Phase 2: Environmental Authorisation Application Processes for the Proposed Twyfelaar Coal Mining Project near Ermelo, Mpumalanga

Wetland Assessment

Project Number:

DAG5603

Prepared for:

Dagsoom Coal Mining (Pty) Ltd

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EXECUTIVE SUMMARY

Digby Wells Environmental was commissioned by Dagsoom Coal Mining (Pty) Ltd to conduct a wetland specialist study to inform the Environmental Impact Assessment (EIA) process being conducted for the proposed Twyfelaar coal mining project (hereafter "the project").

The wetland assessment carried out in September 2019 revealed the presence of twelve wetland systems within the proposed project area and its 500 m zone of regulation, with varied HGM units associated with each.

The HGM unit types observed within the project area included: bench, hillslope seep, channelled valley bottom and unchanneled valley bottom systems. These HGM units were categorized largely on topography and their respective locations within the landscape.

The health and integrity of each of the HGM units present varied considerably, with anthropogenic disturbances being the most significant driver of change to date. These disturbances were related largely to agropastoral activities and linear infrastructures traversing the greater project area, and the hillslope seeps and bench HGM units on the 'koppie' and other higher lying areas were mostly regarded as natural and/or minimally modified, while the lower lying HGM units were mostly regarded as moderately to largely modified.

In terms of service provision and functionality, the wetlands observed within the study area, with special mention of the bench and hillslope seep HGM units, play an important role in the maintenance of biodiversity for v*arious plant and bird* species (including *Geronticus calvus* (Southern Bald Ibis) and *Sagittarius serpentarius* (Secretary Bird)) observed, as well as streamflow regulation. The lower lying wetlands were also observed to be important in the maintenance of biodiversity, but played a larger role in terms of services such as flood attenuation and the provision of human benefits such as water supply, cultivation of crops and grazing potential.

The hydrological driver of the wetlands within the project area appear to be two-fold. It is suspected that the benches and hillslope seeps situated on the 'koppie" are driven to a large extent by the underlying geologies (i.e. the geomorphology). It is suspected that a shallow aquifer is present in the 'koppie', which is comprised of sandstone and shale, with an overlaying sill of dolerite, where daylighting moisture and the origin of many of the hillslope seeps associated with wetlands (namely WET3, WET4, WET5, WET6, WET7 and WET8) were observed. Portions of WET8 in the foothills, with specific reference to the large channelled valley bottom wetland (CVB4), may be regarded as hydrologically connected to the hillslope seeps on the "koppie" and the other high lying areas, however, it is likely that a deeper aquifer supplies water to CVB4 and dewatering of this aquifer for the proposed underground mining has the potential to impact negatively on both WET8 as well as WET9 due to the potential loss of groundwater supply.

Without suitable management and mitigation, should the proposed project proceed, there are likely to be a number of impacts expressed on the wetland ecology of the project area (moderate and minor impacts), with impacts such as erosion, sedimentation, impaired water

quality and the further proliferation of alien and invasive species being of specific concern. However, should the appropriate mitigation and management measures be implemented, along with the recommendations outlined in this report, it is expected that these impacts can be reduced to minor and negligible impacts. In lieu of this finding, it is the opinion of the wetland ecologist that should the appropriate management and mitigation measures be adopted and the mining method (i.e. continuous mining) in place at the time of submission of this report be adhered to, that should the project be approved, impacts to the wetland ecology of the area can be managed in such a way as to minimise the potential deterioration of these systems. Should any changes to the mining method be proposed, this will require revision of the impact assessment as various mining methods (such as blasting), have the potential to impact the shallow aquifer on which many of the ecologically significant bench and hillslope seep HGM units rely for water supply.

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1 Introduction

1.1 Project Description

Dagsoom Coal Mining (Pty) Ltd (hereinafter "Dagsoom") is the holder of a Prospecting Right for coal on the Farm Twyfelaar 298IT, which is situated on the eastern escarpment of the Mpumalanga Highveld in the Ermelo Coal field. Dagsoom intend to apply for a Mining Right in terms of the Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA).

The proposed activities include construction and operation of an underground mine, with all infrastructure around the mine access area on the eastern side of the proposed project area on the farm Twyfelaar 298IT. The footprint of an underground mine on the environment will be limited and contained to the mine access area where all surface activities are concentrated.

The C-seam and, in particular, the C-Lower seam, is the only seam that occurs at mineable thickness (>1.4m for Continuous Miners) over the Project Area. There is a sandstone and shale parting of more than three meters that separates the C-Upper and C-Lower seams and no opportunity exists for these seams to be mined together as per the case at other mines in the area. No faults or dykes were discovered during the exploration phase and bord and pillar mining with continuous miners is the preferred mining option. The proposed Life of Mine is between four and five years.

1.1 Resource Access

The position for the mine access is selected based on a practical view on the seam access, mine layout, ventilation considerations, terrace for product handling and access road from the tar road together with the surface infrastructure needing to be positioned outside the wetlands.

The resource will be accessed through a boxcut on the side of the mountain and the C-lower seam will be accessed directly without any declines. No detailed geotechnical analysis has been done on the strata formation stability where the boxcut is planned and a typical safe excavation is planned for the purpose of this exercise. Detailed designs will also reveal if the boxcut must access the seam at a dip or if the floor of the boxcut will be an extension of the coal floor of the C-Lower seam. The current design accesses the seam at 7 degrees which allows for the smallest and lowest cost excavation.

1.2 List of Infrastructure

- Underground mine accessed by adit;
- Small rock dump (from boxcut);
- Access and haulage road – Maximum 9.6m wide, maximum 6km long;
- Two ventilation fans;

- Processing plant;
- Pollution control dam (volumetric capacity of approximately 5 500 m^3 and measures 40x35x4 m);
- Raw water pump station and process water pump station;
- Pipelines:
  - Both pipelines are 2 inch HPDE. Maximum requirement 22.1 m3/h;
  - Raw water pipeline = 1.49km (traverses two watercourses and road);
  - Process water pipeline;
- Electricity supply – 22kV line 2.3 km long;
- Potable water treatment plant and associated tanks;
- Sewage treatment plant;
- Reverse Osmosis plant;
- 2 x change houses;
- Offices and ablutions;
- Workshops and cable workshop;
- Refuel bay;
- Weighbridge and weighbridge control room; and
- Access control office.

1.3 Project Phases and Activities

Project Phase	Project Activity
Construction Phase	Site/vegetation clearance
	Access and haul road construction
	Infrastructure construction
	Power line construction
	Diesel storage and explosives magazine
	Topsoil stockpiling
Operational Phase	Removal of rock (blasting)
	Stockpiling (rock dumps, soils, run of mine (ROM), discard dump) establishment and operation

Project Phase	Project Activity
	Diesel storage and explosives magazine
	Operation of the underground workings
	Operating processing plant
	Operating sewage treatment plant
	Water use and storage on-site – during the operation water will be required for various domestic and industrial uses. Dams will be constructed that capture water from the mining area which will be stored and used accordingly
	Storage, handling and treatment of hazardous products (including fuel, explosives and oil) and waste
	Maintenance activities – through the operations maintenance will need to be undertaken to ensure that all infrastructure is operating optimally and does not pose a threat to human or environmental health. Maintenance will include haul roads, pipelines, processing plant, machinery, water and storm water management infrastructure, stockpile areas
Decommissioning Phase	Demolition and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation of the final land rehabilitation
	Rehabilitation – rehabilitation mainly consists of spreading of the preserved subsoil and topsoil, profiling of the land and re-vegetation
	Post-closure monitoring and rehabilitation

1.4 Terms of Reference

Digby Wells Environmental (hereafter “Digby Wells”) was commissioned by Dagsoom to conduct a wetland specialist study to inform the Environmental Impact Assessment (EIA) process being conducted for the proposed Twyfelaar coal mining project (hereafter “the project”). The aim of the wetland specialist assessment is to provide a report describing the following:

- Desktop investigation of the catchments, regional context and potential freshwater resources within the Project Area;
- The identification, characterisation, and delineation of wetlands within the project area;
- Assessment of the Present Ecological State (PES), wetland service provision, and Ecological Importance and Sensitivity (EIS);
- Sensitivity mapping and the recommendation of buffer zones;

- Impact assessment of the proposed activities based on the findings of the desktop and field assessments in relation to the proposed activities and infrastructure; and
- Discussion of recommended management and mitigation measures.

2 Biodiversity and Importance of Wetlands

Biodiversity within inland water ecosystems in southern Africa is both highly diverse and of great regional importance to local livelihoods and economies as these valuable natural resources (including any associated biota) provide a broad array of goods and services (Darwall, Smith, Tweddle, & Skelton, 2009; Dudgeon et al., 2006). However, these freshwater systems may well be the most endangered ecosystems in the world, as economic growth and development threatens any of the 126,000 described species that depend upon these habitats for any critical part of their life cycle, as well as any associated provisioning and/or regulatory ecosystem services (Dudgeon et al., 2006).

The major global threats identified within these species-rich systems include (i) ecosystem destruction, (ii) habitat alteration, (iii) changes in water chemistry and (iv) direct additions and/or losses of aquatic biota (Malmqvist & Rundle, 2002). The magnitude of the threat to and loss of biodiversity in these vulnerable ecosystems is an indicator of the extent to which current practices are unsustainable. Hence, the importance of implementing conservation and management strategies that protect all elements of freshwater biodiversity, which in turn, would help to guarantee water availability in the future (Dudgeon et al., 2006).

The fact that South Africa is a water-scarce country makes these ecosystems even more susceptible to pressure by anthropogenic activities and their associated impacts. Consequently, the state (quality and quantity) of the county's water resources is fully dependant on good land management practices. In order to achieve ecological and socio-economic sustainability, our natural water resources rely upon an integrated ecosystem-based approach to natural resource management (Integrated Water Resource Management).

Wetlands are sensitive ecosystems that perform many complex functions including the maintenance of water quality, assimilation of nutrients, carbon storage, stream-flow regulation, flood attenuation, various social benefits as well as the maintenance of biodiversity ((D. C. Kotze, Marneweck, Batchelor, Lindley, & Collins, 2009)). The Ramsar Convention on Wetlands refers to wetlands as one of the most important life support systems on earth owing to the aforementioned services provided. According to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), wetlands are defined 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."

Wetlands in South Africa are poorly conserved primarily due to a general underestimation of the ecological and economic importance of these systems. According to the National Biodiversity Assessment (2011), 48% of South Africa's wetlands are critically endangered, and thus wetlands are classified as the country's most threatened ecosystem type (Driver et al., 2012). It is further estimated that between 35-50% of all the wetland areas within South Africa have been destroyed as a result of anthropogenic stressors and a cumulative loss of these important systems is on-going. Some of the major factors contributing to the decline of wetlands in South Africa include mining, industrial and agricultural activities as well as poor treatment of waste water from industry and mining.

Wetlands are highly susceptible to the degradation of quality and a reduction in quantity as a result of anthropogenic resource use activities, land surface development, landscape-management and all practices that alter the hydrological regime impacting these wetland systems. Historically, wetlands have been perceived to be wastelands. This has resulted in the exploitation, alteration and in many cases the complete destruction of these ecosystems, with an accompanying loss of associated ecosystem goods and services. It is now acknowledged that these ecosystems perform functions making them invaluable to the management of both water quantity and quality, and as a result, wetlands are regarded as integral components of catchment systems. The dilemma facing South Africa is that there is a growing demand for energy (in the form of coal) as well as the need to protect wetland ecosystems. Wetlands are inextricably linked to coal mining, as coal deposits are often overlain by wetlands. The need therefore arises to sustainably manage South Africa's wetlands and assess the potential adverse impacts that may arise, whilst ensuring sufficient coal is mined to facilitate economic growth.

3 Policy and Legal Framework

The wetlands assessment aims to support the following regulations, regulatory procedures and guidelines:

- Section 24 of the Constitution of the Republic of South Africa ,1996 (Act No. 108 of 1996);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA); and
- Section 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

4 Methodology

4.1 Literature Review and Desktop Assessment

Preliminary wetland boundaries were delineated on a desktop level using detailed aerial imagery (Southern Mapping, 2015) along with 5 m contours and wetland signatures. Background information was researched and used to understand the area on a desktop level. This included but was not limited to:

- National Freshwater Ecosystem Priority Areas (NFEPA) (Nel et al., 2011);

- Mining and Biodiversity Guidelines (DEA, DMR, SAMBF, SANBI, 2013);
- Water Management Areas (WMA) and Quaternary Catchments; and
- Mpumalanga Biodiversity Sector Plan (MBSP) (MBSP, 2014).

4.2 National Freshwater Ecosystem Priority Areas (NFEPA)

The National Freshwater Ecosystem Priority Areas (NFEPA) project represents a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water Affairs (DWA; now Department of Water and Sanitation, or DWS), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). More specifically, the NFEPA project aims to:

1. Identify Freshwater Ecosystem Priority Areas (hereafter referred to as 'FEPAs') to meet national biodiversity goals for freshwater ecosystems; and
2. Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

The first aim uses systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity within the context of equitable social and economic development. The second aim is comprised of two separate components: the (i) national component aimed to align DWS and DEA policy mechanisms and tools for managing and conserving freshwater ecosystems, while the (ii) sub-national component is aimed to use three case studies to demonstrate how NFEPA products should be implemented to influence land and water resource decision-making processes. The project further aimed to maximize synergies and alignment with other national level initiatives, including the National Biodiversity Assessment (NBA) and the Cross-Sector Policy Objectives for Inland Water Conservation (Driver et al., 2011a).

Wetland clusters are groups of wetlands embedded in a relatively natural landscape. This allows for important ecological processes such as migration of frogs and insects between wetlands. In many areas of the country, wetland clusters no longer exist because the surrounding land has become too fragmented by human impacts (Driver et al., 2011b).

Based on a desktop-based modelled wetland condition and a combination of special features, including expert knowledge (e.g. intact peat wetlands, presence of rare plants and animals, etc.) and available spatial data on the occurrence of threatened frogs and wetland-dependent birds, each of the wetlands within the inventory were ranked in terms of their biodiversity importance and as such, Wetland FEPA's were identified in an effort to achieve biodiversity targets (Driver et al., 2011b). Table 4-1 below indicates the criteria that were considered for the ranking of each of these wetland areas.

Table 4-1: NFEPA wetland classification ranking criteria

NFEPA Wetland Criteria	NFEPA 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 AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition 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

4.3 Mining and Biodiversity Guideline

The Mining and biodiversity guideline was developed collaboratively by SANBI, the 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 4-2 below, each with associated risks and implications.

Table 4-2: 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.

4.4 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, published in 2014 by the Mpumalanga Tourism and Parks Agency (MTPA), 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 summarized below (Table 4-3).

Table 4-3: 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 authorization 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 authorization 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.

4.5 Wetland Identification, Delineation and Classification

The wetlands in the vicinity of the proposed project area were delineated according to the accepted methodology from DWS 'A practical field procedure for identification and delineation of wetlands and riparian areas' (DWAF, 2005) as well as the "Updated manual for identification and delineation of wetlands and riparian areas" (DWAF, 2008). These methodologies use the following four indicators of wetland conditions:

- Terrain Unit Indicator (TUI) – helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator (SFI) – identifies the soil forms, which are associated with prolonged and frequent saturation;
- Soil Wetness Indicator (SWI) – 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.

4.5.1 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 ((South African Dept. Water Affairs and Forestry, 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 or topographic setting. Once wetlands have been identified, they are categorised into HGM units as shown in Table 4-4.

Table 4-4: 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.

4.5.2 Soil Form Indicator

Hydromorphic soils are taken into account for the SFI, which will display unique characteristics resulting from prolonged and repeated water saturation (South African Dept. Water Affairs and Forestry, 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 result in alternation between aerobic and anaerobic conditions in the soil (South African Dept. Water Affairs and Forestry, 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 (South African Dept. Water Affairs and Forestry, 2005).

4.5.3 Soil Wetness Indicator

In practice, the SWI is used as the primary indicator (South African Dept. Water Affairs and Forestry, 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 (South African Dept. Water Affairs and Forestry, 2005). A feature of hydromorphic soils are coloured mottles which are usually absent in permanently saturated soils, are most prominent in seasonally saturated soils, and are less abundant in temporarily saturated soils (South African Dept. Water Affairs and Forestry, 2005). The hydromorphic soils must display signs of wetness within 50 cm of the soil surface, as this is necessary to support hydrophytic vegetation.

4.5.4 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 et al., 1999); South African Dept. Water Affairs and Forestry, 2005). This is summarised in Table 4-5 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 (South African Dept. Water Affairs and Forestry, 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 4-5 becomes more important. If vegetation was to be used as a primary indicator, undisturbed conditions and expert knowledge are required (South African Dept. Water Affairs and Forestry, 2005). Due to this uncertainty, greater emphasis is often placed on the SWI to delineate wetland areas.

