management Committee).
- **Vanchem:** Water Use Licence Audit (Vanadium Plant and Tailings Facility).

5.4 ENVIRONMENTAL RISK ASSESSMENT AUDITS

- **Iscor Vanderbijlpark:** Flat Steel Plant, Environmental Risk Assessment and SHE audit. Galvanising, Hot Mills, Cold Mills, Continuous casting, Arc Furnaces, Blast furnaces.
- **Iscor Vereeninging:** Specialist Steel Plant, Environmental Risk Assessment and SHE audit.
- **Iscor Newcastle:** Profile Steel Plant, Environmental Risk Assessment and SHE audit.
- **National Metals:** Scrap Steel processing facilities, Environmental Risk Assessment and SHE audit.
- **Dunswart Direct Iron Ore Reduction:** Direct Iron Ore Kiln and Reduction Plant, Environmental Risk Assessment and SHE audit.
- **Vantin:** Flat Steel Processing and packaging Plant, Environmental Risk Assessment and SHE audit.
- **Suprachem:** Coking oven gas plant, BTEX Plant, Environmental Risk Assessment and SHE audit.

Professional affiliations

- **Kusile Power Station:** Environmental Monitoring Committee (Chairperson: 2011 - Current).
- **Fellow:** Water Institute of South Africa.
- **IAIAsa**.
- **Botanical Society of South Africa**.
- **Simmer & Jack Management Committee:** Environmental Management Committee member (2004).

6 PROFESSIONAL REGISTRATION

Registered Natural Scientist S.A (Reg. No. 400096/02)

7 PUBLICATIONS

- Howie, D.R. and Otto. D. (1996). The Impact of Gold Mining Activities on the Water Quality and Users in the Upper Klip River Catchment. WISA Conference Proceedings 1996.
- Pulles, W., Howie, D., Otto, D., and Easton, J. (1996) A Manual on Mine Water Management And Treatment Practices in South Africa. WRC Report TT 80/96.
- Contributing Author. A manual to Assess and Manage the Impact of Gold Mining Operations on the Surface Water Environment. WRC Report No. TT79/96.
- Matla's successful wetland undertaking, SA Mining, March 2009.
- Grundling, A.T; Price, J.S; Linstrom, A; Grundling, P; Van den Berg, H.M.; Riddel, E and Otto, D.J. (2010) The South African National Wetland Classification System: Relevance to the wetlands in the Kruger National Park. 8th Savanna Science Network Conference. Skukuza, South Africa.

Ms Kieren Jayne Bremner

Biophysical: Wetland and Aquatic Ecology

Digby Wells Environmental

1 Education

Tertiary Education:

M.Sc Aquatic Health (2011) - University of Johannesburg (UJ)

B.Sc. Hons, Natural and Environmental Sciences (2005) - Rand Afrikaans University (RAU)

B.Sc. Zoology and Biochemistry (2004) - Rand Afrikaans University (RAU)

Supplementary training:

Wetland Plants Taxonomy – Short Course (2017) – SANBI

SASS5 Accreditation (2015) – South African River Health Programme

Bread Baking Course (2013) – Il de Pain

First Aid for Children and Family (2011) – Lifestyle Projects

Public Participation (2008) – Golder Associates

First Aid Certificate – Level 1 (2008) – Sharpminds

Environmental Auditing Workshop (2006) – University of Johannesburg (UJ)

Advanced 4x4 driving course (2005) – Driving School

2 Language Skills

English (Fluent)

Afrikaans (Fluent)

French (Basic)

Spanish (Basic)

3 Employment

Institution	Time period	Position held
Digby Wells Environmental	September 2017 - Present	Senior Ecologist: Wetlands and Aquatics
Scientific Aquatic Services	August 2015 – August 2017	Senior Aquatic and Wetland Ecologist
Estuary Care	2014 - 2015	Ecologist
Sustainable Seas Trust	2014	Team Member
The Bakery – Kenton on Sea	November October 2013 – April 2015	Owner and manager
Scientific Aquatic Services	2009 – April 2013	Aquatic Ecologist
TWP Engineering (Johannesburg)	2008	Junior Environmental Scientist
University of Johannesburg	2006 - 2007	Practical demonstrator
University of Johannesburg	2006 - 2007	Laboratory assistant
University of Johannesburg	2005	Research assistant

