PROPOSED BATTERY ENERGY STORAGE SYSTEM (BESS) AND WATER RESERVOIR FOR THE WAAIHOEK WIND ENERGY FACILITY (WEF)

UTRECHT, EMADLANGENI LOCAL MUNICIPALITY, KWAZULU-NATAL

Wetland Assessment Report

Version 1.1

Date: 12th November 2020

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Report No: EP527-01

Prepared for: **CES – Environmental and Social Advisory Services**

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SPECIALIST ASSESSMENT REPORT DETAILS AND DECLARATION OF INDEPENDENCE

This is to certify that the following assessment and report has been prepared independently of any influence or prejudice as may be defined by the relevant environmental authorities and as per the following requirements:

1. The Department of Human Settlements, Water & Sanitation (DHSWS) requirements for Water Use Licensing and wetland/aquatic assessments, as outlined in the '*Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals*' contained in the Government Gazette No. 40713 of 24 March 2017.
2. Section 32 (3) of the NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (Act No. 107 OF 1998) ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS 2014 as per Government Notice No. 38282 GOVERNMENT GAZETTE, 4 DECEMBER 2014 (as amended in 2017).
3. Procedures to be followed for the assessment and minimum criteria for reporting of identified environmental themes in terms of Section 24(5)(a) and (h) of the NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998, when applying for Environmental Authorisation, as per Government Notice No. 648 in Government Gazette No. 42451 (10 May 2019).

Document Title:	**Wetland Assessment Report**
Project:	Waaihoek BESS and Water Reservoir for the Waaihoek Wind Energy Facility
Location:	Utrecht, eMadlangeni Local Municipality, KwaZulu-Natal
Report No.	527-01
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Date:	12th November 2020
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Client:	CES – Environmental and Social Advisory Services

Details of Specialist Team

The relevant experience of specialist team members involved in the compilation of this report are briefly summarized below. *Curriculum Vitae's* of the specialist team are available on request.

Member	Project Role	Details
Adam Teixeira-Leite Principal Scientist *Pr.Sci.Nat.*	Project Support and Report Review	Adam is an employee at Eco-Pulse and Principal Scientist with a BSc Honours degree in Environmental and Earth Science (completed Cum Laude) and is presently awaiting the results of his MSc thesis completed part-time in Environmental Science (wetland ecology and restoration). Adam's MSc thesis focused on a wetland rehabilitation project near Mtunzini in KZN titled '*Monitoring the short-term response of a coastal freshwater wetland following the cessation of sugarcane farming'*. He is a registered Professional Natural Scientist (Pr.Sci.Nat.) with SACNASP in the 'Ecological Science' and 'Environmental Science' fields of practice. Over the past 13 years he has worked extensively on numerous wetland projects requiring the delineation of wetlands and assessment of wetland functional importance and sensitivity, as well as wetland rehabilitation planning, in KwaZulu-Natal, the Western Cape and Eastern Cape, the Free State and in Gauteng. Adam has also been involved in a range of projects requiring the assessment of terrestrial and aquatic biodiversity, requiring both desktop analysis and field verification as well as in the development of a Biodiversity Sector Plan for the Ugu District Municipality. He has also been involved in vegetation assessments and extensively in alien invasive plants surveys and nursery audits for eThekwini Municipality. Adam has successfully completed several Water Use License Applications (WULAs) for residential / commercial developments within KZN (eThekwini Municipality, KwaDukuza Municipality) and Eastern Cape.
Ryan Kok Scientist *Pr.Sci.Nat.*	Wetland specialist: Field Sampling & Reporting	Ryan holds a BSc degree in Environmental Science; BSc Honours and MSc degree in Biological & Ecological Sciences. His MSc thesis focused primarily on the impacts of climate change and human land use on the species distribution of Malagasy bats (past-present-future). Ryan has >7 years' experience in GIS and environmental modelling, with extensive field experience in monitoring and analysing data. Since being part of Eco-Pulse Ryan has utilized his GIS skills in Environmental Management Frameworks, Wetland Inventories and Prioritization Assessments for major Municipalities. Ryan also has experience in wetland and riparian delineations, functional and impact assessments. He has also been involved in numerous freshwater ecosystem assessments and has experience in the compilation and management of Water Use Licence Applications. He is a registered Professional Natural Scientist (Pr.Sci.Nat.) with SACNASP in the 'Ecological Science' field of practice.

EXECUTIVE SUMMARY

This report sets out the findings of a **Specialist Wetland Assessment** to inform the application for environmental approval in terms of the NEMA: EIA Regulations (2014, as amended in 2017) and a water use license application (WULA) in terms of the National Water Act, for the Battery Energy Storage System (BESS) and associated infrastructure to support the authorised Waaihoek Wind Energy Facility (WEF) located near the town of Utrecht in the eMadlangeni Local Municipality, Amajuba District, Kwa-Zulu Natal.

An assessment of the wetlands located within BESS assessment area was undertaken by Eco-Pulse Environmental Consulting Services in October 2020. The main findings of the wetland baseline and impact/risk assessment have been summarized below.

Catchment Context:

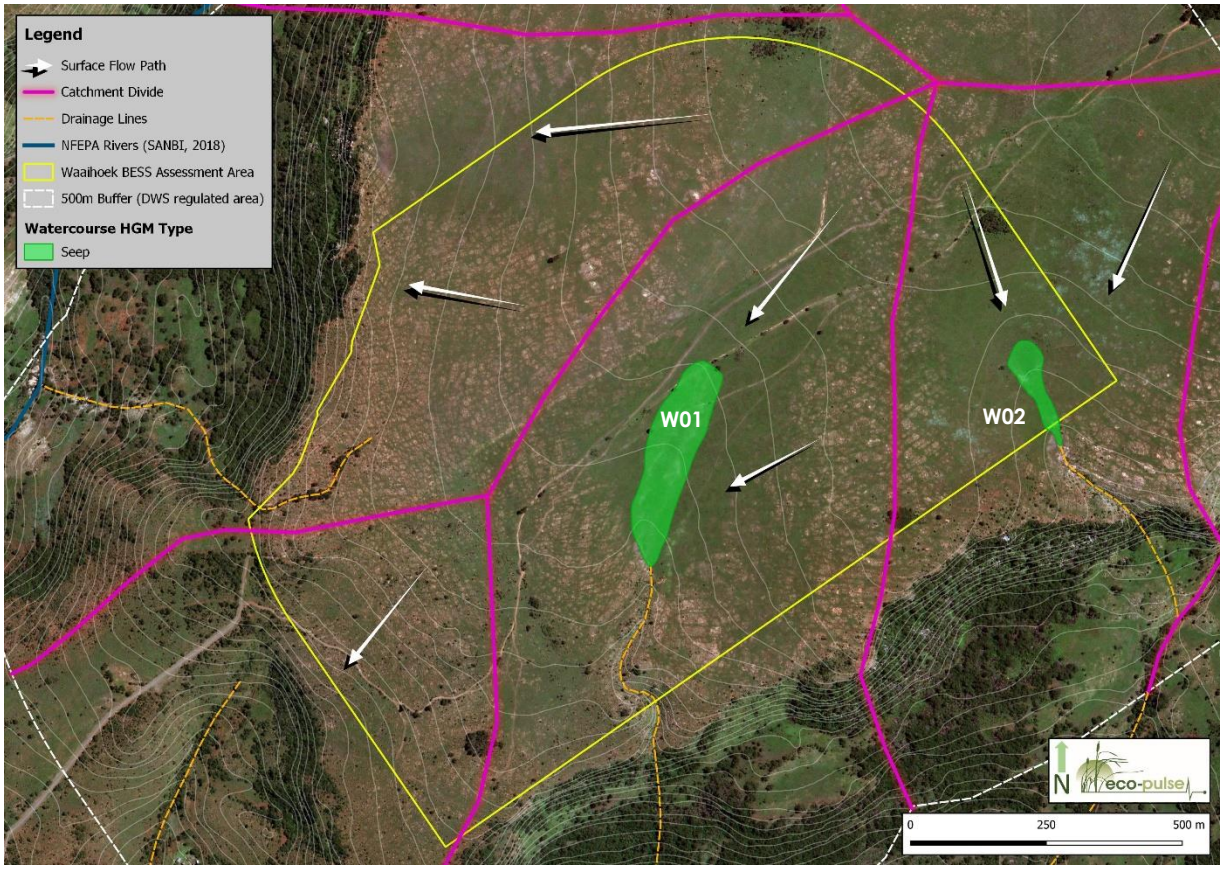
The area of study is located close to the catchment divide between DWS Quaternary Catchment V32C and V32G, in the uMzimkulu - uMvoti Water Management Area (WMA), and drained by a number of larger perennial rivers including the Tiyna, Mbabane, Buffels (V32C) and Bloed (U30G) Rivers. The wetlands identified on the site and located in the southern portion of the assessment area (catchment V32G) are narrow hillslope seeps that feed into the tributaries, which eventually drains into the larger Bloed River some distance downstream to the south-east of the site.

Baseline River PES & EIS:

An impact potential screening assessment was undertaken and identified two (2) individual wetlands (W01 & W02) on the site that are at risk of being potentially measurably impacted during the construction and operational phases of the BESS and water reservoir. NO RIVERS stand to be impacted either directly or indirectly, therefore only wetlands have been assessed and reported on. The baseline assessment focused on the two wetlands (seeps), with the results summarised below:

Watercourse Units	PES Class	EIS Rating	REC	RMO	Proposed Action
Wetland W01	B	Moderately Low	B	Maintain PES & EIS	Manage risk of potential ecological degradation
Wetland W02	B	Moderately Low	B		

Map showing the two delineated 'seep' wetlands in relation to the broader BESS assessment area:



Resource Management Objectives & Recommendations:

Based on the consideration of the PES, EIS and realistic opportunities to improve the PES, the minimum recommended management objective for the assessed wetlands should be to '*maintain the current status quo of wetlands without any further loss of integrity/condition or functioning*' which can be achieved through careful management of catchment sediment, erosion, flow and water quality impacts/risks and by avoiding direct impacts to the wetlands.

Risk and Impact Assessment:

The development will take place on a privately owned property, which is untransformed and undeveloped 'greenfields', used primarily as grazing land at present. The most significant ecological risks and impacts associated with the project are linked with the potential for erosion and sedimentation of adjacent and downstream wetlands during the construction phase, and long-term storm water (erosion) related risks and impacts during operation, as well as the potential risk of water quality impacts through the leakage of battery units. These impacts can be mitigated with best management practices such that under a 'good' mitigation scenario, impact significance can be maintained at a 'low' level, which can be considered to be environmentally acceptable.

Mitigation of Risks and Impacts:

Recommendations to mitigate key risks and impacts related to the project have been provided in Chapter 7 of the wetland report. The focus of impact/risk mitigation has been on addressing potential construction and operational phase risks and impacts on freshwater wetland habitat. These include development layout recommendations to avoid wetlands and recommended buffer zones (development set-back and No-Go areas), best-practice management measures and controls to minimise impact probability of occurrence and to reduce impact intensity where impacts cannot be avoided entirely and a rehabilitation strategy to rehabilitate any residual impacts to wetland habitat as a result of the development (*this is unlikely to take place as direct impacts are to be avoided in the first instance*).

Licensing & Permitting Requirements:

The activities associated with the Waaihoek BESS project are considered Section 21(c) and 21(i) water use in terms of Section 21 and Chapter 4 of the National Water Act No. 36 of 1998 (NWA), and this is as a result of construction and operation phase activities set to take place within the DHSWS 'Regulated Area for Section 21 c & i, water use', i.e. within 500m of a wetland. As risks all fall within the 'Low' risk category / class, and the significance of the impacts was assessed as being low with appropriate mitigation applied, a General Authorization (GA) in terms of Section 39 of the NWA is most likely to be applicable at the project level. The DHSWS will still need to be approached to confirm this is the case and any further WULA requirements.

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1. INTRODUCTION

1.1 Project Details

1.1.1 Project Background and Locality

Waaihoek Wind Farm (Pty) Ltd is proposing the construction and operation of a Battery Energy Storage System (BESS) and associated infrastructure (including access roads and a water storage reservoir), to support the Waaihoek Wind Energy Facility (WEF) located near the town of Utrecht in the eMadlangeni Local Municipality, Amajuba District, in Kwa-Zulu Natal Province of South Africa. (Figure 1).

Eco-Pulse Environmental Consulting Services ('Eco-Pulse') was appointed through CES Environmental on behalf of Mainstream Renewable Power (the Applicant) to undertake the specialist Wetland Assessment necessary to inform the environmental authorization and water use licensing requirements for the BESS project.

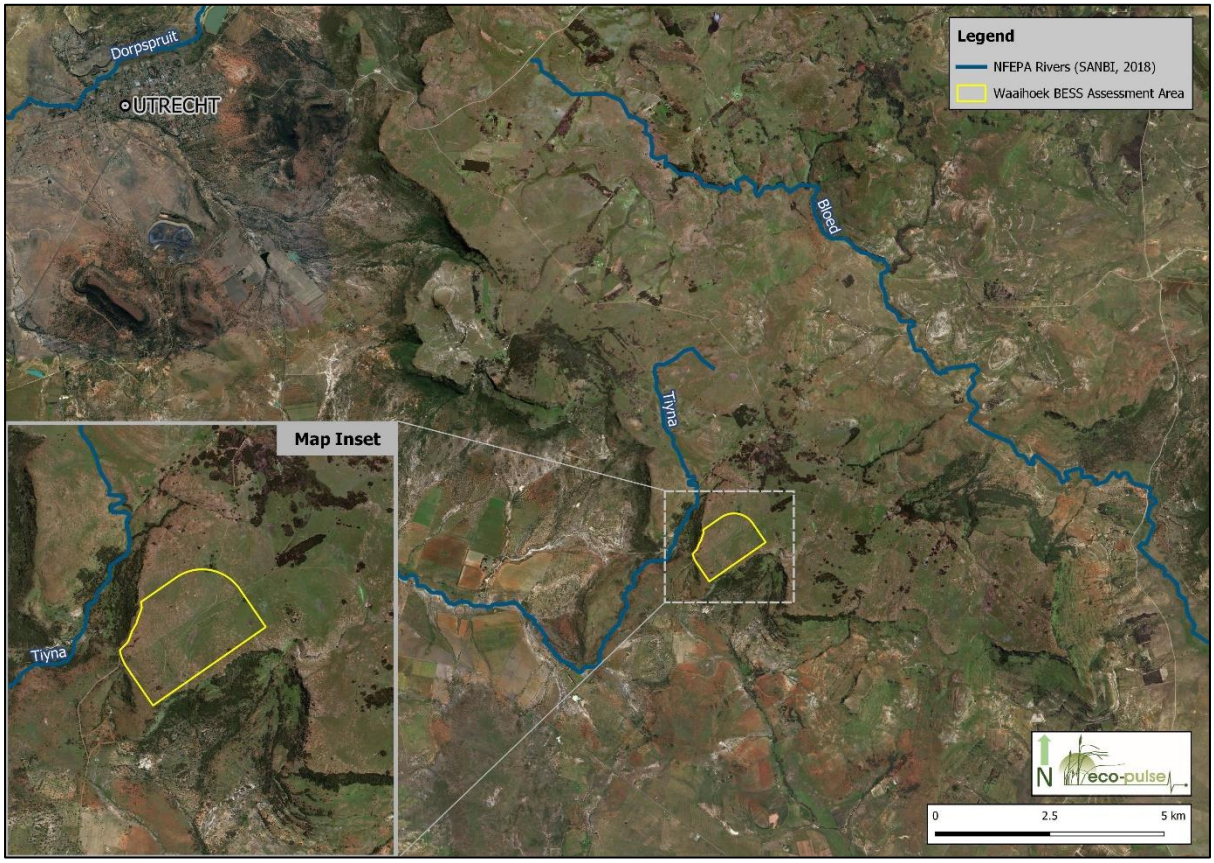


Figure 1 Locality map showing the site of the proposed Battery Energy Storage System (BESS) and Water Reservoir, located south-east of Utrecht town, KZN.