Table 4-5: Classification of plant species according to occurrence in wetlands (South African Dept. Water Affairs and Forestry, 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.

4.6 Wetland Ecological Health Assessment (WET-Health)

According to Macfarlane, Kotze, & Ellery (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 wetland. A Present Ecological State (PES) analysis was conducted to establish baseline integrity (health) for the wetland. 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 on wetland health and then to convert the impact scores to a PES 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 PES categories are provided in Table 4-6.

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Table 4-6: Impact scores and PES categories (Macfarlane et al., 2009)

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 PES, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit, 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 4-7).

Table 4-7: Trajectory of change classes and scores used to evaluate likely future changes to the PES 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	↓
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, PES, trajectory of change, and health for individual HGM units and for the entire wetland.

4.7 Wetland Ecological Services (WET-Ecoservices)

The importance of a water resource in ecological, social or economic terms, acts as a modifying or motivating determinant in the selection of the management class'. The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze et al. (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;

- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics were used to quantitatively determine the value and, by extension, sensitivity of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland (**Table 4-8**).

Table 4-8: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

4.8 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, Malan, & Weston (2013) 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 4-9.

Table 4-9: Interpretation of overall EIS scores for biotic and habitat determinants

Ecological Importance and Sensitivity Category (EIS)	Range of Median
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
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
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
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

4.1 Impact Assessment Methodology

Details of the impact assessment methodology used to determine the significance of potential impacts associated with the project 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

Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts

The matrix calculates the rating out of 147, whereby Intensity, Extent, Duration and Probability are each rated out of seven as indicated in Table 4-12. 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 measure proposed in this EIA/EMP Report. The significance of an impact is then determined and categorised into one of eight categories, as indicated in Table 4-11, which is extracted from Table 4-10. The description of the significance ratings is discussed in Table 4-12.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Table 4-10: Impact Assessment Parameter Ratings

Rating	Intensity/Replicability		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. <80% probability.

Rating	Intensity/Replicability		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/Replicability		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 extending only as far as the development site 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 affectik8ng 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 to the site and its immediate surroundings.	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/Replicability		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.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 4-11: Probability/Consequence Matrix

Probability	Significance																																					
7	-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
6	-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
5	-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
4	-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
3	-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
2	-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
1	-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
	-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 4-12: 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	An important positive impact. The impact is insufficient by itself to justify the implementation of the project. 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 but not essential. 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	An important negative impact which 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 serious negative impact which may prevent the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe effects	Moderate (negative)
-109 to -147	A very serious negative impact which 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)

5 Assumptions and Limitations

The assumptions for this report are the following:

- This wetland assessment was based on a single site visit conducted at the end of the winter season and prior to the spring rains (early September 2019), and as a consequence, many floral species (wetland indicators) were unidentifiable owing to a lack of flowers and identifying features. Hydrophilic plants are an important indicator used for delineation of wetland boundaries and the determination of wetland integrity and biodiversity;
- Despite the above limitation, a high level of biodiversity and sensitivity was observed in the September 2019 assessment and thus it is highly recommended that a wet season summer assessment be carried out prior to project approval to verify the delineations and to fully determine the significance of the biodiversity support (much of which would have been overlooked due to the nature of the sampling season);
- Wetlands situated within the 500 m zone of regulation were assessed largely on a desktop level with very limited ground-truthing and some discrepancies within this zone may occur; and
- This wetland study forms part of an larger Evironmental and Social Impact Assessment (ESIA) and should be read in conjunction with the ESIA and other related specialist studies.

5.1 Biophysical Description

5.1.1 Climate and Ecoregion

The project area is located within the Highveld ecoregion. The Highveld ecoregion is characterised by plains with a moderate to low relief and various types of grassland vegetation, with an altitude ranging from 1100 – 2100 m above mean sea level (a.m.s.l.). Relative to the country's average mean annual precipitation (MAP) of 490 mm, this ecoregion experiences moderate rainfall of 400 – 1000 mm. The mean annual temperature of the Highveld ecoregion is hot in the west and moderate in the east (Kleynhans et al., 2005).

5.1.2 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 (DWA, 2012). 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 nation's 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 Inkomati-Usuthu water management area (WMA3), and it is associated with primary drainage region X. The quaternary catchment is W53A. The major watercourse associated with the project area is the Sandspruit (i.e. Sub-Quaternary Reach/SQR W53A-01757) (Department of Water and Sanitation, 2014).

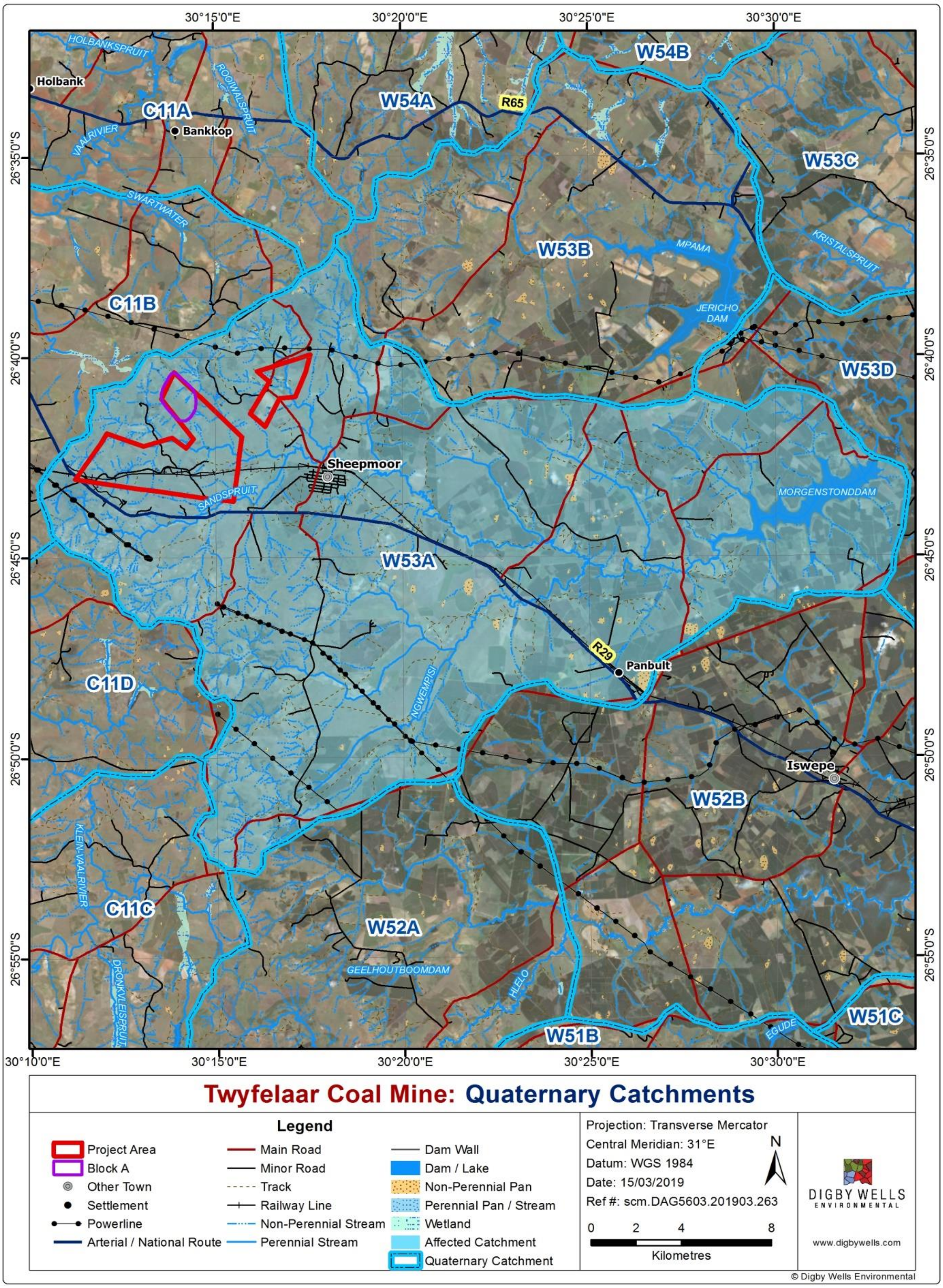

Figure 5-1: Quaternary Catchments

5.1.3 Regional Vegetation

The proposed project falls within the Grassland Biome (Mucina & 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 and Wakkerstroom Montane Grassland regional vegetation types (Mucina & Rutherford, 2012). The Eastern Highveld Grassland is an endangered vegetation type with a conservation target of 24%. The Wakkerstroom Montane Grassland is categorised as a 'Least threatened' vegetation type with a conservation target of 27%. Table 5-1and Table 5-2 list the species characteristic of the Eastern Highveld Grassland and the Wakkerstroom Montane Grassland respectively.

Table 5-1: 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*

Table 5-2: Plant species characteristic of the Wakkerstroom Montane Grasslands

Plant Form	Species
Small Trees	*Canthium ciliatum, Protea subvestita*
Tall Shrubs	*Buddleja salviifolia* (d), *Leucosidea sericea* (d), *Buddleja auriculata, Diospyros lyciodes* subsp. *guerkei, Euclea crispa* subsp. *crispa, Searsia montana, R. rehmanniana, R. transvaalensis*
Low Shrubs	*Asparagus devenishii* (d), *Cliffortia linearifolia* (d),*Helichrysum melanacme* (d), *H. splendidum* (d), *Anthospermum rigidum* subsp. *pumilum, Clutia natalensis, Erica oatesii, Felicia filifolia* subsp. *filifolia, Gymnosporia heterophylla, Helichrysum hypoleucum, Hermannia geniculate, Inulanthera dregeana, Metalasia densa, Printzia pyrifolia, Searsia discolor, Rubus ludwigii* subsp. *Ludwigii*
Graminoids	*Andropogen schirensis* (d), *Ctenium concinnum* (d), *Cymbopogon caesius* (d), *Digitaria tricholaenoides* (d), *Diheteropgon amplectens* (d), *Eragrostis chloromelas* (d), *E. plana, E. racemosa, Harpochloa falx, Heteropogon contortus, Hyparrhenia hirta, Microchloa caffra, Themeda triandra, Trachypogon spicatus, Tristachya leucothrix, Allopteropsis semialata* subsp. *eckloniana, Aristida junciformis* subsp. *galpinii, Brachiaria serrata, Diheteropogon filifolius, Elionurus muticus, Eragrostis capensis, Eulalia villosa, Festuca scabra, Loudetia simplex, Rendlia altera, Setaria nigrirostris*
Herbs	*Berkheya onopordifolia* var. *glabra, Cephalaria natalensis, Pelargonium luridum, Acalypha depressinerva, A. peduncularis, A. wilmsii, Aster bakerianus, Berkheya setifera, Euryops transvaalensis* subsp. *setilobus, Galium thundergianum* var. *thunbergianum, Geranium ornithopodioiodes, Helichrysum cephaliodeum, H. coperi, H. monticola, H. nudifolium* var. *nudifolium, H. oreophilum, H. simillimum, Pentanisia prunelloides* subsp. *latifolia, Plectranthus laxiflorus, Sebaea leiostyla, S. sedoides* var. *sedoides, Selago densiflora, Vernonia hirsuta, V. natalensis, Wahlenbergia cuspidata*
Geophytic Herbs	*Hypoxsis costata, Agapanthus inapertus* subsp. *intermedius, Asclepias aurea, Cheilanthes hirta, Corycium dracomontanum, C. nigrenscens, Cyrtanthus tuckii* var. *transvaalensis, Disa versicolor, Eriospermum cooperi* var. *cooperi, Eucomis bicolor, Geum capense, Gladiolus ecklonii, G. sericeovillosus* subsp. *sericeovillosus, Hesperantha coccinea, Hypoxsis rigidula* var. *pilosissima, Moraea brevistyla, Rhodohypoxis baurii* var.*confecta*
Semiparasitic Herb	*Striga bilabiata* subsp. *Bilabiate*

*d = Dominant

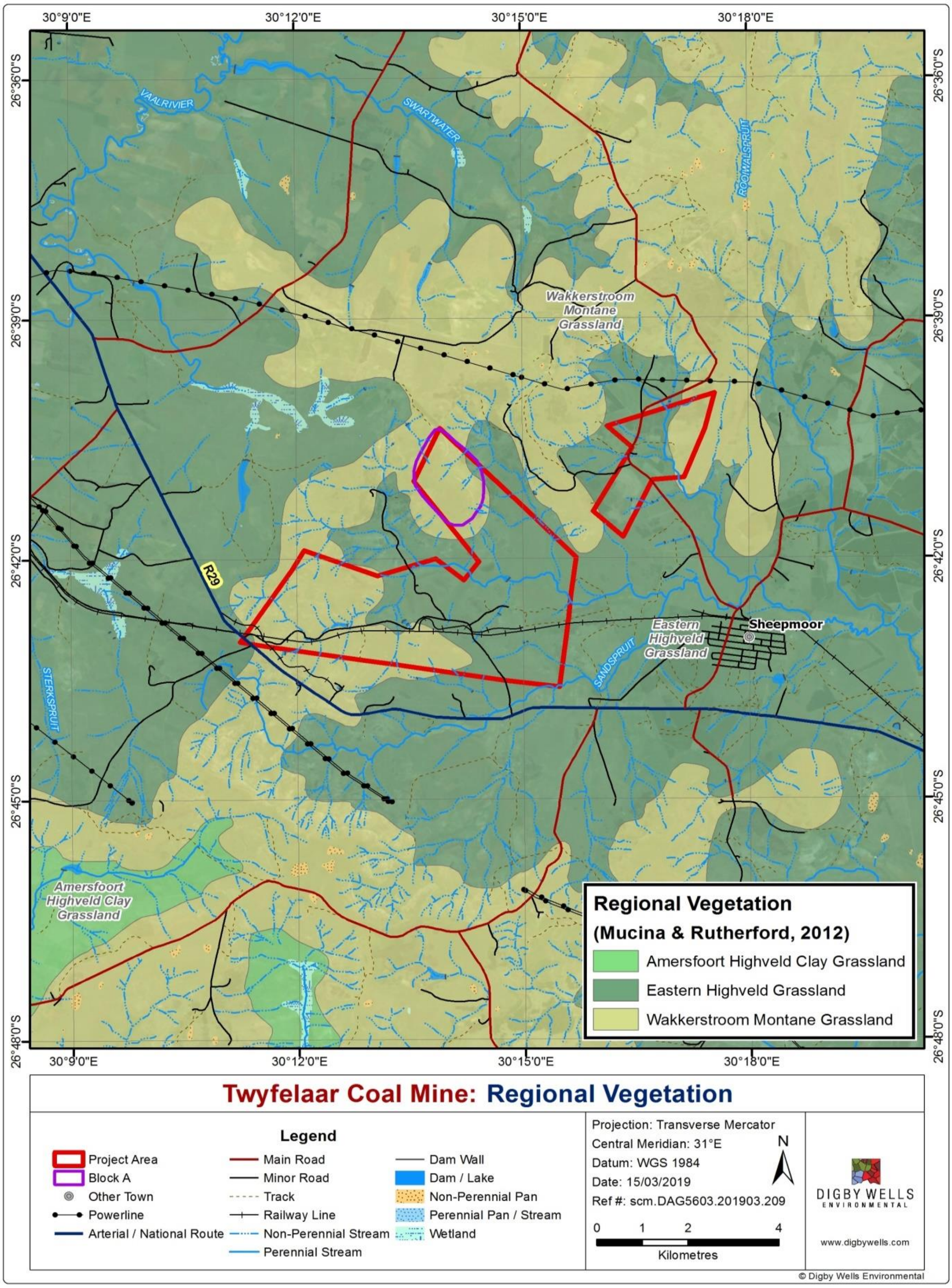

Figure 5-2: Regional Vegetation

5.2 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 5-3 demonstrates the distribution of NFEPA wetlands within the project area. The wetland types that dominate the landscape are valley floor wetlands, particularly channelled valley-bottom wetlands, un-channelled valley-bottom wetlands and bench wetlands.

The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. The wetlands within and in the vicinity of the project area are 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.