4 Experience

Desktop evaluations:

- Consulting various national and provincial databases to determine general ecological characteristics of an assessment site.
- Databases include Mining and Biodiversity Guidelines, National Freshwater Ecosystem Priority Areas, various SANBI databases, PESEIS database, etc.
- Sound knowledge and application of relevant legislature including NEMA, MWA, NEMBA, etc.
- Interpretation of datasets through the use of metadata.
- Knowledge and use of various computer programmes including PlanetGIS, GlobalMapper, Basecamp, ArcGIS, Garmin DNR and Microsoft Office.
- Consulting digital satellite images in order to map potential sensitive freshwater features and various points of interest prior to field verification and assessment.
- Desktop wetland delineation prior to field verifications
- Gathering of background information such as vegetation types, soil, climate and geology, conservation status, ecoregions, quaternary catchments, catchment management areas and sub-quaternary reaches.

Ongoing Aquatic Biomonitoring and Toxicological Assessments:

- Aquatic biomonitoring and toxicological assessments include to varying degrees the application of the following:
    - Desktop evaluations of the project area;
    - Site selections and visual assessments of each site;
    - On-site testing of biota specific water quality parameters including pH, electrical conductivity (EC), dissolved oxygen concentration (DO) and temperature, discussed against the relevant guideline water quality values

defined by the Department of Water and Sanitation (DWS), formerly the Department of water Affairs and Forestry (DWAF 1996 vol. 7).
    - Macro-invertebrate sampling according to the SASS5 protocol;
    - Assessment of habitat suitability using IHAS;
    - Fish sampling by means of electro-shocker, seine nets, cast nets;
    - Diatom, sediment and water sampling;
    - Bioaccumulation studies;
    - Application of various Ecostatus methodologies including: FRAI, MIRAI, VEGRAI, IHI and RHAM;
    - In earlier years, application of older RHP indices including: FAII, IHIA and RVI;
    - Whole Effluent Toxicological testing on various trophic levels;
    - Provinces worked in include Gauteng, Mpumalanga, Limpopo Province, North West Province, Eastern Cape and Kwa-Zulu Natal, Free Sate; as well as other African countries including Ghana and the Democratic Republic of Congo.
    - Project range and variety includes aquatic ecological assessments for commercial, mining, residential and linear developments.

Aquatic and Wetland Present Ecological State assessments conducted as part of the Environmental Impact Assessment Process:

- Aquatic ecological assessments include to varying degrees the application of the following:
    - Site selections and visual assessments of each site;
    - On-site testing of biota specific water quality parameters including pH, electrical conductivity (EC), dissolved oxygen concentration (DO) and temperature, discussed against the relevant guideline water quality values defined by the Department of Water and Sanitation (DWS), formerly the Department of water Affairs and Forestry (DWAF 1996 vol. 7).
    - Macro-invertebrate sampling according to the SASS5 protocol;
    - Fish sampling by means of electro-shocker, seine nets, cast nets;
    - Diatom, sediment and water sampling;
    - Application of various Ecostatus methodologies including: FRAI, MIRAI, VEGRAI, IHI and RHAM;
    - In earlier years, application of older RHP indices including: FAII, IHIA and RVI;
    - RDL wetland mammal assessment;
    - Provinces worked in include Gauteng, Mpumalanga, Limpopo Province, North West Province, Eastern Cape and Kwa-Zulu Natal, Free Sate as well as other African countries including Ghana and the Democratic Republic of Congo.
    - Project range and variety includes aquatic ecological assessments for commercial, mining, residential and linear developments.

5 Project Experience

Some of my project experience includes:

Specialist studies and project management

- Numerous wetland delineation and function studies in the Gauteng, Free State and Mpumalanga provinces, South Africa.
- Development of an aquatic intervention plan and regional impact analysis for the Nokeng Flourspar Mine, Gauteng.
- Development and project management of aquatic biomonitoring studies at the Cronimet Mine, Limpopo Province, and the NECSA complex, Pelindaba.
- Implementation of a water quality monitoring programme on the Bushmans and Kariega Estuaries, Eastern Cape.