1.1.2 Project Description

Waaihoek Wind Farm (Pty) Ltd, a subsidiary of South Africa Mainstream Renewable Power Developments (Pty) Ltd (the 'Applicant'), is proposing the development of a battery energy storage system (BESS)

adjacent to the authorized Waaihoek Substation and a new water reservoir, in association with the Waaihoek Wind Energy Facility (WEF) located south-east of Utrecht.

The need for a BESS stems from the fact that electricity is only produced by the WEF while the wind is blowing, while the peak demand may not necessarily occur during the daytime. Therefore, the storage of electricity and supply thereof during peak-demand will mean that the facility is more efficient, reliable and electricity supply more constant.

The BESS footprint will be up to 2 ha with a 200MWh capacity. The BESS units would be approximately the same height/size as a shipping container and placed upon a small concrete foundation. Currently, the battery technologies being considered are Solid State Lithium Ion Batteries and Redox Flow Batteries. As for the substation, the BESS would be enclosed, fenced off and the ground surface covered in suitable gravel/stones. In addition, the water reservoir proposed is to be located within the BESS assessment area and will have a capacity of at least 250m^3 and will be used to meet water requirements for construction of the BESS. The reservoir is to be built on well-compacted 150-250mm thick G5 material. The sides are corrugated iron lined with sail, which is bound with 5mm steel cable 6 rings on the outside. Dimensions are 2,5m high, 15m diameter to contain roughly 400,000 liters of water.

1.2 Purpose and Scope of the Assessment

Mainstream Renewable Power Developments (Pty) Ltd (the 'Applicant')) is committed to compliance with relevant environmental legislation and other requirements as well as to the continual improvement in environmental performance through the setting, implementing and monitoring of environmental and sustainability targets.

The proposed BESS and reservoir requires Environmental Authorisation as per the latest relevant NEMA: EIA regulations and a water use license is also required due to development being within 500m of a wetland and posing a risk of impacting wetlands both on the property and downstream. This was confirmed by the EAP through the application of the online EIA screening tool. The Eco-Pulse wetland assessment report will be crucial to informing the EIA and WULA that are currently underway for the development project.

The wetland assessment was undertaken in accordance with the following scope of work:

<u>Phase 1 – Baseline Wetland Assessment & Project Planning/ Design Recommendations</u>

- Contextualization of the study area in terms of important biophysical characteristics and freshwater conservation planning through a review of available spatial datasets and relevant conservation plans.
- Desktop mapping and classification of all watercourses (e.g. wetlands, rivers, streams, dams) within 500 m of the BESS assessment area using aerial photography, contours and water resource inventory databases.

- Identifying the watercourses within 500 m of the BESS assessment area that are likely to be measurably negatively affected and the extent of the watercourses which were taken forward for detailed assessment (this constituted the study area).
- Delineation of all watercourses occurring within the study area according to the methods contained in the manual '*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas*' (DWAF, 2005).
- Subdivision of delineated wetland and rivers into definable resource units and the classification of these units according to the national wetland and aquatic ecosystem classification system (Ollis *et al*., 2013).
- Assessment of the present ecological state (PES) of the delineated wetland units using the revised Level 1 WET-Health assessment tool (Macfarlane *et al*., 2020).
- Assessment of the Ecological Importance and Sensitivity (EIS) of the delineated wetland units using the EIS assessment method developed by Eco-Pulse adapted from the DWAF Resource Directed Measures EIS tools (Kleynhans, 1999 & Duthie, 1999).
- Functional assessment of the wetland units using an updated version of the Level 2 WET-EcoServices tool (Kotze *et al*., 2020).
- Recommendations for impact mitigation have been provided in line with the 'mitigation hierarchy', which seeks first to avoid impacts, then minimize potential impacts and finally rehabilitate or offset to compensate for residual impacts to wetlands. This included:
    - Provision of initial best-practice planning and design recommendations for discussion with the client. Key recommendations included:
        - Provision of suitable wetland buffer zones in accordance with the latest National Wetland Buffer Zone Guidelines (Macfarlane & Bredin, 2016);
        - Key stormwater management recommendations; and
        - Avoidance, rehabilitation and offset considerations

<u>Phase 2 – Freshwater Ecosystem Impact Assessment & Risk Assessment:</u>

- Understanding the site development plan and associated infrastructure plans considered the above-listed planning and design recommendations as far as practically possible, the formal impact assessment commenced. The impact assessment involved the following tasks:
    - Subdivision of the proposed development into distinct activities which were assessed separately. Thereafter, the risks and impact pathways associated with each activity were identified and described.
    - Assessment of the significance of the potential impacts using a methodology developed by Eco-Pulse.
    - Application of the "DWS Risk Assessment Matrix" at a project level, as detailed in the General Authorization in terms of Section 39 of the National Water Act No. 36 of 1998 for Water Uses as defined in Section 21 (C) or Section 21 (I), as contained in Government Gazette No. 40229, 26 August 2016 and contained within the DWS document entitled 'Section 21(c) and (i) Risk-based assessment and authorization, October 2014, Edition 2' to inform water licensing requirements for the project (i.e. full WULA vs GA).

- A description of any assumptions made and any uncertainties or gaps in knowledge, as well as recommendations regarding future specialist inputs.

- Reporting: Compilation of a single Specialist Wetland Assessment Report including all relevant maps and supporting information.

1.3 Introduction to Wetlands

Freshwater ecosystems are a subset of the Earth's aquatic ecosystems and include all inland freshwater rivers, streams, wetlands, lakes, ponds and springs. This broad range of freshwater ecosystem types contains a multitude of habitats of varying ecological complexity and diversity (Wrona *et al.*, 2016). Wetlands, streams and rivers fall under the umbrella term of 'freshwater ecosystems'.

Under Section 1(1)(xxiv) of the National Water Act (Act No. 36 of 1998) (NWA), a 'watercourse' is defined as:

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

This assessment has focused on the assessment of natural wetlands and their associated habitats / ecosystems likely to be measurably affected by the proposed development. **Wetlands** are areas that have water on the surface or within the root zone for extended periods throughout the year such that anaerobic soil conditions develop which favour the growth and regeneration of hydrophytic vegetation (plants which are adapted to saturated and anaerobic soil conditions). In terms of Section 1 of the NWA, wetlands are legally defined as: (1) "…*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.*"

1.4 Legislative Context Relevant to Wetlands

Wetlands as freshwater ecosystem types are not formally protected by law but their alteration is regulated by the water use licensing process of the National Water Act (No. 36 of 1998) ('NWA'), the environmental authorization process of the National Environmental Management Act (No. 107 of 1998) ('NEMA') and the regulated activity permission process of the Conservation of Agricultural Resources Act (No. 43 of 1983) ('CARA').

2. APPROACH & METHODS

2.1 Approach

The general approach to the freshwater (wetland/aquatic) habitat assessment was based on the proposed framework for wetland assessment proposed in the Water Research Commission's (WRC) report titled: '*Development of a decision-support framework for wetland assessment in South Africa and a Decision-Support Protocol for the rapid assessment of wetland ecological condition*' (Ollis *et al.*, 2014) (see Figure 2).

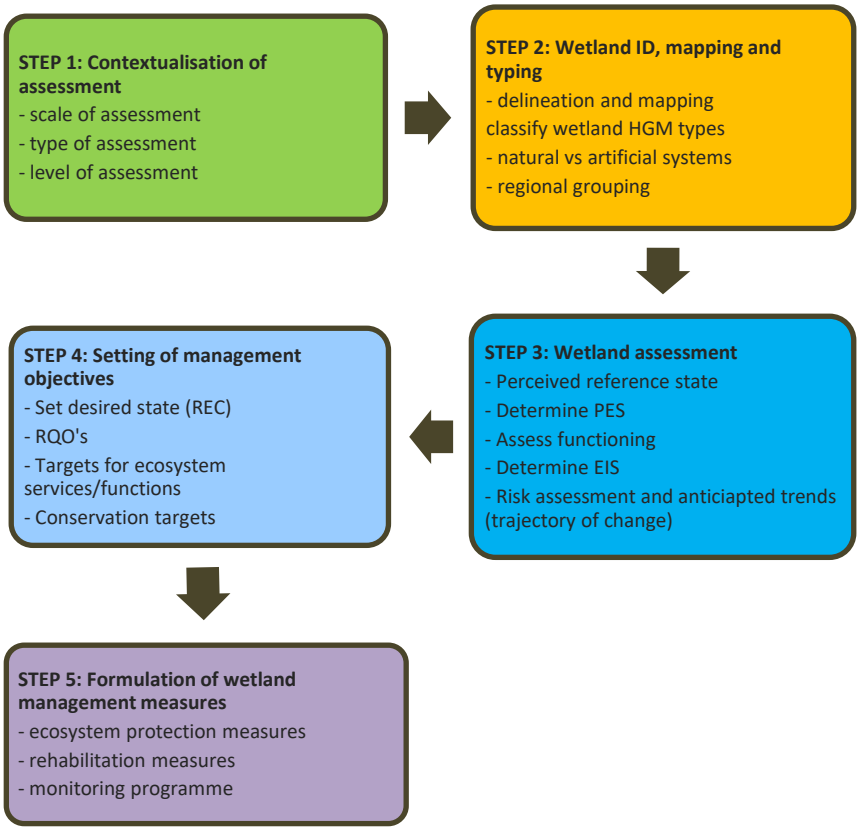


Figure 2 Proposed decision-support framework for wetland assessment in SA (after Ollis *et al.*, 2014).

2.2 Desktop Review of Wetland Ecosystem Context

As freshwater wetland ecosystems are linear features connected over regional scales, it is important to first contextualise the onsite freshwater ecosystems in terms of local and regional setting, and conservation planning. An understanding of the biophysical and conservation context of the site will assist in the assessment of the importance and sensitivity of the onsite freshwater ecosystems, setting management objectives for the affected freshwater ecosystems and the assessment of the significance of anticipated impacts. The following data sources and GIS spatial information listed in Table 1 was consulted to inform the specialist assessment. The data type, relevance to the project and source of the information is provided.

Table 1. Data sources and GIS information consulted to inform the baseline wetland assessment.

DATA/COVERAGE TYPE	RELEVANCE	SOURCE
Latest Google Earth ™ imagery	*To supplement available aerial photography where needed*	Google Earth™ On-line
5m Elevation Contours	*Desktop mapping of drainage network and freshwater habitats*	Surveyor general
National Vegetation Map beta version (GIS Coverage)	*Classify vegetation types and determination of reference primary vegetation and its national threat status*	SANBI (2018)
National Wetland Map 5	*Highlight potential onsite and local wetlands*	NBA (2018)
NFEPA wetlands coverage	*Highlight potential onsite and local rivers and wetlands*	CSIR (2011)
KZN Terrestrial Systematic Conservation Plan (GIS Coverage)	*Determination of provincial terrestrial conservation priorities*	EKZNW (2010 & 2016)
KZN Aquatic Systematic Conservation Plan (GIS Coverage)	*Determination of provincial freshwater conservation priorities*	EKZNW (2007)
KwaZulu-Natal Vegetation Map (GIS Coverage)	*Classify vegetation types and determination of reference primary vegetation and its provincial threat status*	Scott-Shaw and Escott (2011)

2.3 Desktop Mapping and 'Likelihood of Impact' Screening

A desktop 'likelihood of impact' screening assessment for all watercourses within 500m of the proposed development activities was undertaken to confirm the watercourses most likely to be negatively affected by the proposed development (at risk) and the extent of the watercourses to be taken forward for detailed assessment (i.e. to be included in the study area). This assessment involved the desktop mapping of all watercourse units within 500m (this pertains to then DWS 'Regulated Area' for Section 21 c & i Water Use) of the proposed development activities and assigning a likelihood of impact rating to each of these watercourse units (as per Table 2). Units regarded as being potentially indirectly impacted by the development were taken forward in the detailed baseline and detailed risk and impact assessment.

2.3.1 Desktop Mapping

The desktop delineation of all watercourses (wetlands) within 500m of the proposed development / activities was undertaken by analysing available digital elevation contours and colour aerial photography supplemented by Google Earth™ imagery where more up to date imagery was needed. Digitization and mapping was undertaken using QGIS 3.8 GIS software. All of the mapped watercourses were then broadly subdivided into distinct resource units (i.e. classified as either riverine or wetland systems / habitat). This was undertaken based on aerial photographic analysis and professional experience in working in the region. *Please note that the desktop map was updated as part of the finalisation of the assessment to include the detailed delineation of the units occurring within the study area.*

2.3.2 'Likelihood of Impact' Screening Assessment

Following the desktop identification and mapping exercise, watercourses were assigned preliminary 'likelihood of impact' ratings based on the likelihood that activities associated with the proposed

development will result in measurable direct or indirect changes to the mapped watercourse units within 500m of the proposed development. The 'likelihood of impact' ratings were refined following the completion of the field work. Each watercourse unit was ascribed a qualitative rating according to the ratings and descriptions provided in Table 2 below.

Table 2. Qualitative 'likelihood of impact' ratings and descriptions.