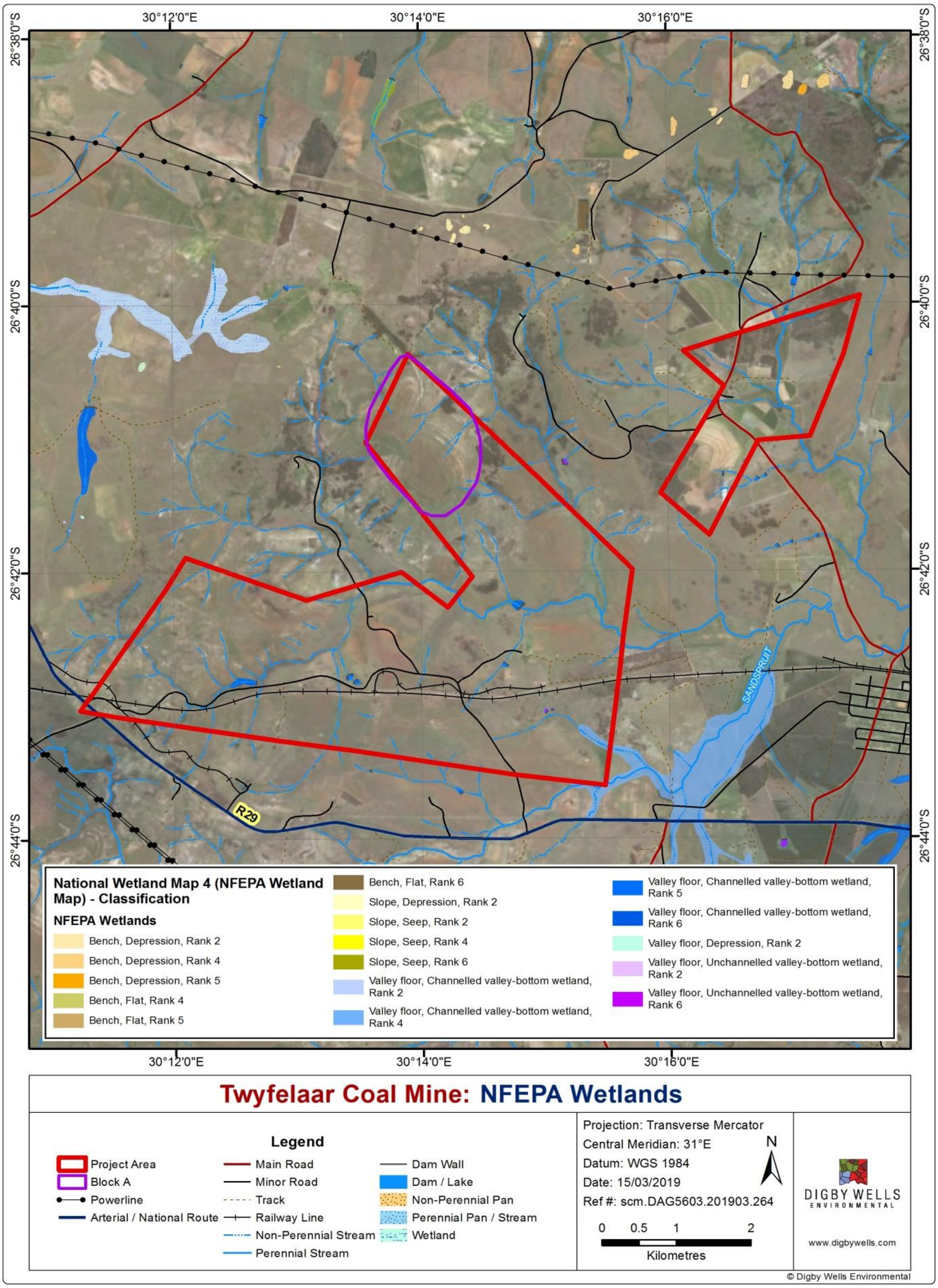

Figure 5-3: NFEPA wetlands

5.3 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 Table 4-2 below.

The project area is predominantly designated as 'Highest Biodiversity Importance: Highest Risk for Mining', with some areas designated as 'Moderate Biodiversity Importance: Moderate Risk for Mining'.

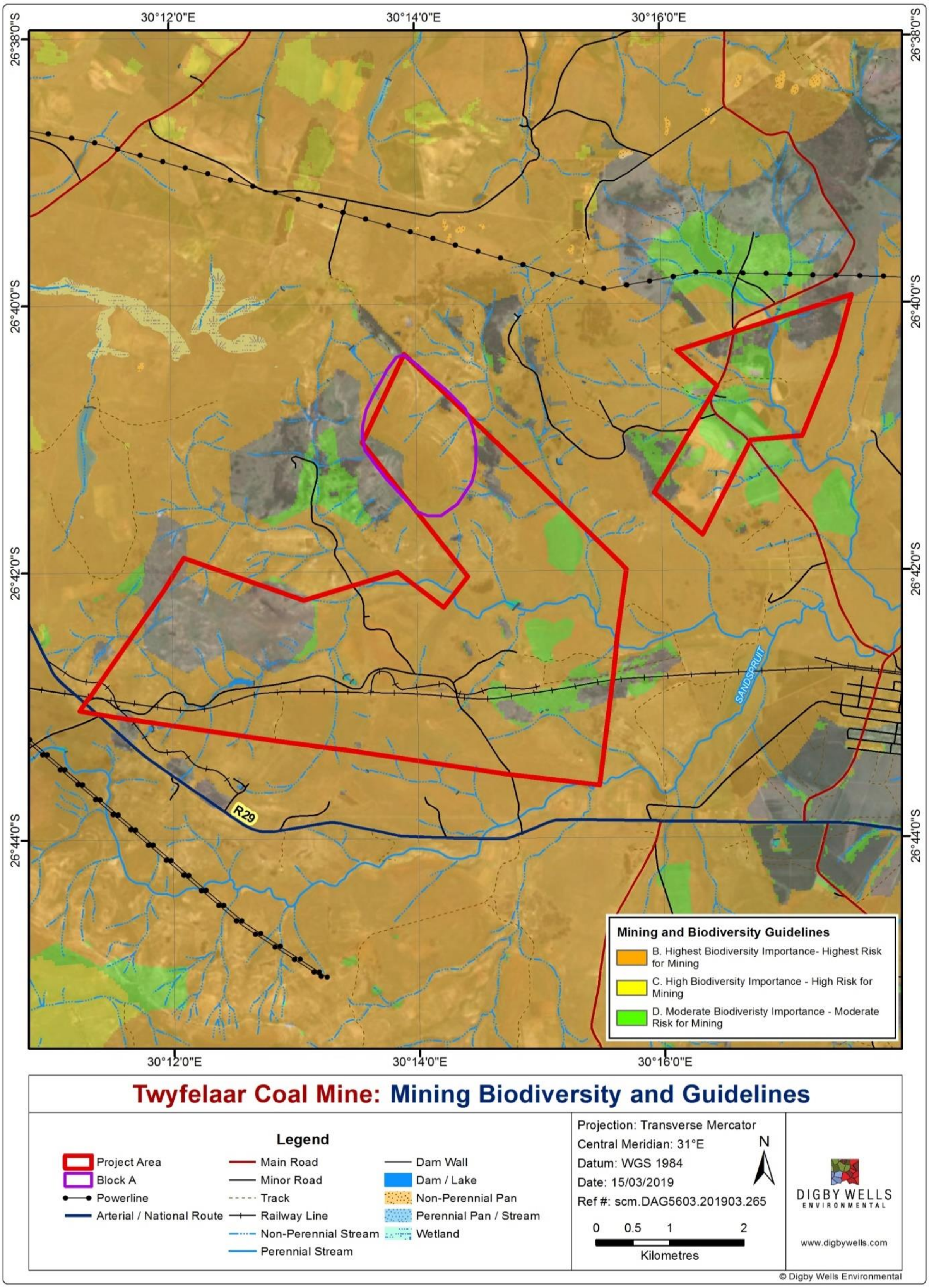

Figure 5-4: Mining and biodiversity guideline

5.4 Mpumalanga Biodiversity Sector Plan

The MBSP (2014) is a spatial tool that forms part of the national biodiversity planning. The proposed project falls largely within 'CBA Irreplaceable', with some 'CBA Optimal' areas, 'Other Natural Areas', 'Moderately modified' and 'Heavily modified' areas as shown in Table 4-3 below. On comparison with the findings of the Fauna and Flora report (Digby Wells, 2019c), large areas of primary grasslands were observed, with smaller areas of secondary grassland, which have been modified due to agro-pastoral activities, with dense patches of alien and invasive plants. These areas appear to correlate well with the data available in the MBSP in terms of modification. 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.

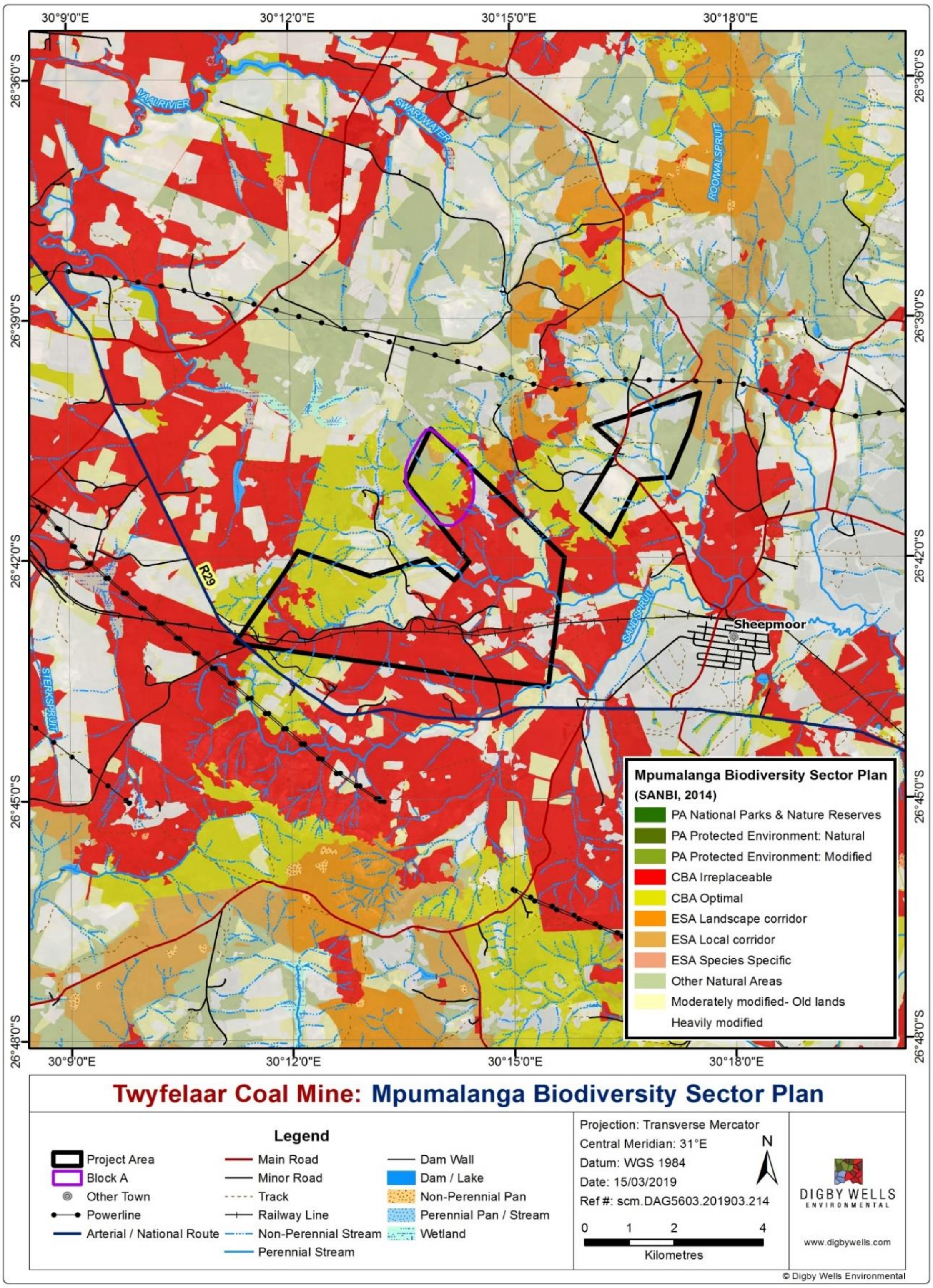

Figure 5-5: Mpumulanga biodiversity sector plan

6 Wetland Assessment Findings

6.1 Wetland Delineation and Classification

1158.36 ha of wetland area were identified within the proposed project area and its associated 500 m zone of regulation. Twelve wetlands were identified: WET1 – WET12. These wetlands have been further divided into HGM units based on terrain units:

- WET1 comprised of five HGM units: three hillslope seep wetlands and two unchanneled valley bottom wetlands.
- WET2 was comprised of eight HGM units: Five hillslope seep wetlands, one unchanneled valley bottom wetland and one channeled valley bottom;
- WET3 was comprised of two HGM units: A channeled valley bottom system and a large hillslope seep wetland;
- WET4 comprised of a hillslope seep and a narrow riparian channel further downslope, which then flowed into a larger river system further downstream;
- WET5 was comprised of one ephemeral drainage line, bench wetlands (more specifically 'shelves'), hillslope seeps, three channeled valley bottom HGM units and a narrow riparian channel further downslope, which then flowed into a larger river system further downstream;
- WET6 comprised of one hillslope seep, which was regarded as hydrologically connected to the larger river system further downgradient;
- WET7 was a hillslope seep;
- WET8 was predominantly comprised of a large channeled valley bottom wetland system, to which 3 benches, 40 hillslope seeps, 13 smaller channeled valley bottom wetlands, and 14 unchanneled valley bottom wetlands were hydraulically connected;
- WET9 was predominantly comprised of a large channeled valley bottom wetland system, to which seven hillslope seeps, one smaller channeled valley bottom wetland, and three unchanneled valley bottom wetlands were hydraulically connected;
- WET10 was comprised of three hillslope seeps hydraulically connected to a channeled valley bottom HGM unit;
- WET11 was comprised of a hillslope seep hydraulically connected to a channeled valley bottom HGM unit; and
- WET12 was comprised of an unchanneled valley bottom wetland, which was hydraulically fed by four hillslope seepage wetlands.

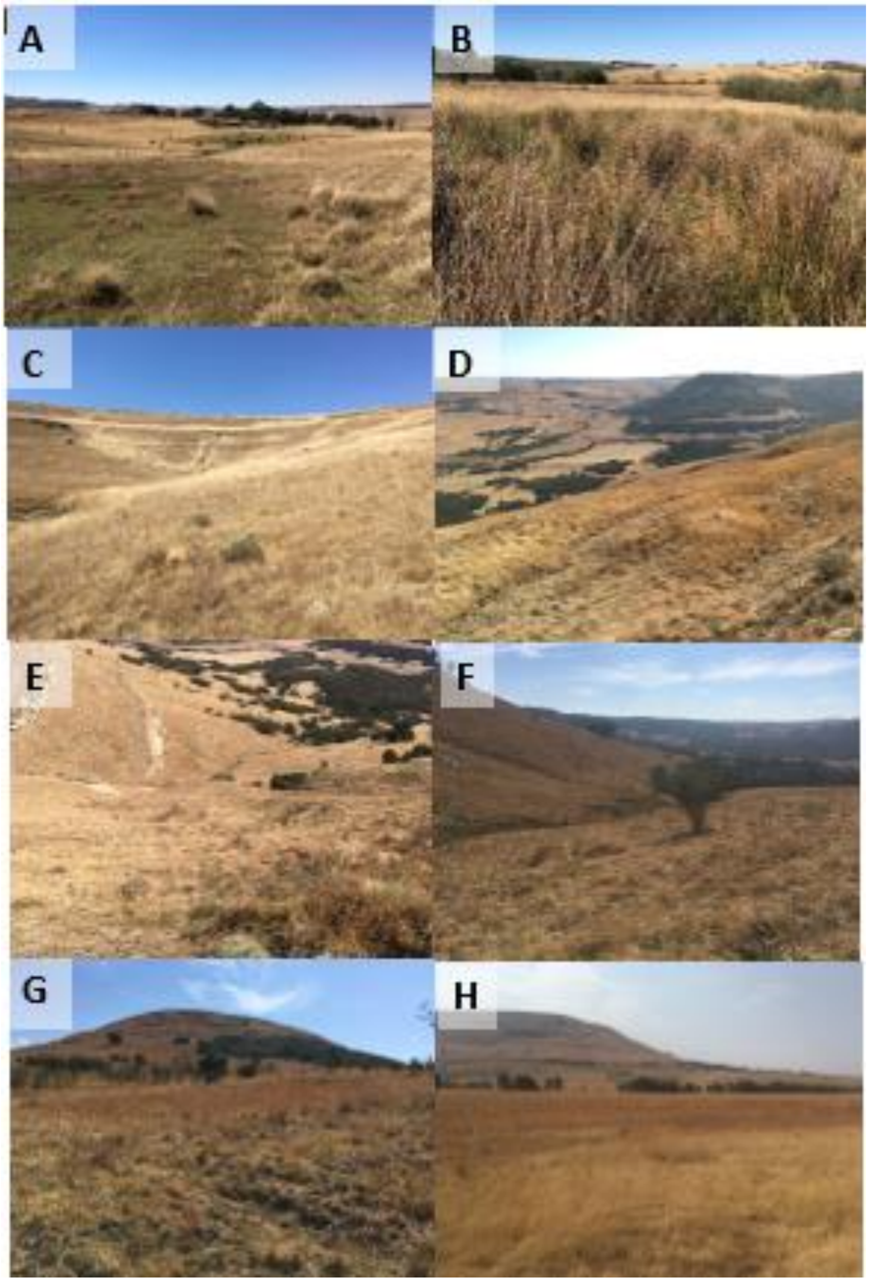

Figure 6-1: A: WET1 – Valley bottom; B: WET2 – Hillslope seep; C: WET3 – Hillslope seep; D: Benches; E: Hillslope seep on western slopes of the koppie; F: Channelled valley bottom showing *Acacia mearnsii* encroachment on the footslopes of the koppie; G: Hillsope seep; H: WET8 – Valley bottom

Table 6-1 indicates the wetlands and the extent of their various HGM types within the proposed project area. Figure 6-2 indicates the location of the wetlands and their various HGM units.