Aquatic and water quality monitoring and compliance reporting

- Development of the 2010 State of the Rivers Report for the City of Johannesburg.
- Development of an annual report detailing the results of the Everest Platinum Mine water monitoring program.
- Aquatic biomonitoring programs for several Xstrata Alloys Mines and Smelters.
- Aquatic biomonitoring programs for several Anglo Platinum Mines.
- Aquatic biomonitoring programs for several Assmang Chrome Operations.
- Aquatic biomonitoring programs for Petra Diamonds.
- Aquatic biomonitoring programs for several coal mining operations.
- Aquatic biomonitoring programs for several mining operations for various minerals including iron ore, and small platinum and chrome mining operations.
- Aquatic biomonitoring program for industrial clients in the paper production and energy generation industries.
- Aquatic biomonitoring programs for the City of Tshwane Waste Water Treatment Works.
- Aquatic biomonitoring programs for the North West Wastewater Treatment Works.
- Baseline aquatic ecological assessments for numerous mining developments.
- Baseline aquatic ecological assessments for numerous residential commercial and industrial developments.
- Baseline aquatic ecological assessments in Ghana and the Democratic Republic of Congo.
- Water quality monitoring on the Bushmans and Kariega estuaries, Eastern Cape.

Wetland delineation and wetland function assessment

- Wetland studies for developments in the mining industry.
- Wetland studies for developments in the residential commercial and industrial sectors.

Public participation processes • Team member in the Public Participation Process for the Cronimet Mine. • Team member in the Public Participation Process for Wesiswe Platinum Mine.
Training and education • Training of junior staff in the aquatic biomonitoring field. • Educational workshops in mini-SASS in both Mpumalanga and the Eastern Cape. • Educational workshops on water quality monitoring and environmental awareness in the Eastern Cape Province.
Research projects • 2006 – 2010: BREMNER, K.J. The use of the Mozambique Tilapia (Oreochromis mossambicus) as a sentinel species of the possible effects on health and reproduction of DDE in vivo exposure and from a DDT sprayed area. • 2006: BREMNER, K.J. KNEIDINGER, T.M. SERFONTEIN, S. An assessment of the water quality status of the Blesbokspruit Wetlands Ramsar Site. Unpublished. Distinction • 2005: BREMNER, K. A study of the effect of barriers on the integrity of the Houtboschloop River Ecosystem. Unpublished. Distinction

6 Professional Registration

Registered RHP SASS5 practitioner.

Mrs Kathryn Roy

Rehabilitation Specialist

Closure and Rehabilitation

Digby Wells Environmental

1 Education

- 2008 – 2010: BSc Ecology and Environmental Science (University of Cape Town)
- 2011: BSc Honours in Environmental Management (University of Cape Town)
- 2013 – 2015: MSc Restoration Ecology (University of KwaZulu-Natal)

2 Language Skills

- English (fluent); and
- Afrikaans (fair).

3 Employment

- February 2016 – *Present*: Digby Wells Environmental – Rehabilitation Specialist
- February 2012 – February 2015: Environmental Planning and Climate Protection Department, EThekwini Municipality – Research Assistant and Programme Facilitator

4 Experience

Kathryn received a Bachelor of Science in Ecology and Environmental Science and an Honours degree in Environmental Management from the University of Cape Town. She has also received her MSc in Restoration Ecology from the University of KwaZulu-Natal. Kathryn also has completed additional courses in Project Management, Herbarium techniques and Invasive Alien Plant Training (advanced). Kathryn has varied experience both in the local government and consulting environments. This experience includes:

- Compilation of Rehabilitation Plans and assessment of rehabilitation actions throughout South Africa, including:
  - Conceptual Rehabilitation Plans;
  - Detailed Rehabilitation Plans; and
  - Final Rehabilitation, Decommissioning and Mine Closure Plans.
- Facilitation of the University of KwaZulu-Natal – eThekwini Municipality Reforestation Research Partnership:

- Acted on behalf of the eThekwini Municipality, in order to actively drive the objectives of the new research partnership;
- Researched critically important biodiversity and ecosystem assets within the eThekwini Municipality's natural environmental areas;
- Undertook and promoted research on biodiversity, climate change, and socio economic upliftment within the context of local ecosystem restoration and reforestation;
- Transcribed scientific and technical work into popular format for dissemination to stakeholders; and
- Student/staff/researcher liaison.