Likelihood of Impact Rating	Description of Rating Guidelines
Likely	These resources are likely to require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within the footprint** of the proposed development activity and will definitely be impacted by the project; and/or ➢ resources located **within 15m upstream and/or upslope** of the proposed development activity and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located **within 15m or downslope** of the development and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located downstream within the following parameters: o **within 15m downstream** of a low risk development; o **within 50m downstream** of a moderate risk development; and/or o **within 100m downstream** of a high risk development e.g. mining, large industrial land uses.
Possible	These resources may require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within 32m but greater than 15m upstream, upslope or downslope** of the proposed development; and/or ➢ resources located within a range at which they are likely to incur indirect impacts associated with the development (such as water pollution, sedimentation and erosion) based on development land use intensity and development area. This is generally resources located downstream within the following parameters: o **within 32m downstream** of a low risk development; o **within 100m downstream** of a moderate risk development; and/or o **within 500m downstream** of a high risk development (note that the extent of the affected area downstream could be greater than 500m for high risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
Unlikely	These resources are unlikely to require impact assessment or Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located a distance upstream, upslope or downslope (>32m) of the proposed development and which are unlikely to be impacted by the development project; and/or ➢ resources located downstream but well beyond the range at which they are likely to incur impacts associated with the development (such as water pollution, sedimentation and erosion). This is generally resources located downstream within the following parameters: o **greater than 32m downstream** of a low risk development; o **greater than 100m downstream** of a moderate risk development; and/or o **greater than 500m downstream** of a high risk development (note that the extent of the affected area downstream could be greater than 500m for high risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
None	These resources will not require impact assessment or a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within another adjacent sub-catchment and which will not be impacted by the development in any way, shape or form.

2.4 Baseline Assessment

The infield baseline habitat assessment focused on watercourse units rated as 'Likely' or 'Possible' in terms of 'likelihood of impact' as per Table 2. These watercourses formed the primary focus of the baseline

assessment. Table 3 below summarises the methods and tools that were used as part of the baseline freshwater ecosystem assessment with the relevant Annexure references.

Table 3. Summary of methods used in the assessment of delineated wetland units.

Method/ technique	Reference for methods/ tools used
Wetland delineation	• 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005).
Classification of wetlands	• National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al.*, 2013).
Present Ecological State (PES): wetlands	• WET-Health (Version 2.0) (Macfarlane *et al.*, 2020)
Functional Importance (Eco-services assessment)	• WET-EcoServices (Version 2) assessment developed by Eco-Pulse based on Kotze *et al.* (2020).
Ecological Importance & Sensitivity (EIS)	• Wetland EIS assessment tool developed by Eco-Pulse based on Rountree and Kotze (2013) and Duthie (1999).

2.5 Risk Assessment

Government Notice 509 of 2016 published in terms of Section 39 of the NWA sets out the terms and conditions for the General Authorisation of Section 21(c[1]) and 21(i[2]) water uses, key among which is that only developments posing a 'Low Risk' to watercourses can apply for a GA. Note that the GA does not apply to the following activities:

- Water use for the rehabilitation of a wetland as contemplated in GA 1198 contained in GG 32805 (18 December 2009).
- Use of water within the 'regulated area'[3] of a watercourse where the Risk Class is **Medium or High.**
- Where any other water use as defined in Section 21 of the NWA must be applied for.
- Where storage of water results from Section 21 (c) and/or (i) water use.
- Any water use associated with the construction, installation or maintenance of any sewerage pipeline, pipelines carrying hazardous materials and to raw water and wastewater treatment works.

To this end, the DWS have developed a Risk Assessment Matrix/Tool to assess water risks associated with development activities. The DWS Risk Matrix/Assessment Tool (based on the DWS 2015 publication: 'Section 21 c and i water use Risk Assessment Protocol') was applied to the proposed project. The tool uses the following approach to calculating risk:

[1] 21(c): Impeding or diverting the flow of water in a watercourse
[2] 21(i): Altering the bed, banks, course or characteristics of a watercourse
[3] The 'regulated area' of a watercourse; for Section 21 (c) or (i) of the Act refers to:

i. The outer edge of the 1:100 yr flood line and/or delineated riparian habitat, whichever is greatest, as measured from the centre of the watercourse of a river, spring, natural channel, lake or dam.
ii. In the absence of a determined 1:100 yr flood line or riparian area, refers to the area within 100m from the edge of a watercourse (where the edge is the first identifiable annual bank fill flood bench).
iii. A 500m radius from the delineated boundary of any wetland or pan.

RISK = CONSEQUENCE X LIKELIHOOD

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

and

LIKELIHOOD = FREQUENCY OF ACTIVITY + FREQUENCY OF IMPACT + LEGAL ISSUES + DETECTION

The key risk stressors[4] associated with each of the five (5) impact groups / types considered were:

1. Direct transformation and modification of habitat – **Physical disturbance**
2. Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities within the watercourse – **Erosive surface runoff, sediment and increased and/or reduced water inputs**
3. Indirect impacts resulting from alteration of hydrological and geomorphic processes as a result of activities outside of the watercourse – **Erosive surface runoff, sediment and increased and/or reduced water inputs**
4. Water pollution impacts – **Chemical, organic and biological pollutants**
5. Ecological process and disturbance impacts – **Alien invasive plants, noise pollution, dust pollution**

For each of the above stressors, risk was assessed qualitatively using the DWS risk matrix tool.
It is important to note that the risk matrix/assessment tool also makes provision for the downgrading of risk to low in borderline moderate/low cases subject to independent specialist motivation granted that (i) the initial risk score is within twenty five (25) risk points of the 'Low' class and that mitigation measures are provided to support the reduction of risk.

2.6 Assumptions and Limitations

The following limitations and assumptions apply to this assessment:

2.6.1 Sampling

- Although all watercourses occurring within 500m of the proposed activities were mapped at a desktop level, field investigations were confined to only those areas that stand to be measurably negatively affected. These areas constituted the study area of assessment.
- The mapping and classification of the watercourse units outside of the study area but occurring within a 500m radius of activities should be considered preliminary and coarse in resolution. These units were not verified in the field.
- Sampling by its nature means that not all parts of the study area were visited. The assessment findings are thus only applicable to those areas sampled.
- Systematic sampling was undertaken along transects spaced approximately 50-200m apart. The outer boundary of the wetland can be considered accurate along and in the vicinity of these transects. Between transects the outer boundary had to be extrapolated using aerial photography and 5m

[4] A stressor is any physical, chemical, or biological entity that can induce an adverse response. Stressors may adversely affect specific natural resources or entire ecosystems, including plants and animals, as well as the environment with which they interact (USA EPA - https://www.epa.gov/risk/about-risk-assessment#whatisrisk).

contours and, as such, the accuracy of such extrapolated sections has limitations and is open to the interpretation of the delineator.

- A Soil Munsell Colour Chart was used to determine the soil matrix colour of the soil sampled. However, it is important to note that the recording of the colours using the soil chart is highly subjective and varies significantly depending on soil moisture and the prevailing light conditions. In this case, all the soils sampled were dry and sampling was undertaken in sunny conditions.
- Soil wetness indicators (i.e. soil mottles, grey soil matrix), which in practice are primary indicators of hydromorphic soils, are not seasonally dependent (wetness indicators are retained in the soil for many years) and therefore seasonality has no influence on the delineation of wetland areas.
- The accuracy of the delineations is based solely on the recording of the onsite wetland indicators using a GPS. GPS accuracy will therefore influence the accuracy of the mapped sampling points and therefore water resource boundaries, and an error of 1-5m can be expected. All soil/vegetation/terrain sampling points were recorded using a Garmin Montana™ Global Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing.
- All vegetation information recorded was based on the onsite visual observations of the author and no formal vegetation sampling was undertaken. Furthermore, only dominant and noteworthy plant species were recorded. Thus, the vegetation information provided has limitations for true botanical applications.
- The wetlands in question had been recently burnt and over grazed which made it extremely difficult to identify the onsite species and vegetation characteristics.
- Although every effort was made to correctly identify the plant species encountered onsite, wetland plants, particularly the *Cyperaceae* (sedge) family, are notoriously difficult to identify to species level. Every effort was made to accurately identify plants species but where identification to species level could not be determined, such species were only identified to genus level.
- Seasonality can influence the species of flora encountered at the site, with the flowering time of many species often posing a challenge in species identification. Since the wetland vegetation in the study area was found to be largely secondary/degraded with low native plant diversity, seasonality would not be as significant a limitation when compared with a vegetation community that is largely natural or high in native plant diversity.
- The location of the study area within the highveld grassland zone of KZN (largely subtropical climate) means that climate has less of an effect on freshwater ecosystems and vegetation characteristics than typical Highveld inland systems, which are exposed to more extreme variations in temperatures between seasons. Thus, vegetation response is limited, and species structure and composition tend to remain the same or very similar between seasons.
- Soil wetness indicators (i.e. soil mottles, grey soil matrix), which in practice are primary indicators of hydromorphic soils, are not seasonally dependent (wetness indicators are retained in the soil for many years) and therefore seasonality has no influence on the delineation of wetland areas where soil sampling was used to determine wetland extent.

2.6.2 PES & EIS Assessments

- The PES and EIS assessments undertaken are qualitative assessment tools and thus the results are open to professional opinion and interpretation. We have tried to substantiate all claims where applicable and necessary.
- The setting of the hypothetical reference state for each of the wetland and riverine units assessed was extremely difficult due to the transformed and modified nature of the systems and a lack of information regarding reference state. Therefore, the reference states presented should be considered highly speculative with a low level of confidence.
- The EIS assessment did not specifically address in detail all the finer-scale ecological aspects of the water resources such as a list of aquatic fauna which are likely to occur (i.e. invertebrates, amphibians and fish) within and make use of these systems.

2.6.3 Impact Assessment

- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor's working knowledge and experience with similar development projects.
- The impact descriptions and assessment are based on the author's understanding of the proposed development based on the information provided.
- Evaluation of the significance of impacts with mitigation takes into account mitigation measures provided in this report and standard mitigation measures included in the Environmental Management Programme (EMPr).

2.6.4 Risk Assessment

- All risk ratings generated by the DWS risk matrix are conditional on the effective implementation of the mitigation measures provided in the specialist wetland assessment report for the project.
- For the purposes of this study, the term 'stressor[5]' was favoured instead of the term 'aspect' referred to in the DWS risk matrix.
- For the purposes of this study, the criterion 'frequency of stressor occurrence' was favoured instead of the criterion 'frequency of activity' referred to in the DWS risk matrix.
- For the severity ratings, impacts to wetlands were assessed on their merits rather than automatically scoring impacts to wetlands as 'disastrous' as guided in the DWS risk matrix.
- The severity assessment for changes in flow regime and physico-chemical impacts were interpreted in terms of the changes to the wetlands represented by the potentially affected reaches.
- For the scoring of impact duration, the predicted change in PES was also considered which could override the actual duration of the impact where applicable e.g. if the impact duration was long term (typically a score of 4 out of 5) but the predicted change in PES is negligible, the impact duration was down-scored to a score of 2 in line with the duration criteria descriptions in the risk matrix tool.

5 Any physical, chemical or biological entity that can induce an adverse response to the structure and function of an ecosystem (Reference: USEPA (1998). Guidelines for Ecological Risk Assessment; Notice Fed. Reg. 6326846-26924. Environmental Monitoring Systems Laboratory, Office of Research and Development, US Environmental Protection Agency, Cincinnati, Ohio.

3. DESKTOP CONTEXTUALISATION / SETTING ASSESSMENT

Understanding the biophysical and conservation context of the study area and surrounding landscape is important to inform decision making regarding the significance of the area to be affected.

3.1 Review of Freshwater Ecosystem Context

3.1.1 Catchment and Drainage Setting

The area of study is located close to the catchment divide between DWS Quaternary Catchment V32C and V32G, in the uMzimkulu - uMvoti Water Management Area (WMA), and drained by a number of larger perennial rivers including the Tiyna, Mbabane, Buffels (V32C) and Bloed (U30G) Rivers. The wetlands identified on the site and in the southern portion of the assessment area (catchment V32G) are narrow hillslope seeps that feed into the tributaries, which eventually drains into the larger Bloed River some distance downstream to the south-east of the site (see map in Figure 3).

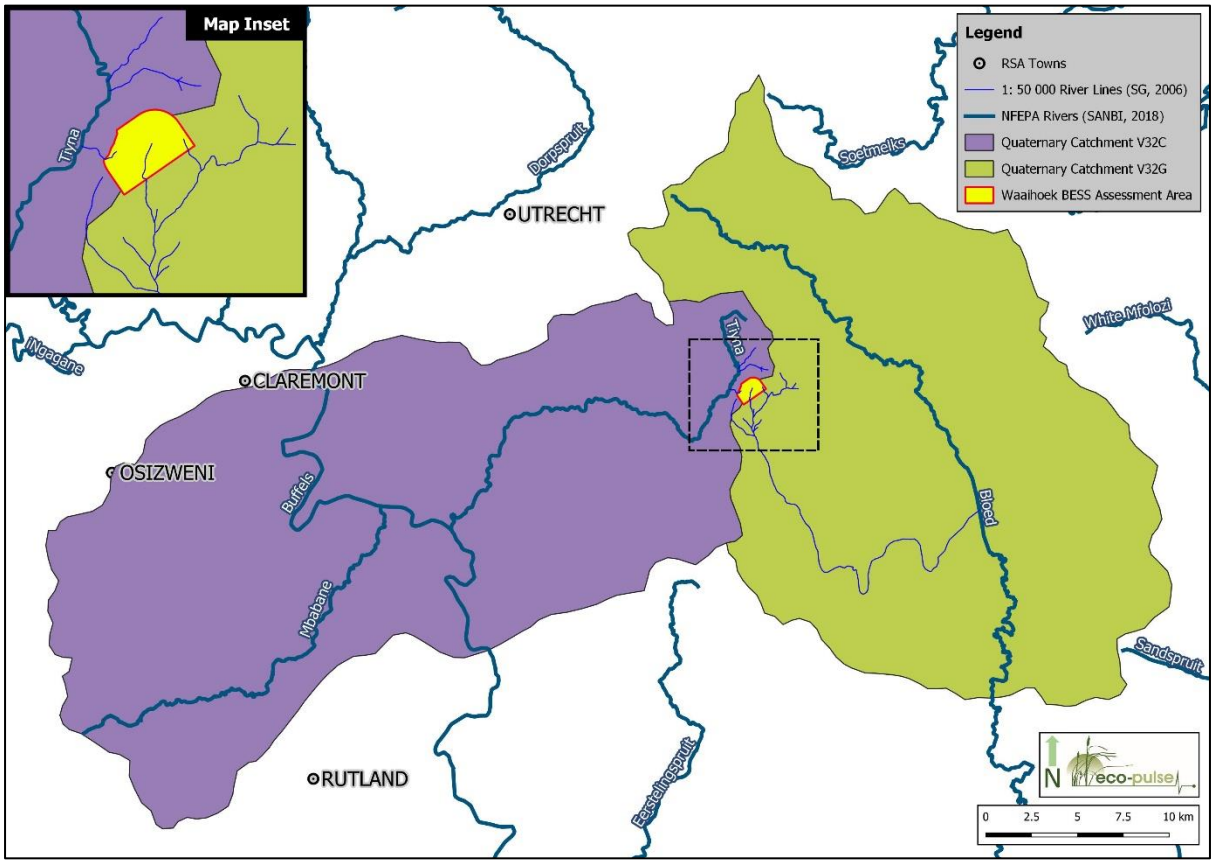


Figure 3 Map showing the local drainage setting and quaternary catchment associated with the proposed BESS project site.