Table 6-1: Wetlands and their various HGM units within the proposed project area and within the 500 m zone of regulation

Wetland	HGM unit	Area (Ha)	Wetland	HGM unit	Area (Ha)
WET1	Unchanneled valley bottom 1-2	15.78	WET7	Hillslope seep	1.7
	Hillslope seeps 1-3	14.75	WET8	Benches 1-3	6.89
WET2	Channeled valley bottom	57.51		Hillslope seeps 1-40	391.36
	Unchanneled valley bottom	5.31		Channeled valley bottoms 1-14	500.00
	Hillslope seeps 1-6	25.74		Unchanneled valley bottom 1-14	211.27
	Riparian	0.34		Riparian	33.63
WET3	Hillslope seep	30.40	WET9	Hillslope seeps 1-7	30.14
	Channeled valley bottom	2.3		Channeled valley bottoms 1-2	89.93
WET4	Hillslope seep	0.61		Unchanneled valley bottoms 1-3	10.49
	Riparian	0.61	WET10	Hillslope seeps 1-3	3.24
WET5	Hillslope seeps 1-8	8.06		Channeled valley bottom	1.19
	Benches 1-6	6.80	WET11	Hillslope seep	7.19

	Channeled valley bottom	3.33		Channeled valley bottom	6.12
	Riparian	0.94	WET12	Hillslope seeps 1-4	14.32
WET6	Hillslope seep	0.51		Unchanneled valley bottoms 1-2	13.76
TOTAL WETLANDS				**1158.36 ha**	

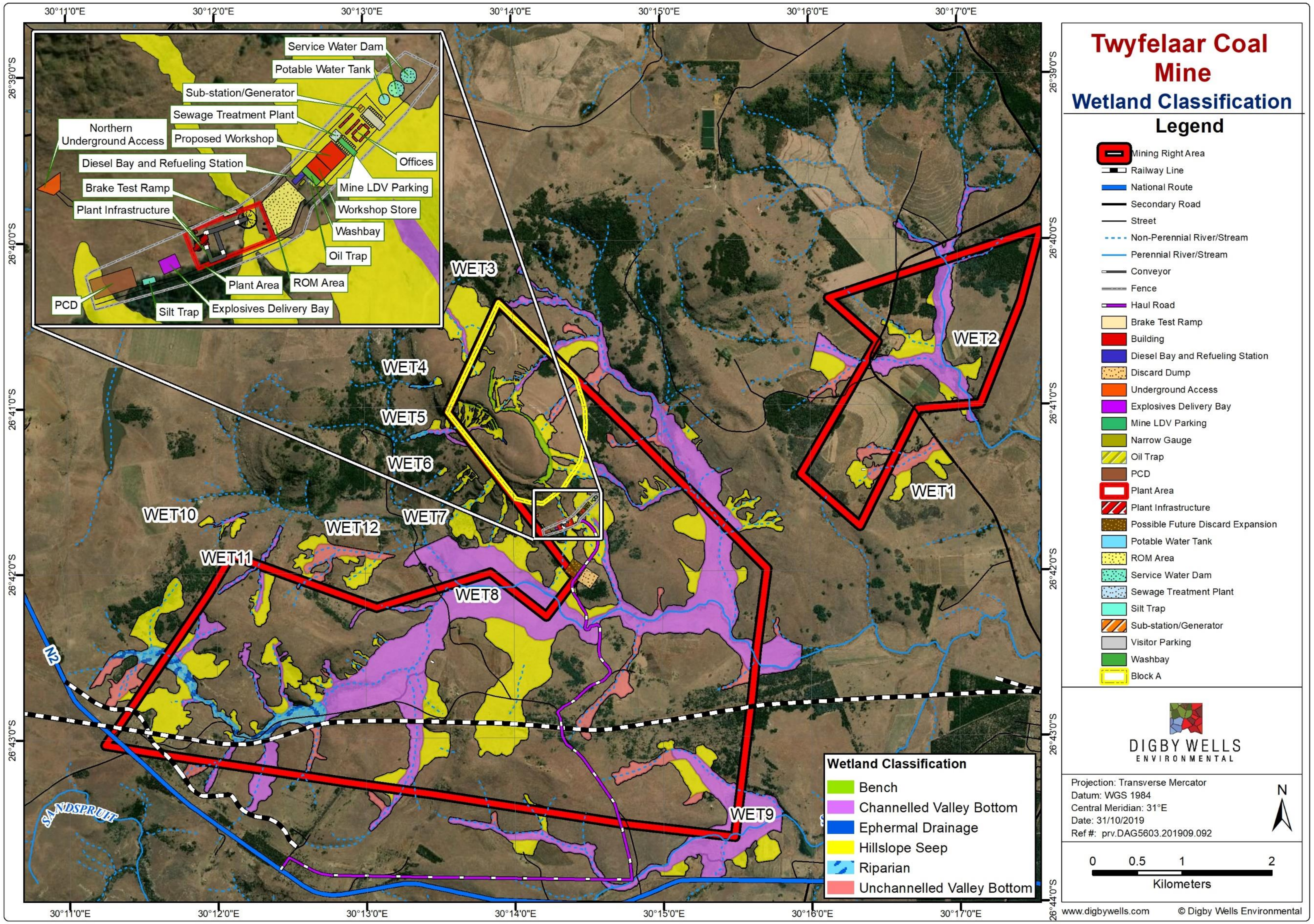

Figure 6-2: Wetland delineation (indicating locality of proposed infrastructure)

6.1.1 Terrain Indicator and Hydrology

The terrain unit indicator was used extensively in the identification of wetlands and their various HGM units. Use was made of topographical maps, and both two- and five-meter contours in the preliminary identification of wetland areas. Further to this, the underlying geology of the area was investigated so as to gain a greater understanding of the potential movement of subsurface water and potential areas of daylighting. The geology of the study area was comprised largely of dolerite, sandstone and shale, with isolated areas of alluvium (Digby Wells, 2019d). The 'koppie' situated in the north western portion of the study area consists largely of sandstone and shale, with an overlaying sill of dolerite, where daylighting moisture and the origin of many of the hillslope seeps associated with WET3, WET4, WET5, WET6, WET7 and WET8 were observed.

6.1.2 Vegetation Indicator

Vegetation structures of the various wetlands and their respective HGM units were relatively variable, being largely dependent on slope as well as the level of anthropogenic impact or disturbance at each point.

NB: It is important to note that the assessment was carried out at the end of the dry season and as such, many species were unidentifiable due to the absence of identifying features such as inflorescences. Thus, the species described as dominant in the sections below, are those representative of a dry season survey. Other dominant species, which may only be identified in the appropriate flowering season, are likely to have been overlooked.

- WET1:

Isolated stands of *Acacia mearnsii* and *Eucalyptus cinerea* were observed along the wetland boundaries. *Seriphium plumosum*, *Eragrostis gummiflua* and *Hyparrhenia tamba* were the dominant species observed in the temporary zones of the two unchanneled valley bottom wetlands, while *Juncus effusus* was observed in the impoundments and *Sporobolus* sp. and *H. tamba* were observed in the permanent zones. The vegetation structure of the hillslope seep wetlands included species such as *E. gummiflua, Paspalum* sp., *Andropogon eucomis, Cynodon dactylon* and *Setaria* sp.

- WET2:

The eastern portion of the channeled valley bottom system was dominated by A. mearnsii, which is likely to have aggravated the channelization observed in the system at the time of the assessment. Other species identified included *Bidens pilosa, Cosmos bipinnatus, Typha capensis, Datura ferox, S. vulgaris* and *Verbena bonariensis. H. tamba* was observed in the temporary zone. A large impoundment was observed in the middle portion of the channeled valley bottom. Species at this point included *J. effuses, B. pilosa, T. capensis, Phragmites australis, Populus* sp. and *A. mearnsii.* To the north, the system is once again dominated by *A. mearnsii*. Large portions of the hillslope seepage wetlands had been cleared for crop farming, however, species observed included *E. gummiflua, Setaria* sp*., H. tamba* and *J. effuses.*

- WET3:

The hillslope seep was dominated by *H. tamba*. Other species observed included *J. effuses, Cyperus* sp., aloes and ferns. Isolated patches of *Themeda triandra* were observed and *S. plumosum* was observed towards the edges of the temporary zone. The channelled valley bottom was dominated by *A. mearnsii*.

- WET4, WET5, WET6 and WET7:

The vegetation structure of WET4 was regarded as natural with no alien invasive species observed. The bench wetlands associated with WET5 were dominated by *H. tamba*, while the hillslope seeps associated with WET5, WET6 and WET7 were dominated by *H. tamba, Imperata cylindrica, Sporobolus* sp. and *T. triandra*. *A. mearnsii* dominated the channelled valley bottom and the riparian zone of WET5, limiting biodiversity and resulting in alterations to the natural vegetation structures at these points.

- WET8:

As with WET5, the bench wetlands associated with WET8 were dominated by *H. tamba*, while the hillslope seeps associated were dominated by *H. tamba, Imperata cylindrica, Sporobolus* sp. and *T. triandra*. Aloes were also observed in the hillslope seep zones. *A. mearnsii* dominated the channeled valley bottoms on the foothills of the koppie with special mention of the large channeled valley bottom wetland to the east of the koppie. Dense stands of *A. mearnsii* has resulted in a complete loss of wetland integrity at this point. Resulting in loss of water and carbon retention, limiting biodiversity, and resulting in alterations to the natural vegetation structures at these points. The southern and western portions of the large channelled valley bottom are more natural, with species such as *E. gummiflua, Agrostis lachnantha, H. tamba, I. cylindrica, Andropogon eucomis* and *Sporobolus* sp. Isolated stands of *V. bonariensis* were also observed. Large portions of hillslope seeps and the unchanneled valley bottoms had been cleared for agricultural purposes.

- WET9:

The majority of this area had been burned at the time of the assessment and the only species identified were *A. mearnsii* along the wetland boundary and *H. tamba.*

- WET10 and WET11:

Species observed in the hillslope seeps included *T. triandra, I. cylindrica* and *H. tamba.* A number of additional species were present, however, these were unidentifiable due to the lack of inflorescences. Isolated stands of *A. mearnsii* were also observed.

- WET12:

This wetland was largely impacted by *A. mearnsii* and the effects of erosion and vegetation was absent in many areas.

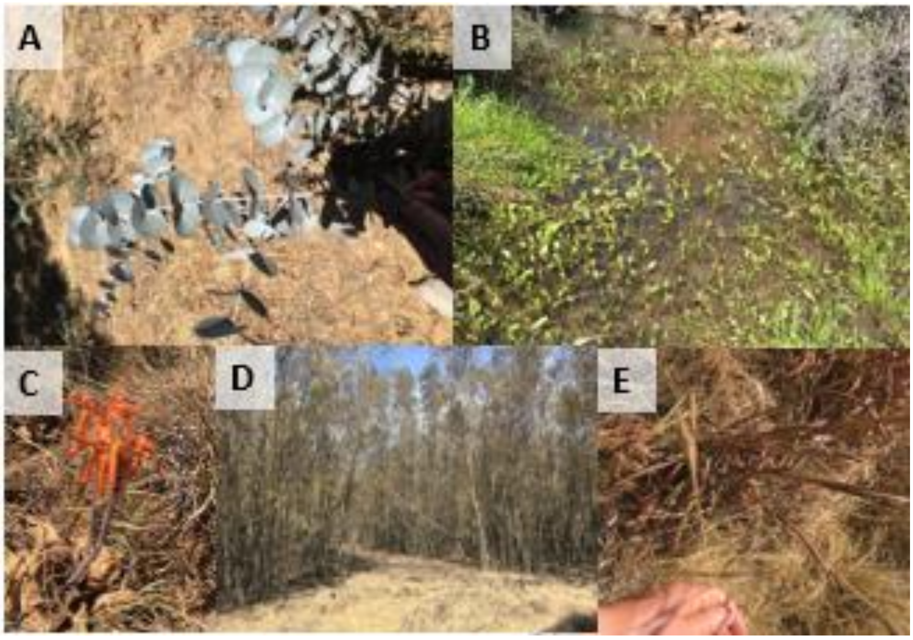

Figure 6-3: Images of some key floral species:- A: *Eucalyptus cinerea;* B: *Limosella* sp.; C: *Aloe* sp.; D: Dense encroachment of *A. mearnsii;* E: *Andropogon appendiculatus*

6.1.3 Soil Indicator

The soils dominating the project area were identified as Mispah, Glenrosa, Clovelly and Swartland (Digby Wells, 2019a).

The Swartland soils were largely identified within the riparian zone associated with WET8, and were not regarded as wetland indicator soils at the time of the assessment. These soils are comprised of an orthic topsoil horizon, followed by a pedocutanic subsoil, overlaying a lithic horizon (ARC-Institute for soil, 2018). Pedocutanic soils are highly structured and were regarded as unlikely to facilitate free drainage of water.

The Katspruit soils were observed to be dominant within the large channelled valley bottom wetland also associated with WET8 as well as with the channelled valley bottom wetland associated with WET2. Katspruit soil types are comprised of an orthic topsoil horizon and a gley subsoil horizon (ARC-Institute for soil, 2018). These soils are generally subjected to long durations of saturation with stagnant and reduced water, and are generally indicative of the permanent zones in wetlands

The Glenrosa soil types were largely associated with the south-western hillslope seepage wetlands associated with WET8. These soils are comprised of an orthic topsoil horizon, with a lithic subsoil horizon which tends to become gleyed when soils are frequently wetted (ARC-Institute for soil, 2018).

The Mispah soils were associated with WET3, WET4, WET5, WET6, WET7, WET9, WET11 and WET12. These soils form part of the orthic topsoil horizon overlaying a hard rock horizon (ARC-Institute for soil, 2018) and are generally regarded as shallow. These soils were thus more likely to be associated with the hillslope seep wetlands observed where the subsurface low of water would be likely to occur.

WET10 as well as large portions of WET8 were associated with Clovelly soils where wetland indicators (i.e. mottling) were situated close to the surface. This soil type consists of an orthic topsoil horizon overlaying yellow-brown apedal and lithic subsoils (ARC-Institute for soil, 2018).

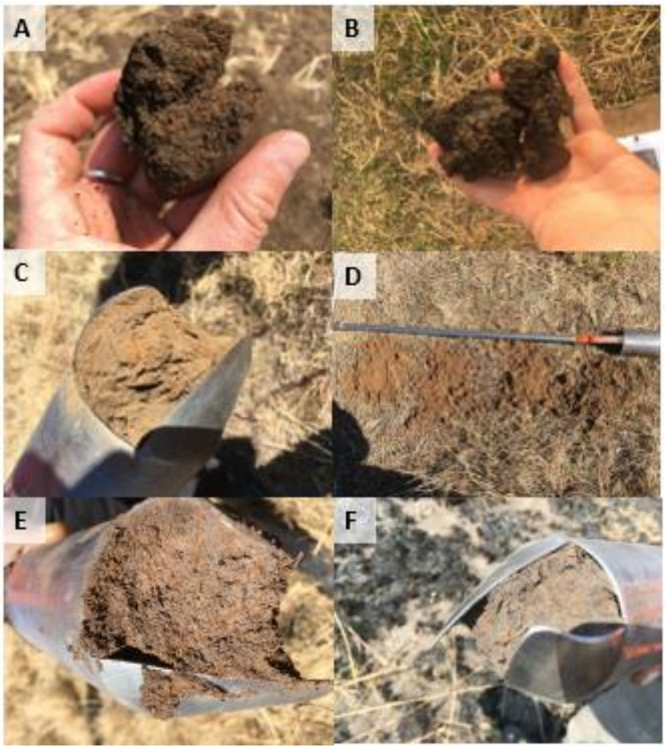

Figure 6-4: A and B: Structured soils; C, E and F: Mottling; D: Example of the soil profile in the hillslope seepage wetlands

6.2 Wetland Health and Integrity (WET-Health)

The health and ecological integrity of each of the wetlands and their respective HGM units were assessed at the time of the field assessment and the results are discussed briefly:

- WET1:

The HGM units associated with WET1 have been heavily impacted as a result of agropastoral activities. Impacts include impoundments along the unchanneled valley bottom wetlands, which has resulted in alterations to the faunal and floral structures, loss of flow connectivity, gully formation and erosion. The unchanneled valley bottom wetlands and the hillslope seep wetlands have been severely impacted due to use of the wetland areas for grazing activities and large portions of the seeps have been cleared for agricultural crops, with special mention of HS2 and HS3.