- Helped to Manage the eThekwini Municipality's Community Reforestation Programme (ecosystem-based adaptation project):
  - Undertook all necessary research, including inputs into experimental design, monitoring, data capture, analyses and verification and contributed to the required proofreading, writing-up, and distribution of research;
  - Showcased the reforestation projects by means of presentations at seminars, field trips, symposiums and conferences locally and internationally;
  - Co-authored a document highlighting the Buffelsdraai Community Reforestation Project;
  - Compiled proposals for funding and awards; and
  - Developed a framework for future monitoring, data capture and evaluation, and ensured relevant databases and reference systems were updated.
- Invasive Alien Plant (IAP) Management:
  - Preparation of tender documents, attendance at tender evaluations, tender briefings, etc.;
  - Project management of the compilation of the Beautiful but Dangerous IAP posters and flash cards, including data and photo collection, collation and liaison with designers; and
  - Project management for the IAP guideline documents, including authoring, data and photo collection, collation and liaison with designers and between authors.

5 Project Experience at Digby Wells

Some of Kathryn's project experience at Digby Wells is listed below:

Year	Client	Project	Responsibility	Location
2016	Copper Sunset Sands (Pty) Ltd	Bankfontein Rehabilitation and Closure Plan	Compilation of Rehabilitation Plan	Free State, South Africa
2016	Naledzi	Geluk Conceptual Rehabilitation and Closure Plan	Compilation of Rehabilitation Plan	Limpopo, South Africa
2016	Eskom	Kilbarchan Rehabilitation and Closure Plan	Compilation of Rehabilitation Plan	KwaZulu-Natal, South Africa
2016	Namane Resources	Namane Generation IPP and Transmission Line Rehabilitation and Closure Plan	Compilation of Rehabilitation Plan	Limpopo, South Africa
2016	Uranex	Nachu Graphite Mine Conceptual Rehabilitation Plan	Compilation of Rehabilitation Plan	Tanzania
2016-present	Sasol Mining	Rehabilitation of the East Overburden Stockpile	Project Manager, Rehabilitation Assessment, and Compilation of Rehabilitation Plan	Free State, South Africa
2016-present	Glencore	Proposed Development of an Underground Coal Mine and Associated Infrastructure near Hendrina, Mpumalanga	Compilation of Rehabilitation Plan	Mpumalanga, South Africa

6 Publications

- Douwes,E., Rouget, M., Diederichs, N., O'Donoghue, S., Roy, K., Roberts, D. The Buffelsdraai Landfill Site Community Reforestation Project. *Unasylva* 247/248, Vol. 67: 12-28.
- Douwes, E., Roy, K.E., Diederichs-Mander, N., Mavundla, K., Roberts, D. 2015. The Buffelsdraai Landfill Site Community Reforestation Project: Leading the way in community ecosystem-based adaptation to climate change. EThekwini Municipality, Durban, South Africa.

- Water Hyacinth Control Guideline Document: Insight into Best Practice, Removal Methods, Training & Equipment. 2013. Environmental Planning and Climate Protection Department. EThekwini Municipality (co-author), p. 58.
- General Invasive Alien Plant Control Guideline Document: Insight into Best Practice, Removal Methods, Training & Equipment. 2013. Environmental Planning and Climate Protection Department. EThekwini Municipality (co-author), p. 78.
- Beautiful but Dangerous posters. 2013. Environmental Planning and Climate Protection Department. EThekwini Municipality, p 5.
- EThekwini State of Biodiversity: Report 2011/2012. Environmental Planning and Climate Protection Department. EThekwini Municipality (acknowledged contributor), p. 27.