3.1.2 Ecological & Conservation Setting

Understanding the ecological and conservation context and importance of the study area and surrounds in terms of conservation planning is important to inform decision making regarding the management of the aquatic resources in the area. In this regard, national, provincial and regional

ecosystem / vegetation classification and conservation planning information was interrogated to obtain an overview of the study site.

National, provincial and regional ecosystem and vegetation classification and conservation datasets were screened, the results of which are presented in Table 4.

Of particular importance from an aquatic (wetland) biodiversity perspective, is the conservation / threat status assigned to the seep wetlands belonging to the 'Mesic Highveld Grassland Bioregion', which are considered to be **Critically Endangered** and **Poorly Protected** according to the National Wetland Map V5 and outputs of the National Biodiversity Assessment (2018). The wetlands identified on site are not considered to be FEPAs (Freshwater Ecosystem Priority Areas).

Table 4. Key ecological and conservation context details for the study area.

Conservation Planning Dataset	Relevant Feature	Location in Relation to Project Site	Conservation Planning Status
NATIONAL ECOSYSTEM AND VEGETATION CLASSIFICATIONS			
National Vegetation Map (SANBI, 2018) – Terrestrial Vegetation	Wakkerstroom Montane Grassland (Gm 14)	Small patches of primary grassland are present with the broader BESS assessment area	Least Concern (Poorly Protected)
	Northern KwaZulu-Natal Moist Grassland (Gs4)		
National Wetland Map 5 (NBA, 2018)	Seep wetlands belonging to the 'Mesic Highveld Grassland Bioregion' wetland vegetation group	Seep wetlands identified with the broader BESS assessment area	**Critically Endangered (Poorly Protected)**
South African Inventory of Inland Aquatic Ecosystems (SAIIAE), (SANBI, 2018) – River Ecosystems	Tiyna River (V32C020000)	Proposed BESS development located >500m upstream od the Tiyna River	Least Threatened (Not protected)
The National Freshwater Ecosystem Priority Area (NFEPA) Assessment (CSIR, 2011) – River FEPAs WMA	Unit ID 2526	Thukela (WMA 7)	**River FEPA and associated sub-quaternary catchment[6]**
	Unit ID 2465		Upstream Management Area[7]
The National Freshwater Ecosystem Priority Area (NFEPA) Assessment (CSIR, 2011) – FEPA SWSA	Phongola Drakensberg	Eastern portion of the project site (Wetland W02)	Category 3[8]
The National Freshwater Ecosystem Priority Area (NFEPA) Assessment (CSIR, 2011)	No Wetland FEPAs within 500m of the BESS assessment area	The presence of two natural seep wetlands was identified	Non-FEPA wetlands

[6] River FEPAs achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species, and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to the biodiversity goals of the country. For river FEPAs the whole sub-quaternary catchment is shown as a FEPA in dark green, although FEPA status applies to the actual river reach shown on the map within such a sub-quaternary catchment.

[7] Upstream Management Areas, shown in very pale green, are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. Upstream Management Areas do not include management areas for wetland FEPAs, which need to be determined at a finer scale.

[8] Strategic Water Source Areas (low MAR) which are collectively responsible for >50% of water supply.

Conservation Planning Dataset	Relevant Feature	Location in Relation to Project Site	Conservation Planning Status
NATIONAL ECOSYSTEM AND VEGETATION CLASSIFICATIONS			
NFEPA Wetland Vegetation Groups (CSIR, 2011)	Mesic Highveld Grassland Group 8	Terrestrial grassland located with the broader BESS assessment area	Least Concerned
	Sub-Escarpment Grassland Group 2		
PROVINCIAL & REGIONAL ECOSYSTEM AND VEGETATION CLASSIFICATIONS			
KZN Vegetation Map (Scott-Shaw & Escott, 2011)	Wakkerstroom Montane Grassland	Small patches of primary grassland are still present with the broader BESS assessment area and surrounds	Least Concerned
	Northern KwaZulu-Natal Moist Grassland		Vulnerable
	Alluvial Wetlands: Temperate Alluvial Vegetation - Midland Floodplain Grassland	Within the broader BESS assessment area	Least Threatened
KZN Terrestrial Conservation Plan (EKZNW, 2010)	Planning Units: No. 126646, No. 126647, No. 133828, No. 126687, No. 126657, No. 126688	Within the broader BESS assessment area	Biodiversity Area
KZN Terrestrial Systematic Conservation Assessment (EKZNW, 2016)	No planning units intersect with the broader BESS assessment area	N/A	N/A
KZN Freshwater Conservation Plan (EKZNW, 2007)	Unit ID 438 Unit ID 756	Whole project site and surrounding area	Available[9]

[9] According to the KwaZulu-Natal FSCP (EKZNW 2007), the 'Available' status implies that the planning unit has not been earmarked for conservation but is available to meet provincial conservation targets should earmarked catchments become 'unavailable' to meet targets.

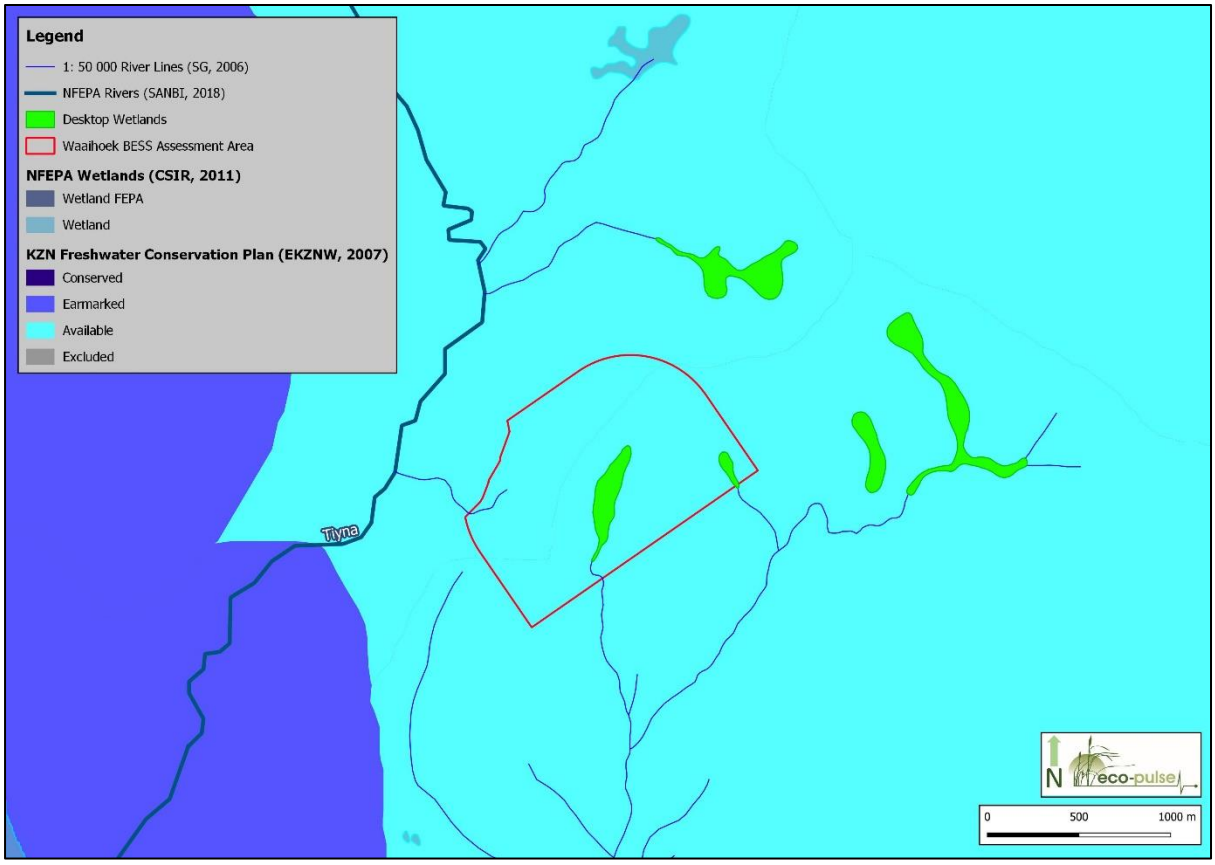


Figure 4 Map showing the location of the broader BESS assessment area and onsite wetlands in relation to wetland FEPAs (CSIR, 2011) and the outputs of the KZN freshwater conservation plan (EKNW, 2007).

4. DESKTOP MAPPING AND IMPACT POTENTIAL SCREENING

The watercourses (wetlands only, no rivers identified) identified and mapped within a 500m radius of the BESS assessment area (i.e. the DWS 'regulated area for Section 21 c & i water use') are shown in Figure 5. The impact potential screening assessment undertaken indicates that a total of two (2) individual wetlands (labelled 'W01' & 'W02'), draining south into a non-perennial drainage line, are at potential risk of being impacted during the construction and operational phases of the BESS project (see Figure 5). These wetland units were therefore assessed in further detail and are reported on here.

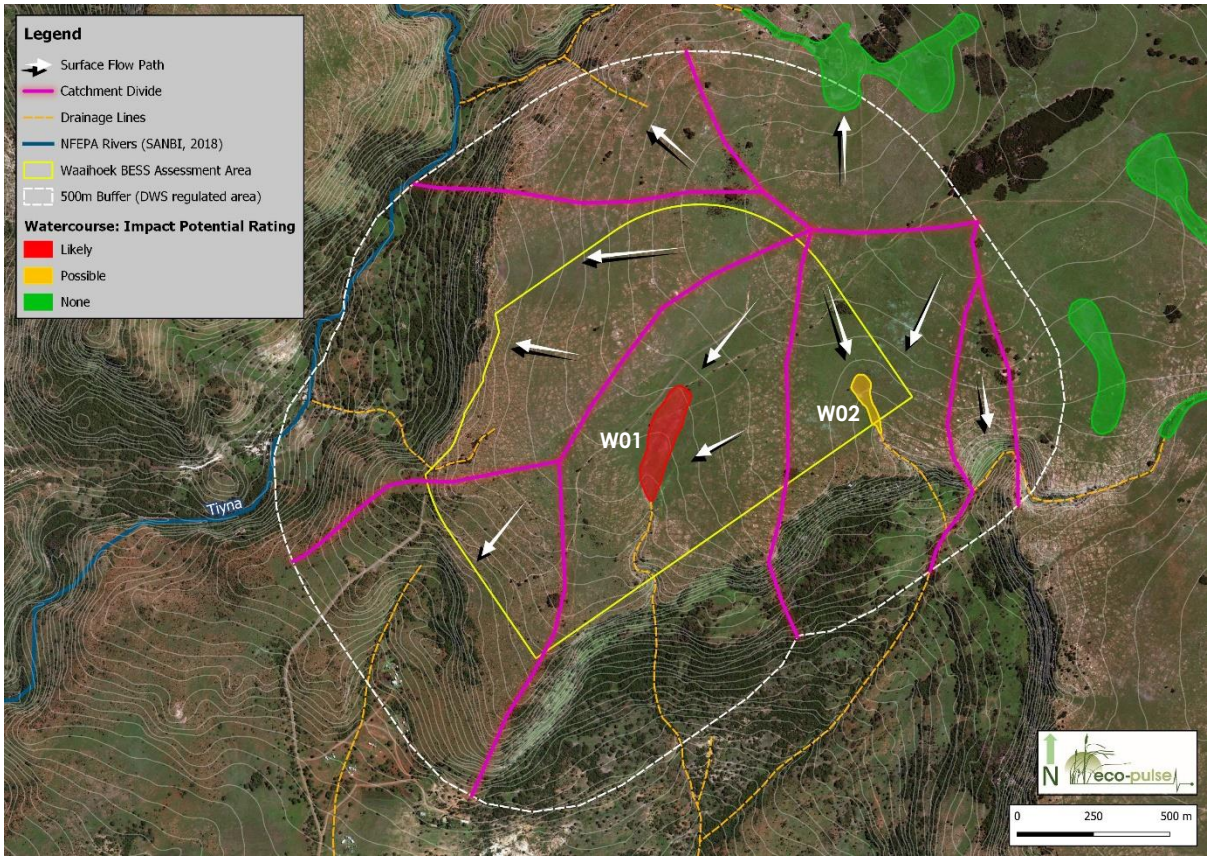


Figure 5 Desktop mapped watercourses with 'impact potential' ratings indicated. The 'white' arrow markers on the map indicate the direction of surface flow paths with the 'purple' lines showing the divide between local sub-catchments.

5. BASELINE WETLAND ASSESSMENT

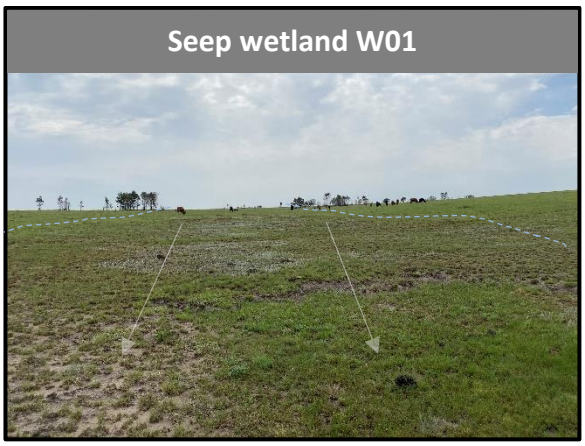
The baseline wetland habitat assessment focused on the two watercourse units (seep wetlands) assessed as at risk of being potentially impacted by the proposed development, as discussed under Chapter 4 of this report. The extent (infield delineation), classification, habitat characteristics, present ecological state (PES) and ecological importance and sensitivity (EIS) of the two seep wetlands (W01 & W02) is discussed in this section of the report.