The HGM units associated with WET1 were all categorized as *moderately modified* (ecological category C).

- WET2:

The HGM units associated with WET2 have been largely impacted as a result of agropastoral activities. Large areas have been affected by severe encroachment of *A. mearnsii* (Black Wattle), with special mention of the channeled valley bottom system. This has resulted in alterations to the soil characteristics (i.e. loss of carbon) and alterations to the vegetation characteristics, which should generally be comprised of natural grasslands (see section 6.1.1). Further to this, the construction of impoundments along the channeled valley bottom have resulted in changes to the natural water flow and distribution, alterations to the natural water tables, erosion and gulley formation.

The hillslope seeps and the unchanneled valley bottom associated with WET2 were categorized as *moderately modified* (ecological category C), while the channeled valley bottom was categorized as *largely modified* (ecological category D).

- WET3:

The middle portion of the channeled valley bottom has been severely impacted by *A. mearnsii*. The northern portion of the hillslope seep on the footslopes of the ‘koppie’ has been utilized extensively for grazing of cattle, while the south western portion of the hillslope seep, in the upper reaches of WET3, were observed as largely natural, with minimal disturbance noted and related to the movement of wild animals. Further to this, apart from the *A. mearnsii* observed in the channeled valley bottom HGM unit, there was very little sign of encroachment of alien and invasive species. Some isolated areas of gully formation were also observed.

The western portion of the hillslope seep associated with WET3 was categorized as *minimally modified* (ecological category B), and the eastern portion of the hillslope seep and the channeled valley bottom were both categorized as *moderately modified* (ecological category C).

- WET4:

The hillslope seep may be regarded as natural and no anthropogenic impacts were observed and may therefore be regarded as *unmodified* (ecological category A).

- WET5:

These HGM units, with the exception of the riparian zone situated further downslope and the lower portion of CVB3 (where severe encroachment of *A. mearnsii* was observed), may be regarded as natural as no anthropogenic impacts were observed. This is especially relevant for the bench wetlands and the hillslope seep zones. CVB1 and CVB2 may be regarded as modified to varying extents, with some alien and invasive encroachment (i.e. *A. mearnsii*) observed.

For WET5, the benches and the hillslope seeps were regarded as *unmodified* (ecological category A), while the unimpacted channeled valley bottom was categorized as *minimally modified* (ecological category B) and the impacted channeled valley bottom was categorized as *moderately modified* (ecological category C).

- WET6:

The portion of the hillslope seep falling within the 500 m zone of regulation may be regarded as natural, with very little alien and invasive encroachment (i.e. *A. mearnsii*) observed. The hillslope seep associated with WET6 may thus be regarded as *unmodified* (ecological category A), however, further downgradient, this wetland is affected by dense stands of *A. mearnsii* and the clearing of natural vegetation associated with croplands.

- WET7:

The upper portion of this hillslope seep may be regarded as largely natural. However, further downgradient, this wetland is affected by dense stands of *A. mearnsii*. The hillslope seep associated with WET7 was categorized as *minimally modified* (ecological category B).

- WET8:

The HGM units within this wetland range in integrity from pristine hillslope seep wetlands on the ridges, to more impacted channeled and unchanneled valley bottom wetlands in the lower lying valley. Large portions of wetland have been impacted by dense stands of *A. mearnsii*, resulting in losses to the natural biodiversity of the area, alterations to the soil characteristics, loss of carbon and water retention capacity and impacts to the natural water table. Other areas have been cleared for agricultural croplands, resulting in loss of biodiversity and soil roughness, as well as loss of the ability of the wetland to capture and trap sediments. Large areas are utilized for grazing of cattle, goats and sheep, reducing surface roughness, disturbing soils and increasing the potential for erosion. Isolated HGM units have been impounded, resulting in changes to the natural flow paths and fragmentation of the systems. Further to these impacts, a network of linear infrastructure, including roads, fences and a railway line, have resulted in some fragmentation of the wetland.

The benches and the unimpacted channeled valley bottoms draining the ‘koppie’ may be regarded as *unmodified* (ecological category A). The hillslope seeps and the unchanneled valley bottoms draining the ‘koppie’ may be regarded as *minimally modified* (ecological category B), while the impacted channeled valley bottom draining the 'koppie' may be regarded as *moderately modified* (ecological category C). The remaining HGM units associated with WET8 and dominating the southern portion of the study area were all categorized as *moderately modified* (ecological category C), with the exception of the unmodified hillslope seeps, which were categorized as *unmodified* (ecological category A), and the large channeled valley bottom traversing the site from the western boundary to the eastern boundary, and which as classified as *minimally modified* (ecological category B).

- WET9:

Large areas are utilized for grazing of cattle, goats and sheep, reducing surface roughness, disturbing soils and increasing the potential for erosion. Other areas have been cleared for agricultural croplands, resulting in loss of biodiversity and soil roughness, as well as loss of the ability of the wetland to capture and trap sediments.

All the HGM units associated with WET9, except for the unimpacted hillslope seep which was categorized as *minimally modified* (ecological category B), were categorized as *moderately modified* (ecological category C)

- WET10 and WET11:

These areas were largely undisturbed; however, some gully formation and erosion were observed.

The hillslope seep associated with WET10 was categorized as *minimally modified* (ecological category B), while the hillslope seep associated with WET11 was categorized as *moderately modified* (ecological category C). The channeled valley bottoms for both wetlands were categorized as *moderately modified* (ecological category C).

- WET12:

This area has been subjected to varying degrees of disturbance, with both soil disturbance as well as the proliferation of AIPs observed at this point.

The hillslope seeps and the small unchanneled valley bottom were categorized as *moderately modified* (ecological category C), while the larger unchanneled valley bottom was categorized as *largely modified* (ecological category D).

The results of the WET-Health assessment are summarized in section 6.5 below and represented graphically in Figure 6-5.

6.3 Wetland Ecological Service Provision (WET-Ecoservices)

The ecological service provision of the various wetland systems and their associated HGM units were regarded as largely dependent on their respective locations in the landscape and the HGM unit type.

The large channeled valley bottom systems in WET2, WET8 and WET9 were found to perform notable services in terms of phosphate and nitrate assimilation due to the surrounding agropastoral activities. These HGM units were also found to play a large role in flood attenuation and streamflow regulation, as well as being important in the maintenance of biodiversity.

The benches associated with WET5 and WET8, were found important in the performance of services such as streamflow regulation, sediment trapping and erosion control. Biodiversity maintenance was regarded as very high.

Similarly, the unimpacted hillslope seepage HGM units played an important role in streamflow regulation and sediment trapping, with very high importance in terms of biodiversity maintenance.

Unimpacted valley bottoms were important in terms of streamflow regulation and erosion control, while impacted valley bottoms had deteriorated slightly in functionality in these respects.

The results of the WET-Ecoservices are summarized in section 6.5 and represented graphically in Figure 6-6.

6.4 Ecological Importance and Sensitivity

As with the ecological service provision, the ecological importance and sensitivity (EIS) of the various wetland systems and their associated HGM units were regarded as largely dependent on their respective locations in the landscape and the HGM unit type. In addition to this, the level of resilience and the anthropogenic impacts affecting each HGM unit was also considered.

The results of the EIS are summarized in section 6.5 and represented graphically in Figure 6-7.

6.5 Results Summary

Table 6-2: Wetlands and their various HGM units within the proposed project area and within the 500 m zone of regulation

Wetland	HGM unit	WET-Health	WET-Ecoservices	EIS	Wetland	HGM unit	WET-Health	WET-Ecoservices	EIS
WET1	Unchanneled valley bottom 1-2	C (3.24)	Intermediate (1.3)	Moderate (1.5)	WET8	Benches 1-3	A (0.46)	Intermediate (1.4)	High (2.4)
	Hillslope seep 1	C (2.32)	Intermediate (1.3)	Moderate (2.0)		Hillslope seeps 1-2, 6-10	B (1.23)	Moderately low (1.2)	High (2.4)
	Hillslope seeps 2-3	C (2.97)	Moderately low (1.0)	Moderate (2.0)		Channeled valley bottoms 1,3,5,11-15	A (0.46)	Moderately low (1.0)	High (2.2)
WET2	Channeled valley bottom	D (5.30)	Moderately low (1.2)	Moderate (1.5)		Channeled valley bottom 2,4 (north-western portion),6,7,8,9,10	C (3.34)	Moderately low (0.9)	Moderate (1.5)
	Unchanneled valley bottom	C (2.99)	Moderately low (1.2)	Moderate (1.5)		Unchanneled valley bottom 1-3	B (1.01)	Moderately low (1.0)	High (2.2)
	Hillslope seeps 1-2,4	C (2.14)	Moderately low (1.2)	Moderate (2.0)		Channeled valley bottom 4 (southern portion)	A (1.94)	Intermediate (1.5)	Very high (3.3)
	Hillslope seeps 3,5-6	C (2.99)	Moderately low (0.9)	Moderate (2.0)		Hillslope seeps 15,20,21	C (3.81)	Moderately low (1.2)	Moderate (2.0)
	Riparian*	NA	NA	NA		Hillslope seeps 11-14,16-19, 22-40	A (0.91)	Intermediate (1.3)	High (2.4)
WET3	Hillslope seep (west)	B (1.67)	Intermediate (1.4)	High (2.4)		Unchanneled valley bottoms 4-14	C (3.81)	Moderately low (1.0)	Moderate (1.5)
	Hillslope seep (east)	C (2.26)	Intermediate (1.6)	Moderate (2.0)		Riparian*	NA	NA	NA
	Channeled valley bottom	C (2.53)	Intermediate (1.3)	Moderate (1.5)	WET9	Hillslope seeps 1,6-7	B (1.99)	Intermediate (1.3)	High (2.4)
WET4	Hillslope seep	A (0.46)	Intermediate (1.4)	High (2.4)		Hillslope seeps 2-5	C (3.03)	Moderately low (1.2)	Moderate (2.0)
	Riparian*	NA	NA	NA		Channeled valley bottoms 1-2	C (2.55)	Intermediate (1.5)	Moderate (1.5)
WET5	Hillslope seeps 1-8	A (0.40)	Intermediate (1.3)	High (2.4)		Unchanneled valley bottoms 1-3	C (3.86)	Moderately low (1)	Moderate (1.5)
	Benches 1-6	A (0.29)	Intermediate (1.5)	High (2.4)	WET10	Hillslope seeps 1-3	B (1.40)	Intermediate (1.3)	High (2.4)
	Channeled valley bottom 1	C (2.55)	Intermediate (1.3)	Moderate (1.5)		Channeled valley bottom	C (2.34)	Moderately low (1.1)	Moderate (1.5)
	Channeled valley bottom 2	B (1.14)	Intermediate (1.3)	High (2.2)	WET11	Hillslope seep	C (2.04)	Intermediate (1.3)	Moderate (2.0)
	Riparian*	NA	NA	NA		Channeled valley bottom	C (2.34)	Moderately low (1.1)	Moderate (1.5)
WET6	Hillslope seep	A (0.99)	Intermediate (1.4)	High (2.4)	WET12	Hillslope seeps 1-4	C (2.84)	Moderately low (1.1)	Moderate (2.0)
WET7	Hillslope seep	B (1.41)	Intermediate (1.4)	High (2.4)		Unchanneled valley bottom 1	C (3.88)	Moderately low (0.9)	Moderate (1.5)
						Unchanneled valley bottom 2	D (4.01)	Moderately low (0.9)	Moderate (1.5)

NA = Not applicable; *Refer to Aquatic Baseline Assessment (Digby Wells, 2019b)

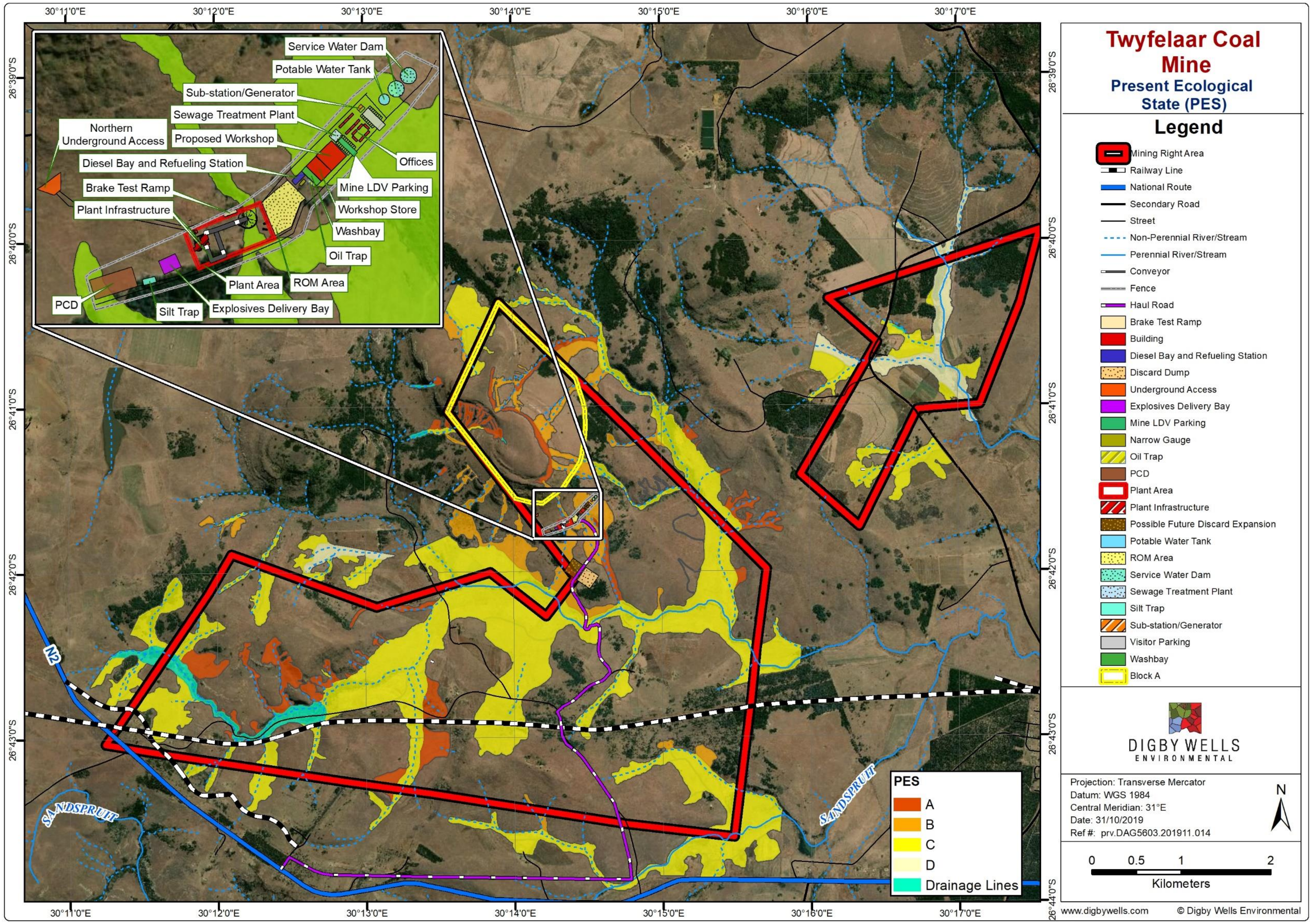

Figure 6-5: Wetland PES

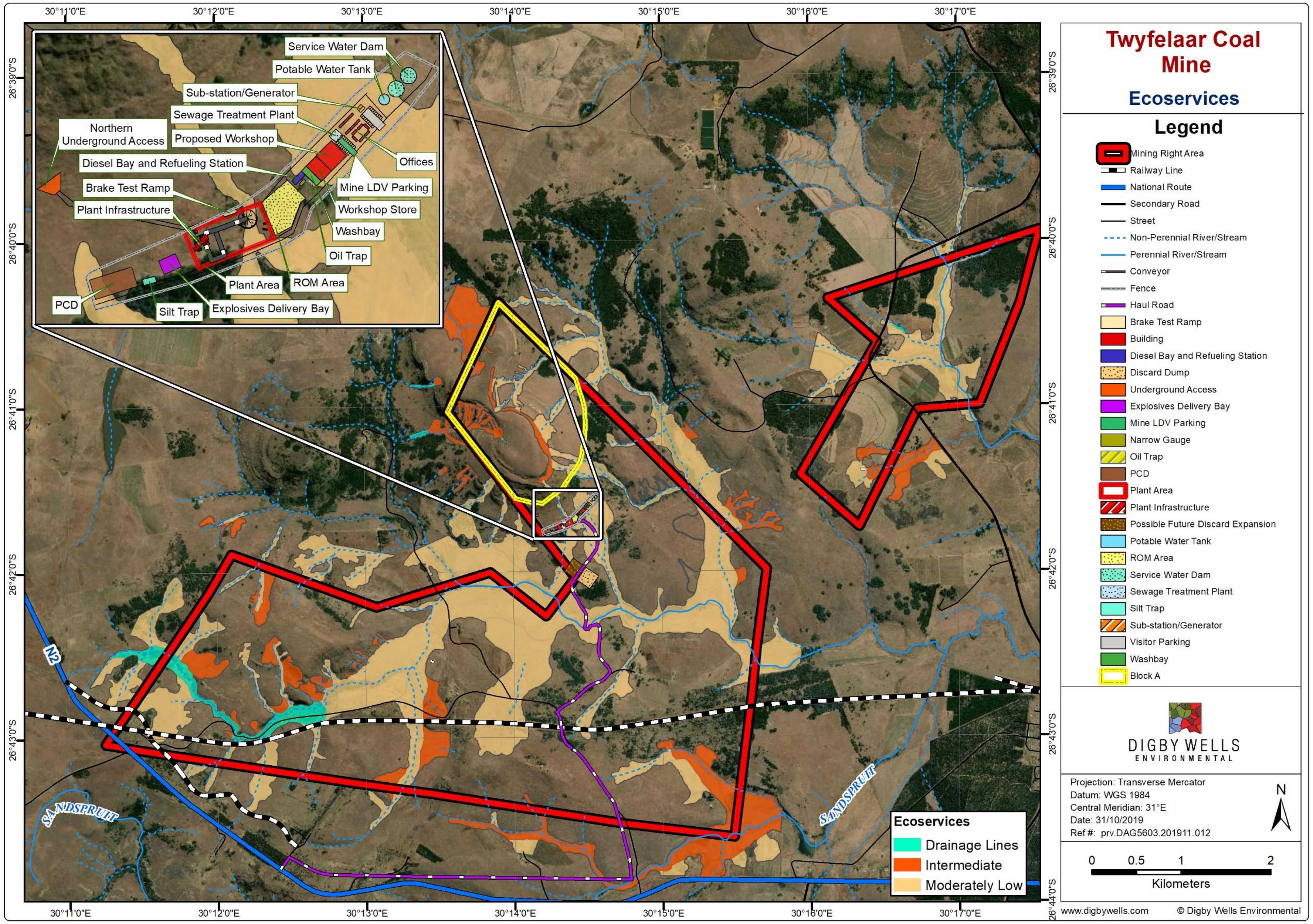

Figure 6-6: Wetland ecological service provision (WET-Ecoservices)

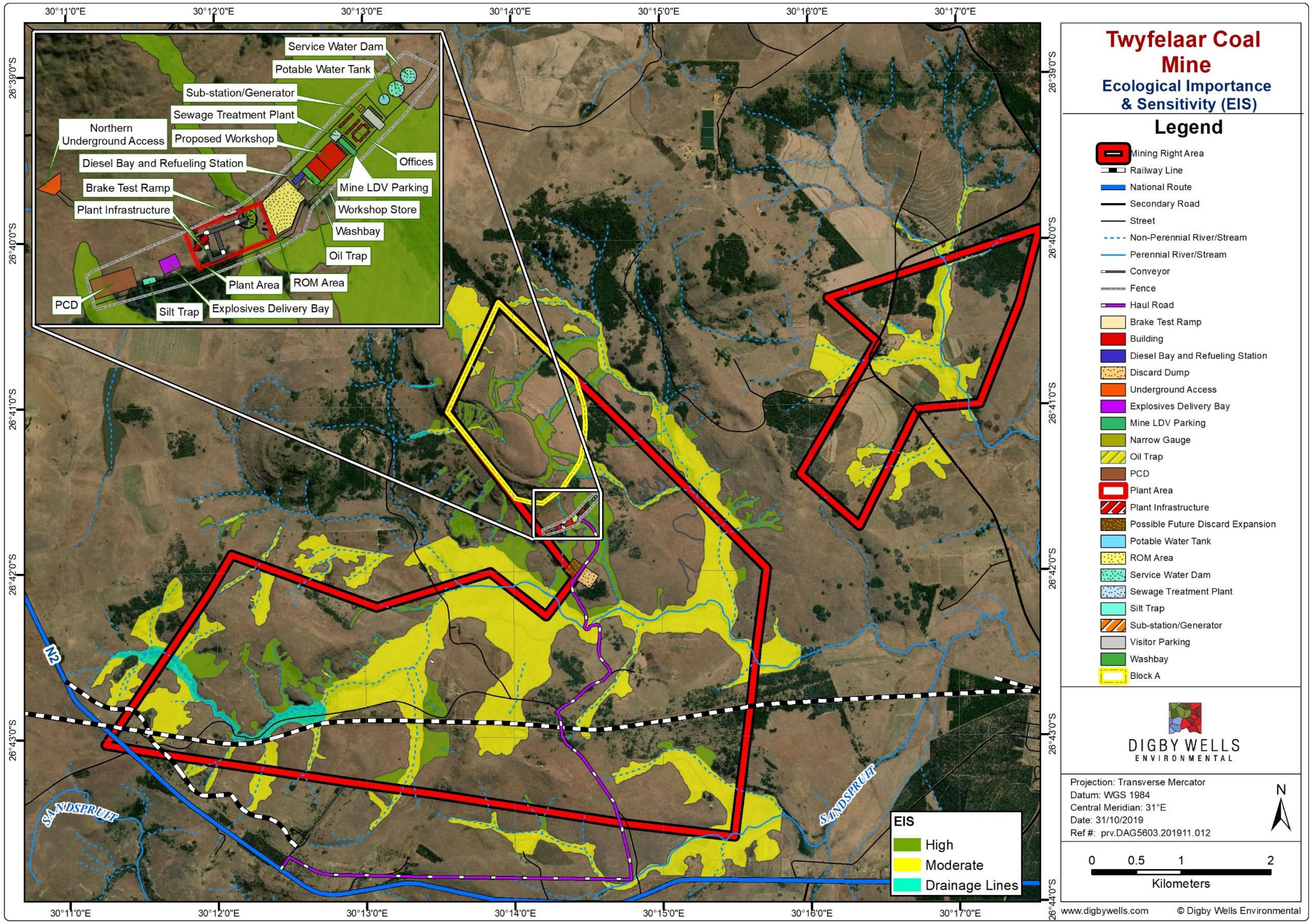

Figure 6-7: Wetland ecological importance and sensitivity

The wetland assessment carried out in September 2019, revealed the presence of twelve wetland systems within the project area and its 500 m zone of regulation, with varied HGM units associated with each.

The HGM unit types observed within the project area included: bench, hillslope seep, channeled valley bottom and unchanneled valley bottom systems. These HGM units were categorized largely on topography and their respective locations within the landscape.

The health and integrity of each of the HGM units present varied considerably, with anthropogenic disturbances being the most significant driver of change to date. These disturbances were related largely to agropastoral activities and linear infrastructures traversing the project area.

The bench wetlands and the hillslope seep wetlands associated with the 'koppie' and other hillslopes situated on and directly below the ridges of most of the higher lying areas were found to be in pristine or near-pristine condition due to the reduced suitability of these areas (steep slopes and limited access) for agropastoral activities and other anthropogenic disturbances.

In the foothills and the valleys of the project area, the wetland systems were used extensively for crops and pastures, and impacts relating to these activities, such as the proliferation of alien and invasive species (with special mention of *A. mearnsii*) and an increased potential for erosion, were observed. Disturbance of soils, linear infrastructures (roads, fences, railways), and various small holdings throughout the project area and its associated zone of regulation, had resulted in additional impacts throughout the project area.

6.6 Sensitivity Mapping

The hydrological driver of the wetlands within the project area appear to be two-fold. It is suspected that the benches and hillslope seeps situated on the 'koppie" are driven to a large extent by the underlying geologies (i.e. geomorphology), as described in section 6.1.1. It is suspected that a shallow aquifer is present in the 'koppie', which is comprised of sandstone and shale, with an overlaying sill of dolerite, where daylighting moisture and the origin of many of the hillslope seeps associated with WET3, WET4, WET5, WET6, WET7 and WET8 were observed. This observation is supported by the findings of the groundwater study carried out by Digby Wells (Digby Wells, 2019d).

Similarly, WET10, WET11 and WET12 appear to be associated with sills of dolerite overlaying sandstone and shale geologies (Digby Wells, 2019d).

In the foothills, the dominant underlying geologies of WET8 is dolerite, sandstone and alluvium, WET9 is dolerite, while that of WET1 and WET2 is sandstone and shale (Digby Wells, 2019d).

The portions of WET8 in the foothills, with specific reference to the large channelled valley bottom wetland (CVB4), may be regarded as hydrologically connected to the hillslope seeps on the "koppie" and the other high lying areas, however, it is likely that a deeper aquifer supplies water to CVB4 and dewatering of this aquifer for the proposed underground mining has the potential to impact negatively on both WET8 as well as WET9 due to the potential loss of groundwater supply (Digby Wells, 2019d).

A buffer of 100 m, in line with the 100 m zone of regulation triggered by GN 704 is regarded as sufficient for the HGM units situated on the 'koppie' as these HGM units are reliant on a shallow aquifer that is unlikely to be affected by the proposed underground mining activities.

Similarly, in terms of surface infrastructure and activities, these 100 m buffers are regarded as suitable, however, it must be stressed that buffers are unlikely to mitigate the potential impacts associated with the dewatering of the deeper aquifer and some loss in wetland health and integrity of the lower lying wetlands, with special mention of CVB4, is deemed likely (refer to Figure 6-8. .

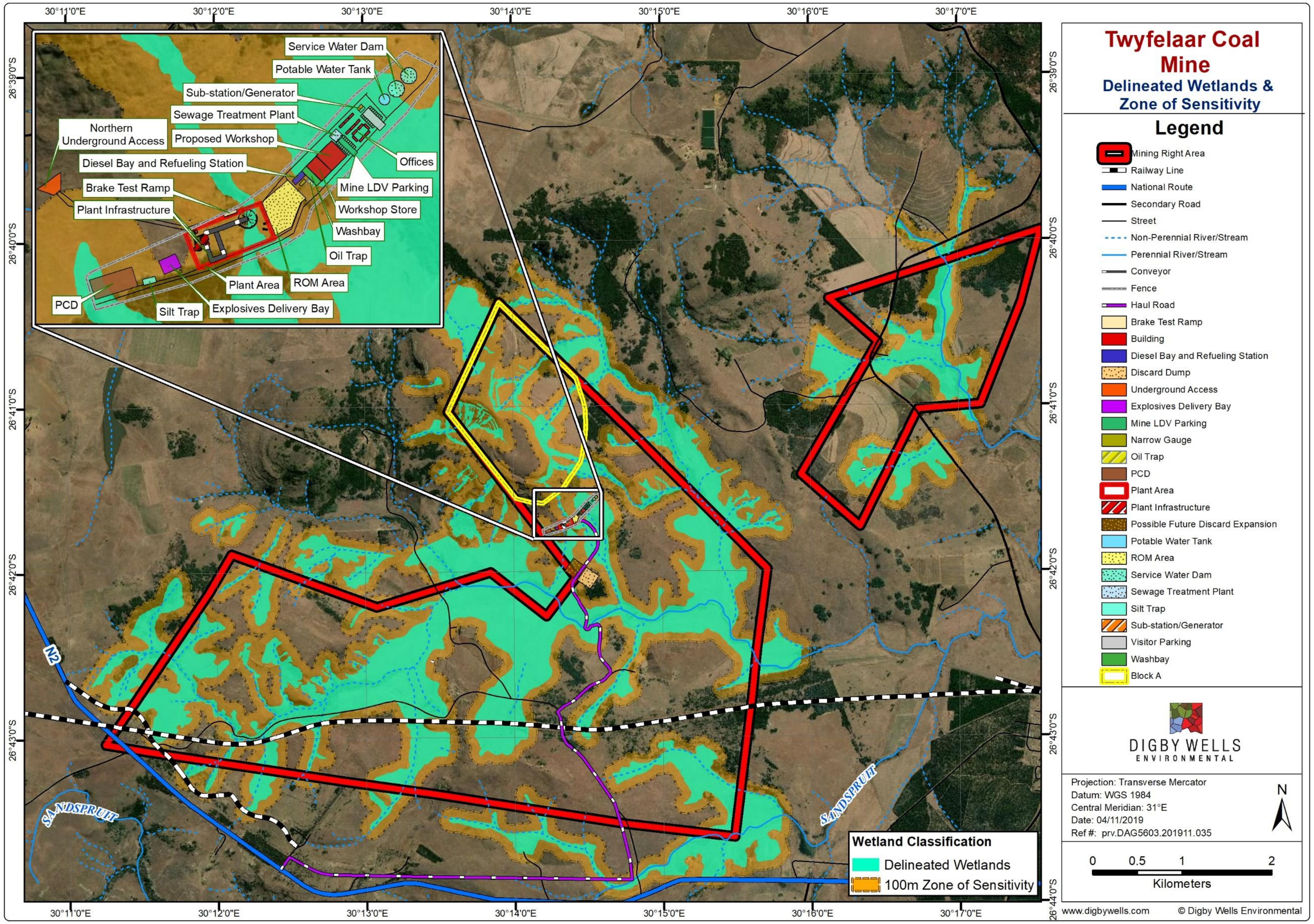

Figure 6-8: Sensitivity mapping and proposed buffer zones for the wetlands present within the proposed project area.

7 Impact Assessment

The proposed infrastructure in relation to the wetlands present in the proposed project area are indicated in Figure 6-8. Focus of the impact assessment is based solely on the proposed infrastructure and associated activities with Block A/Northern underground access. The identified potential impacts that will negatively affect the wetland ecology are discussed below for the various phases of the project (Construction phase, Operational phase and Decommissioning phase). Construction Phase

7.1.1 Impact Description

The bench wetlands and a large portion of the hillslope seepage wetlands may be regarded as ecologically significant with an absence of anthropogenic impacts observed, while in the lower lying areas, hillslope seeps and the channelled valley bottom systems, with special mention of CVB4, are subject to impacts as a result of alien vegetation encroachment as a result of *A. mearnsii* stands, and impacts related to agropastoral activities.

Apart from the obvious loss of vegetation and the associated loss of biodiversity, vegetation clearing and disturbance of soils within hillslope seepage areas for the construction of the proposed surface infrastructure (i.e. Pollution Control Dam (PCD), plant area, infrastructure area and haul road) will result in the direct loss of approximately 7 ha of wetland habitat and fragmentation of the hillslope seeps, potentially resulting in a loss of hydraulic connectivity to CVB4 and ultimately a loss of water supply and catchment yield. Compaction of soils may result in the creation of preferential flow paths and the onset of erosion. The risk of sedimentation and increased sediment loads into wetlands, and an increased potential for erosion, is deemed likely. This in turn has the potential to smother vegetation and result in alterations to the floral and faunal structure and diversity of wetland habitat

There is a risk of contaminants associated with construction activities and machinery entering wetlands from the access roads and the construction footprint, as well as organic waste from lack of ablutions and domestic litter, which has the potential to result in water quality impacts.

The activities related to the construction phase include:

- Site clearing, involving the removal of vegetation and the disturbance of soils; and
- Construction of mine related infrastructure including the plant area, the infrastructure area, the ROM pad, the PCD, the discard dump, the explosives delivery bay, the northern underground access point, and access and haul roads.

7.1.1.1 Management objectives

The main objective for mitigation would be to limit the areas proposed for disturbance/vegetation clearance combined with remaining as far as possible from wetland areas. Areas of disturbance should be limited to the construction footprint.