5.1 Delineation, Classification & Habitat Characteristics

The infield sampling of soil and vegetation in conjunction with the recording of diagnostic topographical / terrain indicators and features, enabled the delineation of two (2) watercourse units (Table 5).

Table 5. Summary of the wetland HGM unit type encountered and the general characteristics.

Units	Classification (HGM unit)	Description
Wetland W01	**Seep**	Seepage wetlands were found to be located in a valley-head setting and fed primarily by lateral subsurface water inputs controlled by generally low permeability shale bedrock at shallow depths. Water naturally moves through these wetlands as subsurface flow with some diffuse overland flow particularly after significant rainfall events. Soils and vegetation sampled reflect both seasonal and permanent zones of water saturation.
Wetland W02		



The location and extent of Wetland W01 (~2.8ha in extent) and Wetland W02 (~0.7ha in extent) is shown on the map in Figure 6, with a summary of the key biophysical characteristics of each of the delineated watercourse units provided in the sections that follow.

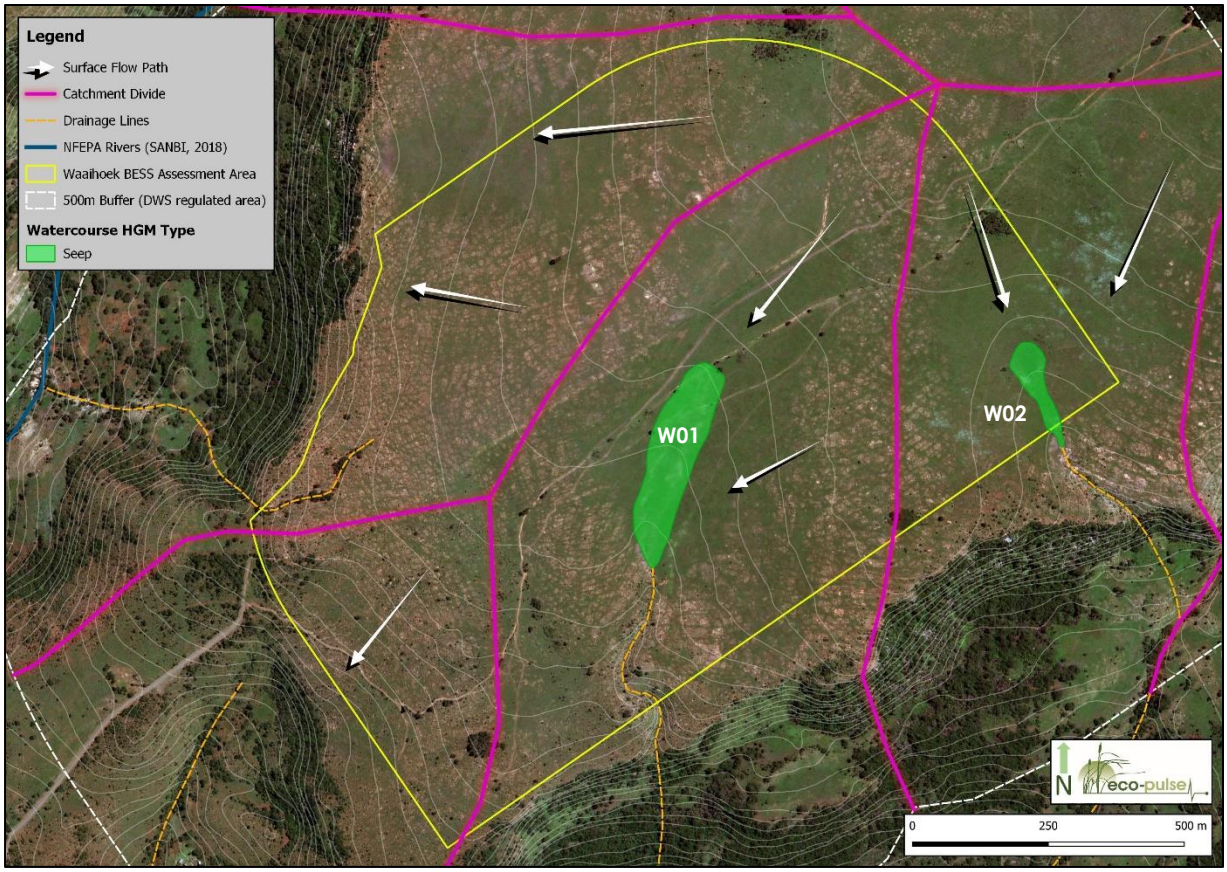


Figure 6 Wetland delineation map: the 'white' arrow markers on the map indicate the direction of surface flow paths with the 'purple' lines representing the catchment divide between micro-catchments in the study area.

5.1.1 Wetland Delineation

Soils sampled within the study area included both dryland soils (no hydric soil indicators) and wetland soils that showed signs of wetness / hydric soil indicators. Soil texture[10] was found to range between moderately and moderately fine textured soils (loam) with a grey-brown soil matrix[11] (hue[12] 7.5yr; value[13] 3/4; chroma[14] 1/2;). Strategic sampling points were taken along cross sections of the predominantly steep terrain (with the few narrow low-lying areas between hillslopes, subjected to marginally more intensive sampling). Redoximorphic features such as a gleyed soil matrix and the presence of soil mottles were observed within the narrow lower lying areas. Both temporary and seasonal wetland soil indicators were observed within the two wetland seeps sampled, with temporarily saturated soils more widely prevalent across wetland unit W01 to the west and seasonally saturated soils within wetland unit W02 to

[10] Soil texture - is a measure of the relative proportion of the various soil particle size fractions in soil (http://www.soilquality.org.au/factsheets/soil-texture).

[11] Soil matrix - is the portion of a given soil having the dominant colour, in most cases, the matrix will be the portion of the soil having more than 50 percent of the same colour.

[12] Hue - A characteristic of colour related to one of the main spectral colours (red, yellow, green, blue or purple), or various combinations of these principle colours, one of the three variables of colour, each colour chart in the Munsell Soil Colour Charts represents a specific hue.

[13] Value - refers to the lightness and darkness of a colour in relation to a neutral grey scale.

[14] Chroma - refers to the intensity or brightness of the colour and has also been described as the purity of the colour. It has also been described as the richness of the colour.

the east. The soil matrix of seasonally saturated soils was found to be predominately dark grey to grey-brown in colour, with soil mottles moderately abundant. These characteristics are indicative of soils that are seasonally wet or saturated for part of the year and can be attributed to the fluctuation between anaerobic (saturated) and aerobic (dry/unsaturated) soil conditions typical of seasonal wetland environments. Anaerobic (saturated) conditions cause minerals (such as Fe/Al) naturally occurring in soil to go into solution, resulting in a greyish/gleyed soil matrix. However, when the soils transition from a saturated state to an unsaturated state (due to a fluctuating water table) the dissolved minerals return to an insoluble state and appear as orange/yellow soil particles. The recurrence of this cycle over time creates grey soils with orange/yellow/ lighter coloured mottles.

Photos 1 - 4 provide an example of selected soil samples collected onsite.

Photo1: Example of a typical dryland soil sample.

Photo 2: Example of a temporary saturated soil (brown-grey matrix with faint soil mottles).

Photo 3: Example of a typical seasonal saturated soil (grey matrix with abundant soil mottles).

Photo 4: Residual clay was found throughout wetland W02, encountered at depths of 40 - >50cm.

Vegetation is usually a principle indicator of wetland habitat with the presence of wetland plants or 'hydrophytes' typically suggesting the presence of water-saturated soils (for a period of at least 2 weeks of the year). At present, the majority of the wetland habitat appeared to be temporarily to seasonally activated and supporting a **vegetation community dominated by a mix of short hydric and dryland grass species** with scattered tufted grasses and forbs. The short grass-dominated vegetation communities

feature a range of native grass species including: *Tristachya leucothrix, Eragrostis capensis, Eragrostis ciliaris, Eragrostis curvula Themeda triandra, Sporobolus africanus* and *Sporobolus pyramidalis*. Importantly, many of these species are known as 'Increaser' grasses that dominate under disturbance and particularly veld that is or has been over historically subjected to overgrazing by livestock. The two seep wetlands were found to host a variety of forbs such as *Becium obovatum, Cyanotis speciosa, Hypoxis multiceps, Moraea elliotii* and *Pelargonium luridum*.

The drier marginal area of both wetlands had been slightly impacted by grazing activities, with some scattered alien/exotic trees, namely *Acacia mearnsii* (Black Wattle), observed as clumps of vegetation within the wetland (W01) habitat and fringing the edges of the delineated wetland.

Selected digital photographs showing the various wetland vegetation communities and habitats have been included below:

Photo 5: View looking upstream over wetland W01 showing the short grassland vegetation comprising of *Tristachya leucothrix, Eragrostis capensis* & *Themeda triandra,* with scattered forbs such as *Hypoxis multiceps.*

Photo 6: View of one of several small patches of dense alien trees (*Acacia mearnsii*) clumped towards the head of the wetland and fringing the edges of the wetland.

Photo 7: View looking downstream of wetland W02 showing the short grassland vegetation comprising of *Tristachya leucothrix, Eragrostis capensis, Eragrostis ciliaris* that has been trampled by cattle.

5.1.2 Classification of Wetland Units

Wetland Unit W01

Wetland W01 was identified as the larger of the two **hillslope seepage** wetlands (being ~2.83 ha in extent) and located in the central portion of the broader BESS assessment area (as shown mapped in Figure 7). The wetland drains in a southernly direction feeding into a non-perennial drainage line that forms part of the broader network eventually feeding into the Bloed River. The wetland is supported by a small (18.2 ha catchment), most of which is natural veld with small areas planted with Black Wattle and presence of a dirt road/cattle paths along the upper reach of the wetland. The vegetation within the wetland itself was found to comprise mix of short hydric and dryland grass species (as described in section 5.1.1). Notably, the broader area had been recently burnt at the time of the field survey taking place, making it difficult to provide an accurate description of the structure and species composition for the wetland.

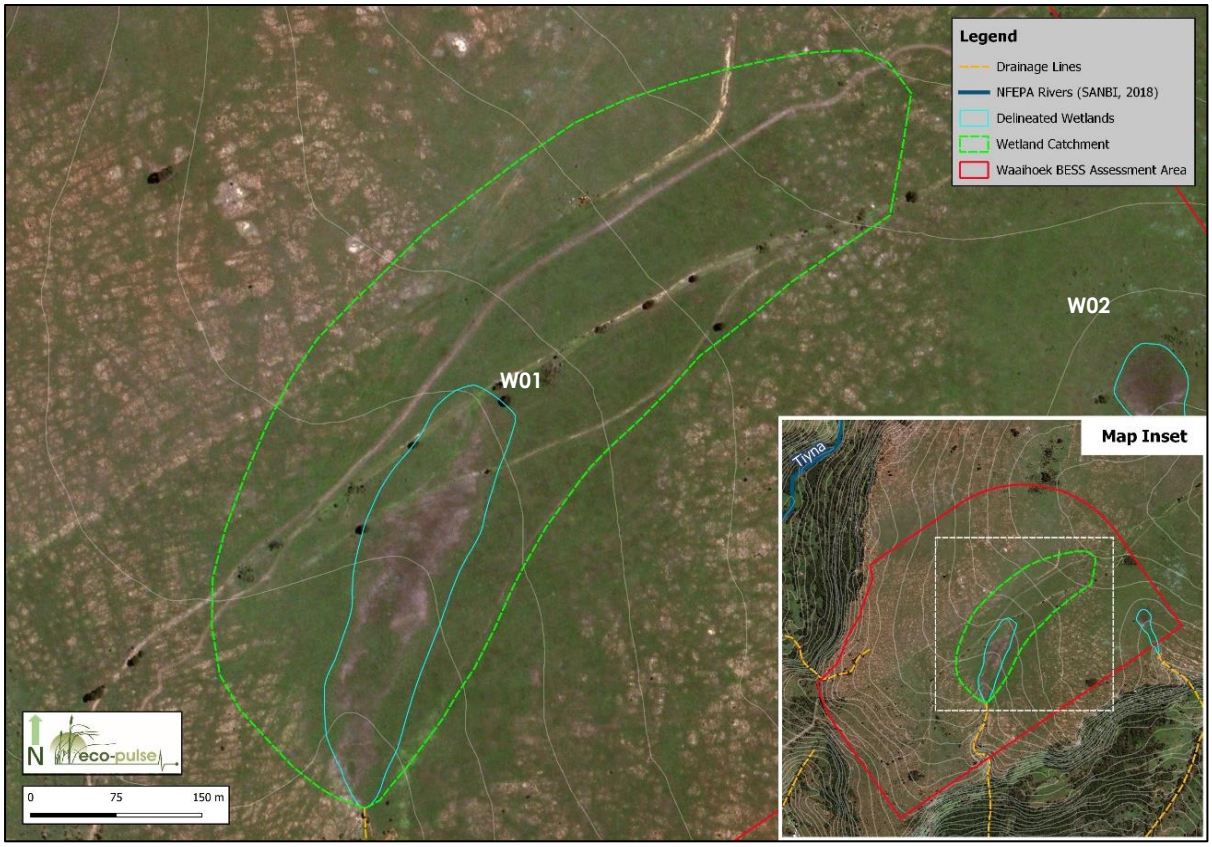


Figure 7 Map showing the delineated seep wetland 'W01' and its supporting catchment area (present day).

Wetland Unit W02

Wetland W02 was the smaller of the two wetlands (0.68 ha) and a narrow **hillslope seepage** wetland located at the south-eastern portion of the BESS assessment area (as shown mapped in Figure 8) and also draining southernly direction feeding into a non-perennial drainage line that forms part of the broader network eventually feeding into the Bloed River. The wetland is supported by a small (10.2 ha catchment), most of which is natural veld with a small area planted with Black Wattle and presence of a dirt road/cattle path. The vegetation within the wetland itself was found to comprise mix of short hydric and dryland grass species (as described in section 5.1.1). Notably, the broader area had been recently burnt at the time of the field survey taking place, making it difficult to provide an accurate description of the structure and species composition for the wetland. Upon further investigation, the presence of an existing erosion 'headcut' in the lower reach of the wetland was identified, possibly linked to grazing impacts by livestock (cattle).

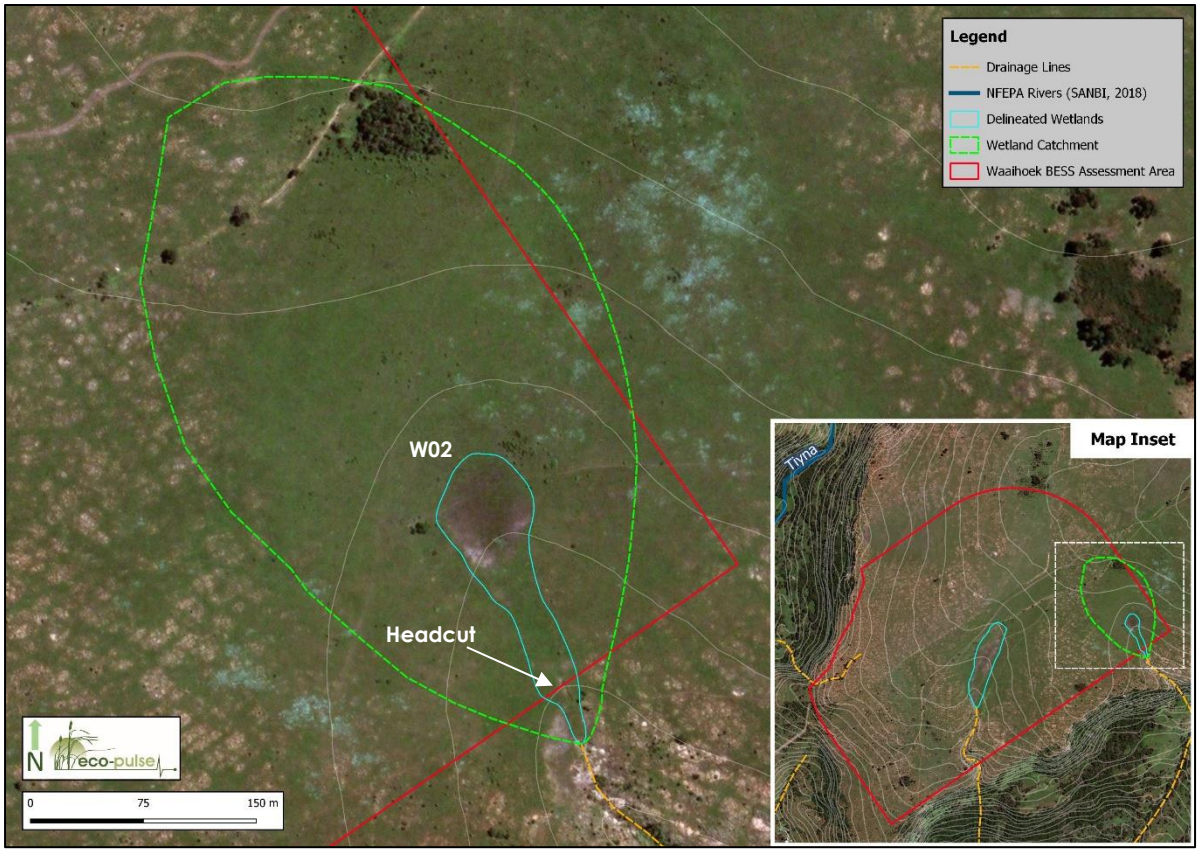
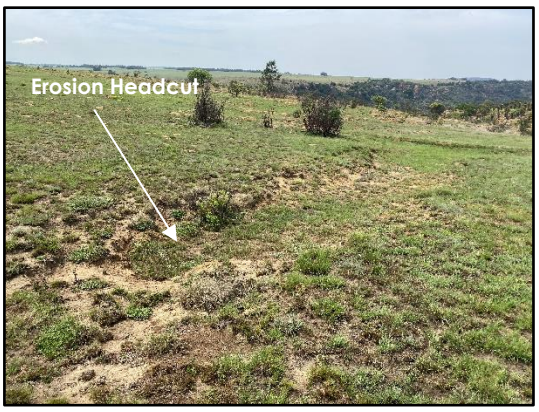
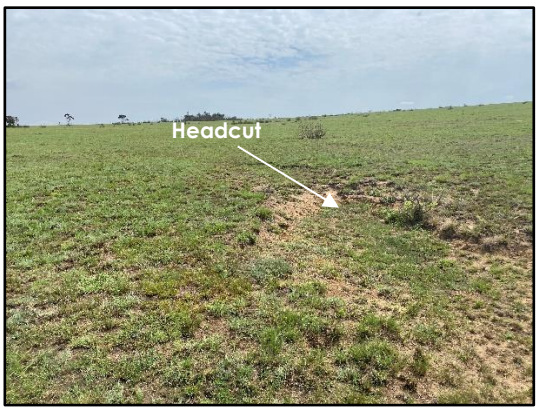


Figure 8 Map showing the delineated seep wetland 'W02' and its supporting catchment area (present day).

Selected photographs of wetland W02 are included below:





5.2 Present Ecological State (PES) Assessment

This section documents the findings of the PES assessment and provides descriptions of key impacts and PES scores and ratings for each of the wetland units assessed.

5.2.1 Hypothetical Reference State

Before assessing the extent to which current state of wetland units have deviated from the reference condition, it is first important to hypothesize and state upfront what the most likely reference state for the units assessed would have been based on a review of historical aerial photography, local reference wetland sites and professional experience working in the area. A summary of the speculated reference states in terms of wetness regime and vegetation for each of the hydro-geomorphic wetland types encountered onsite is provided in Table 6 below.

Table 6. Speculated reference states for the wetland units.

Unit	Reference HGM Type	Hydrological Regime	Assumed Reference Vegetation
W01 & W02	Hillslope seepage wetlands	Temporary/Seasonal wetlands, with lateral flow inputs and diffuse flows, overland flow from catchment runoff limited to storm events.	Predominately hygrophilous grassland and/or short sedgeland dominated by facultative wetland plants. Moderate to high herb / forb diversity. Alien plants and weeds absent.

5.2.2 Wetland PES: WET-Health

The latest (version 2) WET-Health assessment tool (Macfarlane *et al.,* 2020) was applied to wetlands W01, and W02 at a rapid level 1B assessment level. A key step in a Level 1B assessment involves the division of the wetland, its associated 200m buffer and catchment into landcover classes. The landcover classes each have their own impact intensity scores associated with Water Inputs, Sediment Inputs and Water Quality. The landcover delineation and mapping process was completed for both wetlands following sampling and recording of various landcover classes using aerial imagery. The landcover for the wetland units and their associated catchment are shown spatially in (Figures 10 & 11, respectively).

A summary of the baseline PES assessments for both hillslope seep wetlands is provided in Tables 7 & 8. Both wetlands are considered to be in a '**Largely Natural' state ('B' PES Category)** characterised by few existing impacts and were roughly 87% -89% intact at the time of the field survey based on the WET-Health condition (PES) assessment undertaken.

Table 7. Summary of the baseline wetland PES assessment for wetland 'W01" using WET-Health.

WET-Health PES Summary for Wetland W01			
Category	**Impact Score**	**PES Category**	**Impact Description**
Hydrology	1.3 / 10 87% intact	'B' PES	**Hydrologically**, basal cover in some areas of the upstream catchment have been reduced through overgrazing and too frequent burning. Wetland W01 has had limited modifications, both within the wetland and catchment, that has resulted in a small change in hydrological processes. Upstream catchment impacts (i.e. overgrazing, presence of dirt roads/cattle paths & frequent burning) have had a limited on the wetland. Overall, the combined effect of catchment and within-wetland impacts has resulted in a **largely natural hydrological condition.**
Geomorphology	1.5 / 10 85% intact	'B' PES	The **geomorphological** template of the wetland remains predominantly intact, with only minor modifications as a result of increased catchment runoff rates and sedimentation associated with reduced basal vegetation cover in the supporting upstream catchment. Furthermore, localised areas of the wetland have been subjected to trampling by cattle. Overall, the combined effect of these various impacts has had little effect on the **wetland geomorphology which remains largely natural and intact**.
Water Quality	1.0 / 10 90% intact	'B' PES	The **water quality** impact contribution is a combination of the wetland's catchment and within wetland land use. Stormwater runoff from the dirt roads/cattle paths as well as potential nutrient inputs from cattle dung has likely contributed to minor/limited modification of the wetlands water quality. Based on the current land use, water quality is estimated to be **largely natural.**
Vegetation	1.2 / 10 50% intact	'B' PES	The **vegetation** of the wetland has remained largely intact, with the only impacts being due to overgrazing and cattle trampling. In its current state the **wetland vegetation is considered to be largely natural.**
Overall (combined PES)	**1.3 / 10** 87% intact	**'B' PES**	***Largely natural.*** *Overall, A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.*

Table 8. Summary of the baseline wetland PES assessment for wetland 'W02' using WET-Health.

WET-Health PES Summary for Wetland W02			
Category	**Impact Score**	**PES Category**	**Impact Description**
Hydrology	0.8 / 10 92% intact	'A' PES	**Hydrologically**, basal cover in some areas of the upstream catchment have been reduced somewhat through overgrazing and too frequent burning. Wetland W02 has suffered only limited modification to the wetland and catchment that has resulted in a low/negligible change in ecological processes. Overall, the **wetland hydrology remaining largely unmodified/natural.**
Geomorphology	1.2 / 10 88% intact	'B' PES	The **geomorphological** template of the wetland remains predominantly intact, with only minor modifications as a result of increased catchment runoff rates and sedimentation associated with reduced basal vegetation cover in the supporting upstream catchment. Furthermore, localised areas of the wetland have been subjected to trampling by cattle and erosion (with headcuts present). Overall, the combined effect of these various impacts has had little effect on the **wetland geomorphology which remains largely natural and intact**.
Water Quality	1.0 / 10 90% intact	'B' PES	The **water quality** impact contribution is a combination of the wetland's catchment and within wetland land use. The potential nutrient inputs from cattle dung has likely contributed to minor/negligible modification of the wetlands water quality. Based on the current land use, water quality is estimated to **remain largely natural.**
Vegetation	1.5 / 10 85% intact	'B' PES	The **vegetation** of the wetland has remained largely intact, with the only impacts being due to overgrazing and cattle trampling. In its current state the **wetland vegetation is considered to be largely natural.**
Overall (combined PES)	**1.1** 89% intact	**'B' PES**	***Largely natural.*** *Overall, A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.*

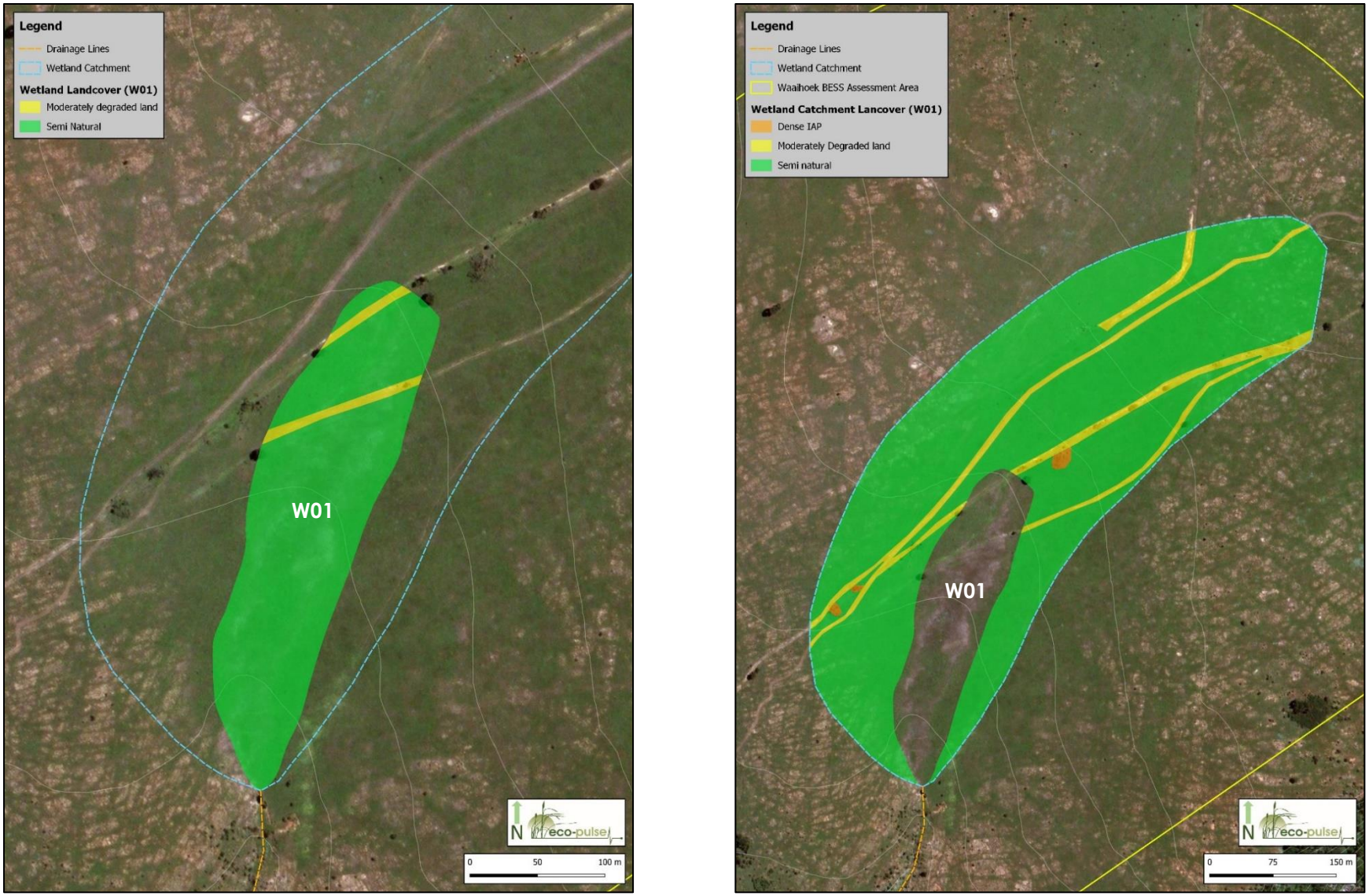
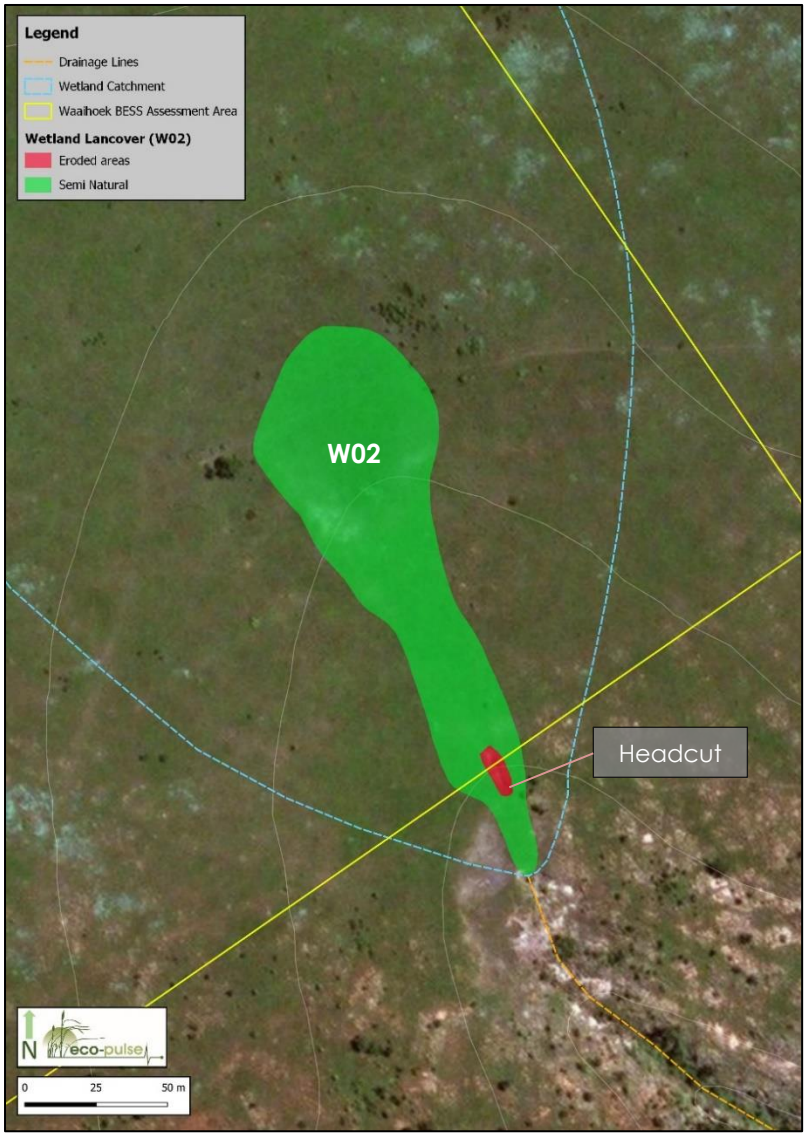