7.1.1.2 Management actions and mitigation measures

The following management actions are proposed for the construction phase:

- Environmental Practitioner to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area;
- Clearly marked buffer zones must be established, which are defined as regions of natural vegetation between watercourses/wetlands and developments or activities (WRC, 2015). This is a key management action that should take place by revising proposed infrastructure locations in line with the sensitivity mapping discussed in section 6.6;
- Limit vegetation removal and construction activities to the infrastructure footprint area only, where removed or damaged vegetation areas should be revegetated as soon as possible;
- An alien and invasive plant species management programme must be in place during the construction phase. In this regard, special mention is made of *A. mearnsii,* which is the dominant alien invasive tree species observed in the watercourses at the time of the assessment;
- Bare land surfaces downstream of construction activities must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Actively re-vegetate disturbed areas immediately after construction;
- Ensure a soil management programme is implemented and maintained to minimise erosion and sedimentation;
- If destruction of wetlands is unavoidable disturbance must be minimised and suitably rehabilitated;
- Ensure no incision and canalisation of the wetland features takes place;
- Erosion berms must be installed on roadways and downstream of the discard dump to prevent gully formation and siltation of the freshwater resources. The following points may serve to guide the placement of erosion berms:
  - Where the track has a 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 a slope greater than 15%, berms every 10m should be installed.
- All erosion within the construction footprint should be remedied immediately and included as part of an ongoing rehabilitation plan;

- Permit only essential personnel within the buffer areas for all freshwater features identified;
- All areas of increased ecological sensitivity should be designated as "No-Go" areas and be off limits to all unauthorised vehicles and personnel;
- No 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;
- At areas where road crossings have been designed, these roads should cross wetland or river features at the narrowest point and at a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing;
- No material will be dumped or stockpiled within any rivers, tributaries or drainage lines in the vicinity of the proposed footprint area.
- Environmentally friendly barrier systems, such as silt nets or, in severe cases, use of trenches, downstream from construction sites to limit erosion and possibly trap contaminated runoff from construction;
- Storm water must be diverted from construction activities and managed in such a manner to disperse runoff and prevent the concentration of storm water flow;
- Water used at construction sites should be utilised in such a manner that it is kept on site and not allowed to run freely into nearby watercourses (i.e. installation of clean and dirty water separation systems);
- Construction during high rainfall periods (usually November to March) should be avoided to decrease surface runoff in areas of vegetation removal and disturbed soils in an attempt to limit erosion and sedimentation into wetlands and instream aquatic systems;
- The clean and raw water separation systems must be some of the first infrastructures installed on site and care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated buffer zones. All vehicles must remain on demarcated roads and within the construction footprint and access roads;
- All vehicles must be regularly inspected for leaks;
- Re-fuelling must take place on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into the topsoil;
- Construction chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions;
- All spills should be immediately cleaned up and treated accordingly;

- Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate waste facility, and
- Wetland monitoring must be carried out during the construction phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources occur; and if so, a solution must be put in place as soon as possible.

7.1.1.3 Impact ratings

Table 7-1 and Table 7-2 present the impact ratings associated the construction phase of the project.

Table 7-1: Potential impact of site clearing for construction

Activity and Interaction 1: Site clearing, including the removal of vegetation and disturbance of soils			
Impact Description: Construction and development activities within a greenfield site are likely to result in negative impacts to functioning freshwater resources and the catchment. This is realised through the resultant habitat fragmentation, spreading of alien and invasive species, soil disturbance and/or compaction, increased incidence of erosion, sedimentation from erosion, potential water quality deterioration, and disturbance to avifauna and other fauna utilising the freshwater resources thus resulting in an overall loss of biodiversity.			
Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Permanent (7)	The impacts caused during the construction will have a long-lasting effect if not mitigated as the current infrastructure layout will result in a direct loss of wetland habitat. Impacts must be managed proactively.	Moderate negative (-75)
Extent	Municipal (4)	The impact could spread beyond the local development boundaries due to the ability of degraded water quality, sediments or alien invasive species to travel significant distances; especially downstream. Habitat fragmentation is also a catchment scale impact.	
Intensity	Serious medium term (4)	These impacts are serious medium-term threats to the important and sensitive freshwater resource habitats.	
Probability	Likely (5)	These impacts are likely.	
Nature	Negative		
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**

Activity and Interaction 1: Site clearing, including the removal of vegetation and disturbance of soils			
Duration	Medium term (3)	The potential impacts caused during the construction will remain a threat throughout the project-life but the mitigated impact may potentially have a medium term impact in the ecosystem.	Negligible negative (-32)
Extent	Local area (3)	Management and mitigation measures have the potential to prevent the impacts from spreading beyond the local development site.	
Intensity	Minor (2)	With fully functional management, monitoring and mitigation plans, the impact to the ecosystem functioning will be minimal.	
Probability	Probable (4)	Despite all intentions to prevent impacts, it is probable that impacts will still be realised due to the nature of the activity and the proximity to sensitive freshwater resource receptors. These potential residual impacts must be managed accordingly.	
Nature	Negative		

Table 7-2: Potential impact from construction of mine infrastructure

Activity and Interaction 2: Construction of mine related infrastructure including the plant area, the infrastructure area, the ROM pad, the PCD, the discard dump, the explosives delivery bay, the northern underground access point, and access and haul roads.			
Impact Description: Fragmentation of the freshwater resources as a result of road crossings. Loss of freshwater resource habitat (soils and vegetation) due to both direct and indirect impacts. These impacts may result in complete loss of wetland ecosystems or part thereof. Although some of these freshwater resources are not in pristine condition, they are providing significant ecological services at the local and catchment scale.			
Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Permanent (7)	The construction activities will result in the installation of permanent infrastructure, the permanent loss of freshwater resource habitat in some areas and permanent alterations to the surrounding landscape.	Major negative (-119)
Extent	Municipal (4)	Loss of significant freshwater resources on a catchment scale.	

Activity and Interaction 2: Construction of mine related infrastructure including the plant area, the infrastructure area, the ROM pad, the PCD, the discard dump, the explosives delivery bay, the northern underground access point, and access and haul roads.			
Intensity	Irreplaceable loss of highly sensitive environment (6)	Freshwater resources are sensitive natural ecosystems providing significant ecological services that are experiencing high levels of cumulative loss and damage. Thus, all remaining functional freshwater resources are even more important and sensitive to impacts that threaten their ecological integrity; directly or indirectly.	
Probability	Definite (7)	According to the proximities of the infrastructure layout, this impact will occur if no mitigation measures are implemented.	
Nature	Negative		
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Permanent (7)	The construction activities will result in the installation of permanent infrastructure, the permanent loss of freshwater resource habitat in some areas and permanent alterations to the surrounding landscape.	Minor negative (-65)
Extent	Local area (3)	Management and mitigation measures have the potential to prevent the impacts from spreading beyond the local development site.	
Intensity	Moderate (3)	With fully functional management, monitoring and mitigation plans, the impact to the ecosystem functioning will be moderate.	
Probability	Likely (5)	Despite all intentions to prevent impacts, it is probable that impacts will still be realised due to the nature of the activity and the proximity to sensitive freshwater resource receptors. These potential residual impacts must be managed accordingly.	
Nature	Negative		

7.2 Operational Phase

7.2.1 Impact Description

Operational activities such as transport of waste rock and coal have the potential to result in impacts such as erosion, sedimentation, compaction and contamination of the surrounding habitat. Crossing of rivers and wetlands may result in sedimentation and impacts on water quality, as well as the ingress of hydrocarbons related to the operation of heavy machinery.

Stockpiles, the discard dump and the TSF have the potential to result in water quality impacts as a result of runoff and erosion, which in turn has the potential to result in sedimentation within the adjacent river and wetland areas.

Dewatering of the deeper aquifers for underground mining (as described in the Groundwater report (Digby Wells, 2019d)) may result in desiccation of the adjacent wetland habitat, with special mention of CVB4, leading to loss of catchment yield and loss of water supply, fragmentation and habitat degradation.

Operational impacts include compaction of soils and hardening of surfaces, loss of catchment yield and surface water recharge, erosion and sedimentation, the potential loss of biodiversity and habitat, loss of natural migration routes for instream fauna and further fragmentation of the systems present. Hardened surfaces, particularly in the steep hillslope seep areas, have the potential to result in sheet runoff and there is likely to be a loss in wetland service provision in terms of flood attenuation, sediment trapping and assimilation of toxicants and other pollutants, with the onset of erosion as a result.

A major foreseeable impact associated with the operational phase of the project is increased runoff possibly resulting in erosion and sedimentation because of constructed impermeable surfaces. The use of chemicals on site and runoff containing contaminants from the exposure of disturbed minerals to oxygen also has the potential to enter nearby watercourses throughout the operational phase.

The activities related to the operational phase include:

- Operational underground mining activities, including excavation and dewatering;
- Uncontrolled runoff of stormwater or water generated from the mining operations from or through the surface infrastructure;
- Use and maintenance of haul roads for the transportation of coal and waste rock.

7.2.2 Management Objectives

Measures to prevent desiccation of the surrounding wetland areas due to the dewatering of the deeper aquifer must be implemented to prevent the loss of water supply to the lower-lying wetland areas. Further to this, water should not be allowed to flow freely from the operational area. Dirty water or water runoff from mine related infrastructure should be stored in PCDs and utilised as intended.

7.2.3 Management Actions and Mitigation Measures

The following management actions are recommended to guide the effective management of stormwater and water generated on site:

- Channelled water should not be dispersed in a concentrated manner. Baffles should be incorporated into artificial drainage lines/channels around the surface infrastructure to decrease the kinetic energy of water as it flows into the natural environment;
- Bare surfaces downstream from the developments where silt traps are not an option should be vegetated in order to attempt to limit erosion and runoff that might be carrying contaminants;
- All erosion noted within the operational footprint should be remedied immediately and included as part of an ongoing rehabilitation plan;
- Ensure that no incision and canalisation of the wetland features present takes place;
- Erosion berms should be installed on roadways and downstream of stockpiles and the discard dump 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 a 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 a slope greater than 15%, berms every 10m should be installed;
- Monitoring of all wetland areas affected as a result of infrastructure developments, including linear infrastructures such as roads watercourses should be carried out by a suitably qualified wetland ecologist in order to determine localities of areas subjected to erosion and increased runoff; where after, new mitigation actions should be implemented as per the specialist’s recommendations.

The following management and mitigation measures should be put in place to minimise the impact of the underground operational activities:

- During the operational phase of the project the Storm Water Management Plan (SWMP) (Digby Wells, 2019e) should already be implemented. This should consider all wetlands and other watercourses associated with the new developments/infrastructure which should divert storm water away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey storm water to silt traps where needed in order to limit erosion and the subsequent increase of suspended solids in downstream watercourses;
- If possible, clean water removed as part of the dewatering activities should be released downgradient of the operational areas to ensure water supply to the lower lying wetlands is maintained.

The following management and mitigation measures should be put in place to ensure impacts to the wetland ecology of the area as a result of the general operational activities is reduced:

- Environmental Practitioner to be present during operational phase to prevent any additional clearing of extensive areas or vegetation or dumping of waste rock and/or coal in areas not part of the direct footprint area.
- The edge of the non-directly impacted freshwater resources, and at least a 100m buffer or 1:100 floodline buffer, should be clearly demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the operational phase.
- All areas of increased ecological sensitivity should be designated as "No-Go" areas and be off limits to all unauthorised vehicles and personnel;
- Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present; and if so that a remedy is put in place as soon as possible.
- Ensure soil management programme is implemented and maintained to minimise erosion and sedimentation;
- Implement and maintain alien vegetation management programme;
- If it is absolutely unavoidable that any of the wetland areas present will be affected, disturbance must be minimised and suitably rehabilitated;
- No material is to be dumped or stockpiled within any rivers, tributaries or drainage lines;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads and within the operational footprint;
- All vehicles must be regularly inspected for leaks;
- Re-fuelling must take place 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; and
- Appropriate sanitary facilities must be provided for the duration of the operational phase and all waste must be removed to an appropriate waste facility.

7.2.4 Impact Ratings

Table 7-3: Potential impacts of the operational underground mining activities

Activity and Interaction 3: Operational underground mining activities, including excavation and dewatering
Impact Description: Operational activities of the proposed underground mining activities have the potential to result in impacts to the water quality of the groundwater, local and downstream

Activity and Interaction 3: Operational underground mining activities, including excavation and dewatering			
resources as well as the potential loss of water supply from the groundwater aquifer. Dewatering activities are likely to result in the loss of water supply to the wetlands, with special mention of the lower lying wetlands such as CVB4, and moisture stress to the surrounding wetland areas.			
Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Permanent (7)	The impacts caused during the operational phase will have a long-lasting effect if not mitigated. Impacts must be managed proactively.	Moderate negative (-108)
Extent	Region (5)	The impact could spread beyond the local development boundaries due to the ability of degraded water quality, sediments or alien invasive species to travel significant distances; especially downstream. Habitat fragmentation is also a catchment scale impact.	
Intensity	Irreplaceable loss and damage (6)	These activities will result in an irreplaceable loss of ecologically important water sources for the region.	
Probability	Highly probable (6)	These impacts are highly probable.	
Nature	Negative		
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Permanent (6)	The operational activities will result in a permanent change to the ecology of the wetlands and is potentially irreversible.	Minor negative (-65)
Extent	Local (3)	Management and mitigation measures have the potential to prevent the impacts from spreading beyond the development site.	
Intensity	Serious loss of highly sensitive environment (4)	Freshwater resources are sensitive natural ecosystems providing significant ecological services that are experiencing high levels of cumulative loss and damage. The proposed pits have the potential to result in a moderate loss of wetland integrity and function.	
Probability	Likely (5)	Despite all intentions to prevent impacts, it is likely that impacts will still be realised due to the nature of the activity and the proximity to	

Activity and Interaction 3: Operational underground mining activities, including excavation and dewatering			
		sensitive freshwater resource receptors. These potential residual impacts must be managed accordingly.	
Nature	Negative		

Table 7-4: Potential runoff related impacts associated with the operational phase

Dimension	Rating	Motivation	Significance
Activity and Interaction: Uncontrolled runoff of stormwater or water generated from the mining operations from or through the surface infrastructure			
Impact Description: Water quality and habitat deterioration of watercourses receiving unnatural/contaminated runoff			
Prior to Mitigation/Management			
Duration	Project Life (5)	It is predicted that contaminant input will continue throughout the life of the Project whenever rainfall events occur.	Minor (negative) – 56
Extent	Municipal (4)	Due to the dry nature of the watercourses in the MRA, runoff is already expected to be limited which should result in limited contaminant input. However, downstream sections of the associated systems will most likely be affected when rainfall events lead to contaminant input and as a precautionary measure for the sensitive biota observed downstream, the extent rating has been increased.	
Intensity x type of impact	Serious - Negative (-5)	Due to the dry nature of the watercourses in the MRA, the intensity of runoff is already expected to be limited. However, aquatic systems are regarded as sensitive and the entry of contaminants will result in serious aquatic related impacts especially if water reaches the Sandspruit reach.	

Dimension	Rating	Motivation	Significance
Probability	Probable (4)	The impact is likely to occur throughout the life of the Project but limited due to periodic rainfall events.	
Nature	Negative		
Post-Mitigation			
Duration	Project Life (5)	Runoff will continue throughout the Project life.	Negligible (negative) – 30
Extent	Limited (2)	Runoff will most likely be largely restricted and captured after mitigation.	
Intensity x type of impact	Moderate - Negative (-3)	If mitigation measures are all incorporated for the Project, the intensity of the impact should decrease. However, contaminants are more difficult to manage compared to solid particles and are predicted to enter associated aquatic systems resulting in water quality deterioration.	
Probability	Unlikely (3)	The likelihood of the impact occurring is reduced by the mitigation actions and should only result in extreme rainfall events or if mitigation structures aren't maintained.	
Nature	Negative		

Table 7-5: Potential Impacts of the operational phase

Activity and Interaction 1: Loading, hauling and stockpiling			
Impact Description: These activities have the potential to result in an increased potential for soil compaction, erosion, sedimentation, loss of water quality, habitat and biodiversity.			
Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project life (5)	The potential impacts caused during the operational phase will cease after the operational life span of the Project	Minor negative (-65)
Extent	Municipal (4)	The impact could spread beyond the local development boundaries due to the ability of	

		degraded water quality, sediments or alien invasive species to travel significant distances; especially downstream. Habitat fragmentation is also a catchment scale impact.	
Intensity	Serious medium term (4)	These impacts are serious medium-term threats to the important and sensitive freshwater resource habitats.	
Probability	Likely (5)	These impacts are likely.	
Nature	Negative		
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project life (5)	The potential impacts caused during the operational phase will cease after the operational life span of the Project	Negligible negative (-34)
Extent	Site (1)	Managing and mitigation measures have the potential to prevent the impacts from spreading beyond the operational site.	
Intensity	Minor (2)	With fully functional management, monitoring and mitigation plans, the impact to the ecosystem functioning will be minimal.	
Probability	Probable (4)	Despite all intentions to prevent impacts, it is probable that impacts will still be realised due to the nature of the activity and the proximity to sensitive freshwater resource receptors. These potential residual impacts must be managed accordingly.	
Nature	Negative		

Table 7-6: Potential impacts from the use and maintenance of haul roads

Activity and Interaction 2: Use and maintenance of haul roads for the transportation of coal and waste rock			
Impact Description: Fragmentation of the freshwater resources as a result of road crossings, contamination of freshwater resources and impacts to water quality as a result of spills, compaction of soils, loss of habitat and biodiversity. Increased potential for sheet runoff from paved/cleared surfaces and increased potential for erosion.			
Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Permanent (7)	The operational activities have the potential to result in the permanent fragmentation of	

Activity and Interaction 2: Use and maintenance of haul roads for the transportation of coal and waste rock			
		wetland and river systems, as well as the contamination and sedimentation of the stream.	Minor negative (-56)
Extent	Municipal (4)	The impact could spread beyond the local development boundaries due to the ability of degraded water quality or sediments to travel significant distances; especially downstream. Habitat fragmentation is also a catchment scale impact.	
Intensity	Moderate loss of sensitive habitat (3)	Freshwater resources are sensitive natural ecosystems providing significant ecological services that are experiencing high levels of cumulative loss and damage. Thus, all remaining functional freshwater resources are even more important and sensitive to impacts that threaten their ecological integrity; directly or indirectly.	
Probability	Probable (4)	These impacts are probable.	
Nature	Negative		
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project life (5)	The potential impacts caused during the operational phase will cease after the operational life span of the Project	Negligible negative (-32)
Extent	Limited (2)	Managing and mitigation measures have the potential to prevent the impacts from spreading beyond the operational site.	
Intensity	Minimal (1)	With fully functional management, monitoring and mitigation plans, the impact to the ecosystem functioning will be minimal.	
Probability	Probable (4)	Despite all intentions to prevent impacts, it is probable that impacts will still be realised due to the nature of the activity and the proximity to sensitive freshwater resource receptors. These potential residual impacts must be managed accordingly.	
Nature	Negative		

7.3 Decommissioning Phase

7.3.1 Impact Description

Similar to the construction phase, the decommissioning and rehabilitation activities pose significant potential negative impacts to functioning wetlands and catchments. Furthermore, the rehabilitated areas could cause major negative impacts due to spread of alien invasive vegetation, increased soil compaction, erosion and subsequent sedimentation into the wetland and river ecosystems.