Figure 9 'Landcover Classes' for wetland W01 and its associated catchment used to inform the level 1B WET-Health assessment.



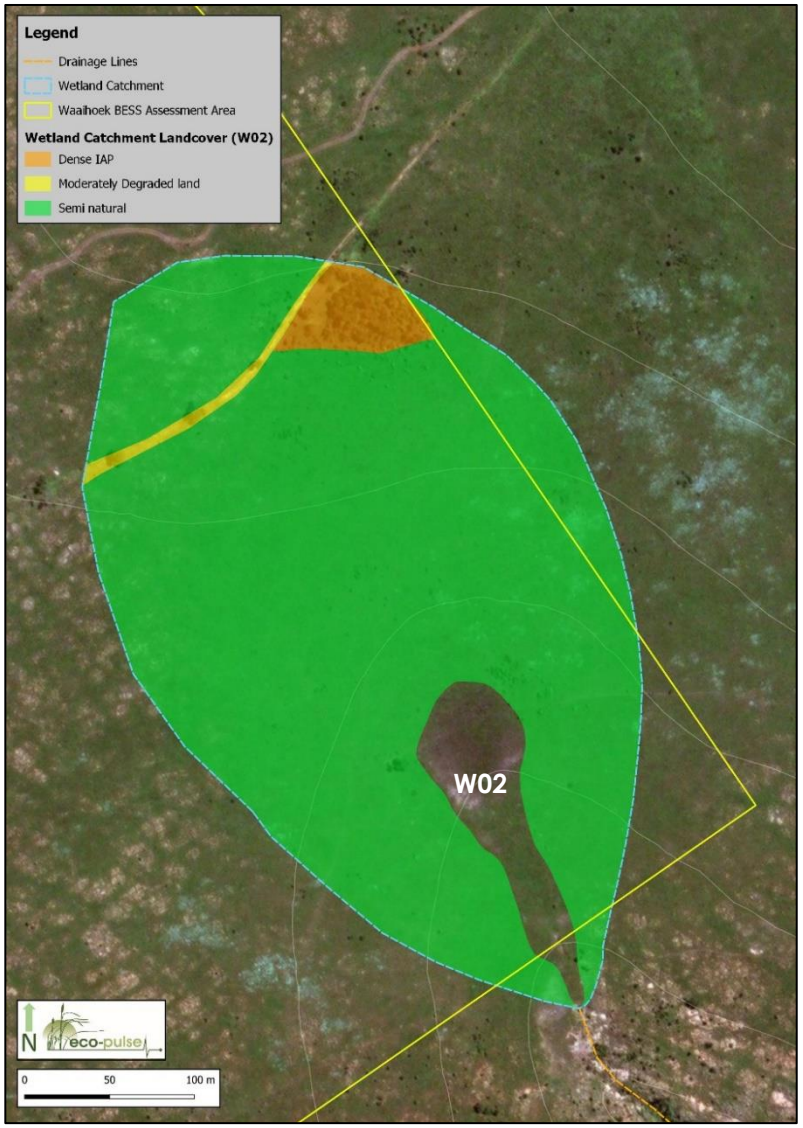


Figure 10 'Landcover Classes' for wetland W02 and its associated catchment used to inform the level 1B WET-Health assessment.

5.3 Wetland Ecosystem Services Assessment

Wetlands are known to provide a range of ecosystem goods and services to society, and it is largely on this basis that policies aimed at protecting wetlands have been founded. This section of the report provides a summary of the predicted level of importance of the various wetland ecosystems in terms of their effectiveness in providing aquatic ecosystem goods and benefits.

Given that both the wetland units are the same HGM type and largely similar in size, setting and context, the supply and demand scores and ratings for the various ecosystem goods and services could not be differentiated between the wetlands, hence both wetlands have been assessed as the same using the WET-EcoServices tool, with a summary provided in Table 9:

- With both hillslope seep wetlands assessed as being 'largely natural' with few impacts, one would initially be led to think that the wetlands are probably quite important from ana ecosystem goods and services perspective.
- However, it is important to note these wetland are extremely isolated with little to no downstream user identified, and it is therefore unsurprising that both wetlands are considered to be of Low to Very Low importance for the range of services considered (Table 9).
- The most important service is considered to be 'biodiversity maintenance' which is considered to be of 'Moderate' importance given the conservation/threat status (Critically Endangered, poorly protected), the relatively natural ecological condition and the wetland's location in a largely natural landscape with high levels of ecological connectivity between natural habitats.
- In terms of direct benefits, the wetlands are considered low to moderately important only for livestock grazing.

Table 9. Summary of the outputs of the WET-EcoServices assessment for the two wetland units assessed.

ECOSYSTEM SERVICE		Importance Rating
		W01 & W02
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.2 (Very Low)
	Stream flow regulation	0.0 (Very Low)
	Sediment trapping	1.3 (Low)
	Erosion control	0.0 (Very Low)
	Phosphate assimilation	0.5 (Very Low)
	Nitrate assimilation	0.5 (Very Low)
	Toxicant assimilation	0.9 (Low)
	Carbon storage	0.7 (Very Low)
	Biodiversity maintenance	1.7 (Moderate)
PROVISIONING SERVICES	Water for human use	0.0 (Very Low)
	Harvestable resources	0.0 (Very Low)
	Food for livestock	1.7 (Moderately Low)
	Cultivated foods	1.0 (Low)

ECOSYSTEM SERVICE		Importance Rating
		W01 & W02
CULTURAL SERVICES	Tourism and Recreation	0.0 (Very Low)
	Education and Research	0.0 (Very Low)
	Cultural and Spiritual	0.0 (Very Low)

5.4 Ecological Importance & Sensitivity (EIS) Assessment

The Ecological Importance and Sensitivity (EIS) of the two wetland units was rated using the Wetland EIS tool developed by Eco-Pulse (2018). The results of this assessment are presented in Table 10.

Both seep wetlands can be regarded as being of 'Moderately Low' EIS, with the overall score/rating being driven by the wetlands moderately-low Biodiversity Importance and Ecological Functional Importance, small size, limited direct use importance and combined with a relatively low ecological sensitivity rating which is linked to an overall poor diversity of habitats, presence of only common local plant species of 'least concern' and limited ecosystem services importance in general.

Table 10. Summary of wetland EIS scores and ratings for the two seep wetlands assessed.

Assessment Aspect / Component	W01	W02
Biodiversity Importance	1.5 (Moderately Low)	1.5 (Moderately Low)
Ecological Functions Importance	1.3 (Moderately Low)	1.3 (Moderately Low)
Socio-cultural Importance	1.0 (Low)	1.0 (Low)
Ecological Sensitivity	0.3 (Very Low)	0.5 (Very Low)
Overall EIS Score	**1.5**	**1.5**
Overall EIS Rating	**Moderately Low**	**Moderately Low**

5.5 Recommended Ecological Category (REC) & Management Objectives (RMOs)

The recommended ecological category (REC) is the target or desired state of resource units required to meet water resource management objectives and quality targets. It is determined through the consideration of the PES, EIS and realistic opportunities to improve wetland PES and/or functioning that is driven by the context / setting.

The modus operandi followed by the DHSWS (Department of Human Settlements, Water & Sanitation) Directorate: Resource Directed Measures (RDM) is that if the EIS is high or very high, the ecological management objective should be to improve the condition of the river (Kleynhans & Louw, 2007). However, the causes related to a particular PES should also be considered to determine if improvement is realistic and attainable (Kleynhans & Louw, 2007). This relates to whether the problems in the catchment can be addressed and mitigated (Kleynhans & Louw, 2007). If the EIS is evaluated as moderate or low, the ecological aim should be to maintain the river in its PES (Kleynhans & Louw, 2007). Within the Ecological Reserve context, Ecological Categories A to D can be recommended as future states depending on the EIS and PES (Kleynhans & Louw, 2007). Ecological Categories E and F are regarded as

ecologically unacceptable, and remediation is needed if possible (Kleynhans & Louw, 2007). A generic matrix for the determination of RECs and RMOs for water resources is shown in Table 11, below.

Table 11. Generic matrix for the determination of REC and RMO for water resources.

			EIS			
			Very high	**High**	**Moderate**	**Low**
PES	**A**	**Pristine/Natural**	A Maintain	A Maintain	A Maintain	A Maintain
	B	**Largely Natural**	A Improve	A/B Improve	B Maintain	B Maintain
	C	**Good - Fair**	B Improve	B/C Improve	C Maintain	C Maintain
	D	**Poor**	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	**Very Poor**	D Improve	E/F Improve	E/F Maintain	E/F Maintain

Based on this matrix (Table 11) and the catchment context, the REC for both wetland HGM units W01 and W02 is a 'B' Ecological Condition Category with the RMO being to 'maintain' the current PES and functioning of the wetlands.

Table 12. REC and RMO for the delineated watercourse units based on their PES and EIS ratings.

Watercourse Units	PES Class	EIS Rating	REC	RMO	Proposed Action
Wetland W01	B	Moderately Low	B	Maintain PES & EIS	Manage risk of potential ecological degradation
Wetland W02	B	Moderately Low	B		

The maintenance of the current PES condition for the assessed watercourses can be achieved through careful management of catchment sediment, flow and water quality impacts/risks and by avoiding direct impacts to the watercourses. This is further supported by Ezemvelo KZN Wildlife (EKZNW) in their guideline document: Guidelines for Biodiversity Impact Assessment (EKZNW, 2013). According to the document, the guiding principle with regards to biodiversity conservation and sustainable development adopted by EKZNW (2013) is one of "***no net loss of biodiversity and ecosystem processes".*** To achieve this principle, a proactive approach to planning and biodiversity conservation must be adopted to ensure:

- The early identification and evaluation of potential ecological impacts that may constitute 'fatal flaws', or significant biodiversity related/management issues;
- The early identification and evaluation of conceptual alternatives which could prevent, avoid or reduce significant impacts on aquatic biodiversity, or enhance or secure opportunities for ecosystem conservation; and
- The appropriate design of mitigation through the mitigation hierarchy which should strive first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining residual negative impacts on biodiversity.

6. RISK & IMPACT ASSESSMENT

This section of the report deals with the prediction, description and assessment of the potential construction and operational phase risks and impacts likely to be associated with the proposed Battery Energy Storage System (BESS) and Water Reservoir to support the Waaihoek Wind Energy Facility (WEF).

The following information/documentation was reviewed to inform the assessment of wetland ecological risks and impacts related to the project:

- Application for EA – Information Requirements Waaihoek (Mainstream Renewable Power, 2020);
- Project Description (CES, 2020); and
- Waaihoek Wind Energy Facility – Wetland Impact Assessment (CES, 2014).

6.1 Description of Development Activities

In order to anticipate potential risks and impacts to wetlands associated with the BESS and Water Reservoir, an understanding of the construction and operational processes and development activities is first required.

6.1.1 Construction Phase Activities and Infrastructure

- **Clearing of vegetation and grading of site**: Vegetation clearing, soil stripping and earthworks required for the establishment of platforms and foundations for the BESS units and reservoir and service infrastructure (access roads, pipelines, etc.) will take place on the property. It is assumed that ALL infrastructure will be located outside of the delineated wetlands and recommended buffer zones and there will therefore be <u>no direct impact to watercourses</u>.
- **Construction of the BESS, Water Reservoir and associated infrastructure**: Once the site has been cleared and graded, construction of the BESS units and reservoir will take place. This will likely entail further bulk earthworks, platforming, cement/concrete mixing and infrastructure construction. As mentioned, no direct impacts are anticipated for wetlands as infrastructure is assumed to be positioned outside of the delineated wetlands and recommended buffer zones.

6.1.2 Operation Phase Activities and Infrastructure

- **Management of stormwater runoff from the BESS infrastructure**: With the hardening of portions of the site where the BESS will be located (concrete lined platform/foundation), it is expected that the natural infiltration of storm water will be interrupted, resulting in modified storm water runoff volumes and velocities, potentially resulting in altered potential for soil erosion and sedimentation of downstream wetlands. Storm water will need to be collected, attenuated and released back into the environment in a controlled and environmentally sensitive manner.
- **Potential leakage of electrolyte chemicals from battery units**: This is associated with the potential for batteries to leak or leach chemicals into the environment if damaged/degraded as well as the storage and disposal of damaged battery units on site.