Due to the depth of the aquifer in relation to the adit access point. No decant is expected to occur post-closure according to the Digby Wells Groundwater Report (Digby Wells, 2018b) and as such, no impact rating table has been included in this regard. It is, however, recommended that these adits be appropriately sealed upon decommissioning and closure of the mine to avoid the unlikely event of any potential spills or decant.

7.3.1.1 Management Objectives

The main management objective would be to rehabilitate the affected areas to near-natural conditions without resulting in additional impacts to the wetland ecology throughout the process.

7.3.1.2 Management Actions

The goal of mitigation should be to limit erosion and runoff from the footprint of the areas/infrastructure during decommissioning as well as during rehabilitation. The following measures may be utilised in attempt to reduce the decommissioning impacts:

- High rainfall periods should be avoided during decommissioning;
- Storm water must be diverted from decommissioning activities;
- Stored mine-affected water should be treated before decommissioning of any mine-related water retention areas, such as PCDs;
- The edge of the non-directly impacted freshwater resources, and at least a 100m buffer or 1:100 floodline buffer, should be clearly demarcated in the field with wooden stakes painted white as no-go zones that will last for the duration of the decommissioning phase;
- All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel;
- Actively re-vegetate disturbed areas as well s decommissioned footprint areas as part of the decommissioning process;
- Implement and maintain an alien vegetation management programme for the duration of the decommissioning phase and into closure;

- No material should be dumped within any wetlands or watercourses;
- No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads;
- All vehicles must be regularly inspected for leaks;
- Re-fuelling must take place on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into the topsoil;
- All spills should be immediately cleaned up and treated accordingly;
- Appropriate sanitary facilities must be provided for the duration of the decommissioning phase and all waste must be removed to an appropriate waste facility; and
- Wetland monitoring must be carried out during the decommissioning phase to ensure no unnecessary impact to wetlands takes place.

7.3.1.3 Impact Ratings

The impact rating associated with activities related to the removal of surface infrastructure and rehabilitation of potentially affected areas have been predicted in below.

Table 7-7: Potential Impacts from rehabilitation and dismantling of infrastructure

Activity and Interaction 1: Rehabilitation of site and dismantling of infrastructure			
Impact Description: Erosion onset, sedimentation and establishment of alien plants			
Prior to Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Long term (4)	The impacts caused during the decommissioning activities will have a long lasting effect if not mitigated.	Minor negative (-65)
Extent	Municipal (4)	The impact could spread beyond the local development boundaries due to the ability of degraded water quality or alien invasive species to travel significant distances; especially downstream.	
Intensity x type of impact	Serious damage to or loss of sensitive environments (5)	These impacts are serious threats to sensitive habitats such as wetlands; especially due to their sensitivity and importance to local communities.	

Activity and Interaction 1: Rehabilitation of site and dismantling of infrastructure			
Probability	Likely (5)	These are commonly observed impacts for the decommissioning phase, especially for wetlands of this climate.	
Nature	Negative		
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Medium term (3)	Impacts will last as long as decommissioning activities are ongoing.	Minor negative (-36)
Extent	Local (3)	Mitigation will allow impacts to be within the local site.	
Intensity x type of impact	Moderate damage to sensitive environments (3)	Decommissioning activities may still have a moderate effect on the wetlands in the Project area. These wetlands are sensitive environments.	
Probability	Probable (4)	Negative impacts to the wetlands during decommissioning could occur given the nature of the task.	
Nature	Negative		

7.4 Cumulative Impacts

The current impacts to the project area were related largely to the agropastoral activities observed. In addition to this were the linear infrastructures observed throughout the project area such as roads and powerlines.

Grazing activities and the spread and proliferation of dense areas of alien and invasive plant species had resulted in severe impacts to the health and integrity of large portions of the wetlands present, which in turn had aggravated impacts related to erosion, sedimentation and loss of carbon and biodiversity. Further to this, some impacts related to fragmentation, the creation of preferential flow paths and compaction of soils due to the presence of existing roads and infrastructure had resulted in loss of water retention and erosion.

The influx of people to the area as a result of mining activities have the potential to result in further impacts related to subsistence farming activities, informal settlements and additional linear infrastructures. This may result in further degradation of the wetland systems and reflect greater modification of scores as indicated by the determined PES.

Forestry activities in the vicinity of the town of Sheepmoor was regarded as likely to contribute to impacts in relation to wetland integrity, with impacts such as loss of carbon, changes in soil chemistry and water retention capacity, and loss of surface roughness (increasing surface runoff) had the potential to increase runoff resulting in an increased potential for erosion.

The dominant land-use of the project area was related to agropastoral activities and forestry. The approval of mining activities within the project area has the potential to result in further approvals for mining within the greater area. This may result in a significant overall land-use change and with this, the loss of sensitive habitats important for the maintenance of biodiversity, loss of catchment yields and decreases in water quality, the latter being of special concern as the freshwater resources downstream of the project area, with special mention of the Sandspruit River. The Sandspruit River is classified as an ecological category B (minimally modified), flowing into the Ngwempisi River, which flows into Swaziland, and is deemed important for the maintenance of biodiversity as well as for water supply.

7.5 Unplanned and Low Risk Events

There is a risk that wetland areas associated with the mining operations/infrastructure throughout the life of the proposed project might be affected by the entry of hazardous substances, such as hydrocarbons, in the event of a spillage or unseen seepage from storage facilities; and

Accidents or deterioration of structures along the roadways and river/wetland crossings, including pipelines, may result in impacts to the habitat and water quality

Table 7-8 outlines mitigation measures that must be adopted in the event of unplanned impacts throughout the life of the proposed project.

Table 7-8: Unplanned events and associated mitigation measures

Unplanned Risk	Mitigation Measures
Chemical and (or) contaminant spills from mining operation, infrastructure and associated activities.	▪ Ensure correct storage of all chemicals at operations as per each chemical's specific storage requirements (e.g. sealed containers for hydrocarbons); ▪ Ensure staff involved at the proposed project have been trained to correctly work with chemicals at the sites; and ▪ Ensure spill kits (e.g. Drizit) are readily available at areas where chemicals are known to be used. Staff must also receive appropriate training in the event of a spill, especially near wetlands, watercourses and/or drainage lines.
Unplanned structural deterioration or accidents along the roadways and pipelines in the vicinity of wetlands	▪ Install safety valves and emergency switches that can be used to seal off leakages from pipelines when noticed or triggered;

Unplanned Risk	Mitigation Measures
	▪ Ensure that spill kits and trained staff capable of using the kits are available on site in case of accidental spillages; ▪ Maintenance of roadways, river crossings and pipelines should be considered an ongoing process where leakages or issues with the pipe should be reporting to acting Environmental Control Officer (ECO) of the project immediately after notice.

8 Wetland Monitoring Program

The WET-health and WET-Ecoservices tools should be used to re-evaluate PES and eco-services on a quarterly basis by a suitably qualified wetland specialist for the duration of the construction phase, and annually for the duration of the operational phase. Upon closure and decommissioning, annual monitoring should take place for another three years to ensure no emerging impacts are identified, which may need to be addressed.

9 Recommendations

The following actions have been recommended to allow for commencement of the proposed project:

- The extent of the loss of water supply to the lower lying wetlands from the deeper groundwater aquifer should be quantified to determine the potential impacts to wetland integrity and functionality.
- A wet season aquatic survey must be undertaken prior to commencement of the Project; and
- A wetland biomonitoring programme must be developed and adopted on commencement of the project. This programme should continue for the life of the project and for at least three years post the decommissioning phase.

10 Conclusion and Specialist Opinion

The wetland assessment carried out in September 2019 revealed the presence of twelve wetland systems within the project area and its 500 m zone of regulation, which have varied HGM units associated with each.

The HGM unit types observed within the project area included: bench, hillslope seep, channelled valley bottom and unchanneled valley bottom systems. These HGM units were categorized largely on topography and their respective locations within the landscape.

The health and integrity of each of the HGM units varied considerably, with anthropogenic disturbances being the most significant driver of change to date. These disturbances were related largely to agropastoral activities and linear infrastructures traversing the project area and the hillslope seeps and bench HGM units on the ‘koppie’ and other higher lying areas were mostly regarded as natural and/or minimally modified, while the lower lying HGM units were mostly regarded as moderately to largely modified.

In terms of service provision and functionality, the wetlands observed within the study area play an important role in the maintenance of biodiversity as well as streamflow regulation, with special mention of the bench and hillslope seep HGM units. The lower lying wetlands observed were also observed to be important in the maintenance of biodiversity, but played a larger role in terms of services such as flood attenuation and human benefits such as water supply, cultivation of crops and grazing potential.

The hydrological driver of the wetlands within the project area appear to be two-fold. It is suspected that the benches and hillslope seeps situated on the ‘koppie” are driven to a large extent by the underlying geologies (i.e. geohydrology). A shallow aquifer is present in the ‘koppie’. This is comprised of sandstone and shale, with an overlaying dolerite sill, where daylighting moisture was observed along with the origin of many of the hillslope seeps i.e. WET3, WET4, WET5, WET6, WET7 and WET8. Portions of WET8 in the foothills, with specific reference to the large channelled valley bottom wetland (CVB4), may be regarded as hydrologically connected to the hillslope seeps on the “koppie” and the other high lying areas. However, it is likely that a deeper aquifer supplies water to CVB4 and dewatering of this aquifer for the proposed underground mining has the potential to impact negatively on both WET8 as well as WET9 due to the potential loss of groundwater supply.

Should the proposed project proceed without suitable management and mitigation, there is likely to be a number of negative impacts to the wetland ecology of the project area (moderate and minor impacts), including erosion, sedimentation, impaired water quality and the further proliferation of alien and invasive species being of specific concern. However, should the appropriate mitigation and management measures be implemented, along with the recommendations outlined in this report, it is possible that these impacts may be reduced to minor and negligible impacts. In lieu of this finding, it is the opinion of the wetland ecologist that should the appropriate management and mitigation measures be adopted and the mining method (i.e. continuous mining) in place at the time of submission of this report be adhered to, impacts to the wetland ecology of the area can be managed in such a way as to minimise the potential deterioration of these systems. Should any changes to the mining method be proposed, this will require revision of the impact assessment as various mining methods (such as blasting), have the potential to impact the shallow aquifer on which many of the pristine bench and hillslope seep HGM units rely for water supply.

11 References

Darwall, W. R. T., Smith, K. G., Tweddle, D., & Skelton, P. (2009). *The status and distribution of freshwater biodiversity in southern Africa*. Gland, Switzerland: IUCN and Grahamstown, South Africa: SAIAB.

DEA, DMR, SAMBF, SANBI. (2013). Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector. Pretoria. *Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, and South African National Biodiversity Institute.* https://doi.org/10.4159/harvard.9780674864092.c26

Department of Water and Sanitation. (2014). A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa.

Digby Wells (2019a). Soils, Land Capability and Land Use Assessment Report. Dagsoom Twyfelaar Coal Mining Project near Ermelo, Mpumalanga.

Digby Wells (2019b). Aquatic Biodiversity and Impact Assessment Report. Dagsoom Twyfellar Coal Mining Project near Ermelo, Mpumalanga.

Digby Wells (2019c). Floral and Fauna Impact Assessment Report. Baseline Faina and Flora Impact Assessment Report Input for the Environmental Application Process for the Proposed Twyfellar Coal Mining Project, Mpumalanga Province.

Digby Wells (2019d). Groundwater Impact Assessment. Dagsoom Twyfelaar Coal Mining Project near Ermelo, Mpumalanga.

Digby Wells (2019e) Surface water Assessment. Surface Water Assessment for the Proposed Twyfelaar Coal Mine.

Driver, A., Nel, J. L., Snaddon, K., Murray, K., Roux, D. J., Hill, L., … Funke, N. (2011a). Implementation Manual for Freshwater Ecosystem Priority Areas. In *Draft Report for the Water Research Commission*. Retrieved from http://www.wrc.org.za/Knowledge Hub Documents/Research Reports/1801-1-11.pdf

Driver, A., Nel, J. L., Snaddon, K., Murray, K., Roux, D. J., Hill, L., … Funke, N. (2011b). Implementation Manual for Freshwater Ecosystem Priority Areas. *Draft Report for the Water Research Commission*. Retrieved from http://www.wrc.org.za/Knowledge Hub Documents/Research Reports/1801-1-11.pdf

Driver, A., Sink, K. J., Nel, J. L., Holness, S., van Niekerk, L., Daniels, F., … Maze, K. (2012). *National biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems - Synthesis Report*. https://doi.org/10.1017/CBO9781107415324.004

Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z.-I., Knowler, D. J., Lévêque, C., … Sullivan, C. A. (2006). Freshwater biodiversity: importance, threats, status and conservation challenges. *Biological Reviews*, *81*, 163–182.

DWA. (2012). *Classification of Significant Water Resources (River , Wetlands , Groundwater and Lakes) in the Upper , Middle and Lower Vaal Water Management Areas (WMA) 8 , 9 , 10 INCEPTION REPORT : Copyright reserved*. *2011*(September).

Kleynhans, C. J., Thirion, C. A., Moolman, J., & Gaulana, L. (2007). *A Level II River Ecoregion classification System for South Africa, Lesotho and Swaziland* (No. Report No. N/0000/00/REQ0104.). Pretoria, South Africa: Department of Water Affairs and Forestry - Resource Quality Services.

Kotze, D. C., Marneweck, G. C., Batchelor, a L., Lindley, D. S., & Collins, N. B. (2009). WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands. *Wetland Management Series*.

Kotze, D., Marneweck, G., Batchelor, A., Lindley, D., Collins, N., Kleynhans, C. J., … Thirion, C. (1999). A technique for rapidly assessing ecosystem services supplied by wetlands.

Известия Высших Учебных Заведений. Радиофизика, *408*(Version 2), 2–3.

Macfarlane, D., Kotze, D., & Ellery, W. (2009). *WET-Health A technique for rapidly assessing wetland health* (TT 340/09). WRC Report.

Malmqvist, B., & Rundle, S. (2002). Threats to the running water ecosystems of the world. *Environmental Conservation*, *29*(2), 134–153.

Mucina, L., & Rutherford, M. C. (2012). The vegetation of South Africa, Lesotho and Swaziland.Strelitzia 19. In *Strelitzia*.

Nel, J., Murray, K., Maherry, A., Petersen, C., Roux, D., Driver, A., … Nienaber, S. (2011). *Technical Report for the National Freshwater Ecosystem Priority Areas project, to the WRC*. (1801), WRC Report No. 1801/2/11.

Rountree, M. W., Malan, H. L., & Weston, B. C. (2013). *Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Vers.2.0).*

South African Dept. Water Affairs and Forestry. (2005). *A practical field procedure for identification and delineation of wetlands and riparian areas*. *Edition 1*. Retrieved from http://biodiversityadvisor.sanbi.org/wp-content/uploads/2016/07/DWS-wetland-delineation-manual.pdf