6.2 Risk, Stressor & Impact Identification

Freshwater ecosystems such as wetlands are inherently vulnerable to human activities and these activities can often lead to irreversible damage or longer term, gradual/cumulative changes to ecosystems. Threats to freshwater biodiversity include processes and activities which reduce system persistence, and alter community diversity and patterns, including reduced genetic diversity (Rivers-Moore *et al*., 2007).

The general framework for the risk and impact assessment is shown in Table 13, which presents the expected risks, stressors and impacts for the construction and operational phase of the project.

Potential risks/stressors associated with the development include (a) vegetation clearing and exposure of bare soils to erosive elements, (b) increased runoff from bare soils and any open trenches, (c) concrete/cement mixing, (d) management of waste water and potential pollutants, (e) discharge of stormwater runoff to the environment (f) litter/waste entrained in stormwater and (g) potential for spills due to malfunction or accidental failure of the batteries in the BESS containers (Table 13). These are likely to translate into the following freshwater ecosystem (wetland) impacts in general:

- Modification of hydrological regime;
- Potential for enhanced soil erosion and sedimentation linked to modified storm water discharge; and
- Pollution of soils and runoff into wetland habitat, leading to reduced water quality.

Table 13. Freshwater Impact Assessment Framework for the BESS and water reservoir.

FRESHWATER IMPACT ASSESSMENT FRAMEWORK			
DEVELOPMENT TYPE & ACTIVITIES: *Waaihoek BESS development and Water Reservoir*			
Construction Phase Activities: • Clearing of vegetation and grading of site • Construction of concrete/gravel platforms and associated support infrastructure		Operational Phase Activities: • Management of stormwater runoff from the BESS	
ENVIRONMENTAL STRESSORS/RISKS			
Construction Phase Stressors/Risks:		**Operational Phase Stressors/Risks:**	
a	Vegetation clearing and exposure of bare soils to erosive elements	a	Discharge of storm water runoff to the environment, leading to increased volumes and velocities of runoff water
b	Increased runoff from bare soils and open trenches	b	Litter/waste entrained in storm water
c	Concrete/cement mixing in the vicinity of watercourses	c	Potential for pollution due to battery leakage
d	Management of waste and potential pollutants	d	Human activity & Alien plant colonisation of disturbed areas

FRESHWATER ECOSYSTEM IMPACTS	
1	Direct physical loss or modification of wetland habitat (*not applicable*)
2	Alteration of hydrological and geomorphological processes (*flow, erosion & sediment regime changes*)
3	Impacts to water quality (*pollution*)
4	Impacts to ecological connectivity and/or ecological disturbance impacts

6.2.1 Impact Significance Assessment

A summary of the impact significance assessment for the construction and operational phases of the Waaihoek BESS development project is contained in Tables 14 and 15, respectively.

Construction phase impacts:

Table 14. Summary results of the impact significance assessment for construction phase impacts associated with the BESS, Water Reservoir & associated infrastructure.

Construction Phase Impact Assessment		Impact Significance	
		'poor' mitigation scenario	'good' mitigation scenario
C1	**Direct physical loss or modification of wetland habitat**	**Low**	**Low**
It is assumed that the BESS and water reservoir infrastructure will be positioned outside of the delineated wetlands and recommended buffer zones, hence the probability of incurring direct impacts associated with habitat/vegetation destruction and modified wetland soils is highly unlikely. Through impact avoidance (sound environmental planning to avoid wetland areas), impact significance is likely to be 'Low' and environmentally acceptable. Key mitigation measures for avoiding direct impacts are listed below. Key mitigation recommendations: • Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to buffer zones for wetlands, with planned development infrastructure to remain outside of the recommended wetland buffer zones. • Demarcate the edge of wetland buffers on the ground to avoid incursions into these areas. • Restrict access to wetland areas beyond the development footprint. • Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands, riparian areas and buffer zones and in accordance with the conceptual 'Wetland Rehabilitation Strategy'. • Implement appropriate ecological monitoring during construction and use findings to inform site management. • Construction phase method statement(s) to be developed and finalised prior to construction taking place, taking into consideration the wetland impact mitigation measures and requirements of the EMPr to be developed.			
C2	**Alteration of hydrological and geomorphological processes (erosion and sediment)**	**Impact Significance**	
		'poor' mitigation scenario	'good' mitigation scenario
		Moderately Low	**Low**
Construction activities in the catchment areas of onsite watercourses will result in a temporary reduction in catchment vegetation cover which could be associated with increased runoff and increased sediment supply to downstream wetlands, especially where bare soils are exposed during peak rainfall periods. If runoff and erosion control measures are not effectively implemented by the contractors, erosion rills/headcuts may form along the cleared and exposed slopes within the construction footprint and lead to increased rates of erosion and sedimentation within the wetland habitat downslope of the construction zone. These impacts are likely to be more pronounced during heavy rainfall events. Such impacts could potentially alter the geomorphic structure and			

hydrological regime of nearby wetlands and could affect freshwater habitat and flora. Should these impacts occur they are however likely to be indirect, temporary and are unlikely to significantly affect long-term ecological processes associated with onsite watercourses.

Overall, given the low EIS of the wetlands (limited ecological importance/sensitivity), impact intensity is likely to be relatively low and hydrological and geomorphological impacts are therefore also likely to be of relatively 'low' ecological significance. Best practical mitigation should be implemented (*as listed below and explained in detail in Chapter 7 of this report*), to maintain the impact at a 'low' and environmentally acceptable level.

Key mitigation recommendations:

- Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to buffer zones for wetlands, with planned development infrastructure to remain outside of the recommended wetland buffer zones.
- Limit construction activities to the dry (winter) season where possible, to reduce erosion and sediment risks.
- Address potential construction-phase erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control.
- Temporary erosion and sediment control measures are to be implemented, with a greater level of need if construction proceeds into the summer (wet/rainy) period. Temporary erosion/sediment control to remain in place until construction has been completed and operational storm water management infrastructure is suitably in place and operating correctly.
- Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible and in accordance with the conceptual '*Wetland Rehabilitation Strategy*'.
- Implement appropriate ecological monitoring during construction and use findings to inform site management.
- Construction phase method statement(s) to be developed and finalised prior to construction taking place, taking into consideration the wetland impact mitigation measures and requirements of the EMPr to be developed.

		Impact Significance	
C3	**Impacts to water quality**	'poor' mitigation scenario	'poor' mitigation scenario
		Low	**Low**

Water quality impacts during construction will likely be limited to potential increased surface water turbidity due to sediment inputs and / or erosion (*already discussed under impact C2 above*) and physio-chemical pollution related to potential spillages of cement and fuels during construction. Although water pollution impacts can potentially be experienced during the construction phase of the project, the quantity of pollutants is likely to be limited and thus be of low significance for wetlands in the area of study. This is especially relevant given the presence of a 'well-vegetated' buffer zone between the proposed development and the nearest watercourses, such that the intensity and probability of such impacts being sustained by wetlands downstream the BESS development are likely to be low, with impact significance also likely to be relatively 'Low' during the construction phase where well-managed (*as per the impact mitigation recommendations listed below and explained in detail in Chapter 7 of this report*).

Key mitigation recommendations:

- Limit construction activities to the dry (winter) season where possible, to reduce erosion and sediment risks.
- Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control.
- Sediment controls (e.g. silt fences/berms) should be implemented to reduce sediment inputs to the nearby wetlands.
- Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management.
- Rehabilitate any spill related impacts as soon as practically possible.
- A suitable spill response and remediation plan is to be developed for the construction phase.
- Implement appropriate ecological monitoring during construction and use findings to inform site management.
- Construction phase method statement(s) to be developed and finalised prior to construction taking place, taking into consideration the wetland impact mitigation measures and requirements of the EMPr to be developed.

C4	Impacts to ecological connectivity and/or ecological disturbance impacts	Impact Significance	
		'poor' mitigation scenario	'poor' mitigation scenario
		Low	**Low**

Since it is assumed that the BESS and water reservoir infrastructure will be positioned outside of the delineated wetlands and recommended buffer zones, the probability of incurring direct impacts to the delineated wetlands is presumed to be unlikely, hence impacts to wetland ecological connectivity are expected to be of 'Low' significance overall and wetland habitat fragmentation is highly unlikely to take place. Maintaining the recommended wetland buffer zones will also discourage edge disturbance and related impacts and maintain some form of ecological connectivity between wetland and adjacent terrestrial grassland habitats.

The presence of workers and machinery during the construction phase may create ecological noise and vibration disturbances that can temporarily disturb amphibians, reptiles, birds and small mammals; however, these will be minor, and fauna will likely move into intact adjacent areas or revisit the site once construction has ceased and the disturbance has halted. Given the limited availability of functional habitat and water for wetland-dependent species provide by the two rather dry temporary/seasonal seep wetlands at the site, faunal impacts are likely to be very limited to negligible, meaning that disturbance-related impacts during the construction phase could be of 'Low' significance. Best practical mitigation should be still implemented (*as listed below and explained in detail in Chapter 7 of this report*) to maintain the impact at a an appreciably low and environmentally acceptable level.

Key mitigation recommendations:

- Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to buffer zones for wetlands, with planned development infrastructure to remain outside of the recommended wetland buffer zones.
- Demarcate the edge of wetland buffers on the ground to avoid incursions into these areas.
- Restrict worker and machinery access to the active construction site and construction site camp areas only.
- Prohibit the poaching of animals and/or collection of plants and biota from natural areas, including wetlands.
- Temporary erosion/sediment control to be removed only once construction has been completed and operational storm water management infrastructure is suitably in place and operating correctly.
- Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands, riparian areas and buffer zones and in accordance with the conceptual 'Wetland Rehabilitation Strategy'.

Operational phase impacts:

Table 15. Summary results of the impact significance assessment for operational phase impacts associated with the BESS, Water Reservoir & associated infrastructure.

Operational Phase Impact Type: descriptions		Impact Significance	
		'poor' mitigation scenario	'good' mitigation scenario
O1	**Direct physical loss or modification of wetland habitat**	**Low**	**Low**

This is largely a construction phase risk/impact and given that the BESS, Water Reservoir and associated infrastructure will be planned to avoid delineated wetlands and their recommended buffer zones, direct loss or modification impacts are unlikely to occur during the operational phase.

Key mitigation recommendations:

- Appropriate storm water management to be implemented with a focus on reducing erosion risk.
- No solid waste dumping to take place within wetlands or buffers.
- Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands, riparian areas and buffer zones and in accordance with the conceptual 'Wetland Rehabilitation Strategy'.

O2	Alteration of hydrological and geomorphological processes (erosion and sediment)	Impact Significance	
		'poor' mitigation scenario	'good' mitigation scenario
		Moderately Low	**Low**

The BESS, Water Reservoir and associated infrastructure will result in limited / minor hardening of a portion of the catchment area supporting the wetlands at the site, with a resulting small to moderate increase in storm water runoff expected into the receiving environment from the stormwater management system. The ecological impacts are likely to include altered water inputs, modification to the timing, frequency and volume of low flows and storm water runoff as a result of a change in catchment land use. The hardening of a portion of the catchment will ultimately lead to a risk of enhanced runoff volumes and velocities (increased storm flows), with the potential to cause erosion within the downstream wetlands (scouring). Any soil erosion problems initiated during the construction phase and that are not timeously and adequately addressed through on-site rehabilitation post-construction, can also persist into the operational phase of the project and continue to have a negative impact on adjacent/downstream water resources for an extended period of time. Appropriate stormwater outfall and attenuation design should be implemented, and bearing this in mind, the impact could potentially be reduced to a 'Low' impact significance with best practical ecological design incorporated to allows flows and sediment fluxes to remain largely unmodified.

Key mitigation recommendations:

- Appropriate Storm Water Management Plan (SMWP) to be implemented with a focus on reducing downstream erosion risk.
- Monitoring plan to be implemented for water quality and erosion/sediment.
- Maintain storm water infrastructure as necessary through unblocking of drains, desilting where required, etc.
- Implement and adhere to the recommended buffer zones for wetlands.
- Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible and in accordance with the conceptual '*Wetland Rehabilitation Strategy*'.

O3	Impacts to water quality	Impact Significance	
		'poor' mitigation scenario	'good' mitigation scenario
		Low	**Low**

Water quality impacts during the operation of onsite infrastructure will likely be limited to potential increased water turbidity due to sediment inputs and / or erosion, which is linked to Impact O3 (*dealt with above*). There is however also some potential for contaminated surface runoff / stormwater flows, should at any point the batteries (i.e. Redox Flow Batteries) leak electrolyte chemical into the surrounding environment for various reasons such as faulty or damaged battery units. Water turbidity and / or pollution risks should be effectively mitigated, using practical mitigation (*as listed below and explained in detail in Chapter 7 of this report)* to maintain a 'Low' significance level, at an environmentally acceptable level.

Key mitigation recommendations:

- Implement best practice stormwater management design.
- Design the facility to contain any potential leakages from battery units and prevent environmental pollution risk.
- Water pipelines associated with the water reservoir to be buried below ground to prevent exposure and damage.

O4	Impacts to ecological connectivity and/or ecological disturbance impacts	Impact Significance	
		'poor' mitigation scenario	'good' mitigation scenario
		Low	**Low**

Operationally, impacts to wetland ecological connectivity are expected to be of 'Low' significance overall and wetland habitat fragmentation is highly unlikely to take place given that the facility will be located well outside of the delineated wetlands. Maintaining the recommended wetland buffer zones will also discourage edge disturbance and related impacts and maintain some form of ecological connectivity between wetland and adjacent terrestrial grassland habitats. Best practical mitigation should be still implemented (*as listed below and*

explained in detail in Chapter 7 of this report) to maintain the impact at a an appreciably 'low' and environmentally acceptable level.

Key mitigation recommendations:

- Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to buffer zones for wetlands.
- Restrict worker and machinery access to the BESS facility and planned access roads only.
- Eradicate and/or control Invasive Alien Plant species as necessary.
- Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands, riparian areas and buffer zones and in accordance with the conceptual 'Wetland Rehabilitation Strategy'.

6.2.2 Impact Significance Assessment Summary Table

A summary of the impact significance assessment is provided in Table 16.

Table 16. Impact significance assessment summary table.

Impact Type	Impact Significance	
	'poor' mitigation scenario	'good' mitigation scenario
CONSTRUCTION PHASE (C1)		
C1 Direct physical loss or modification of wetland habitat	Low	Low
C2 Alteration of hydrological and geomorphological processes	Moderately Low	Low
C3 Impacts to water quality	Low	Low
C4 Impacts to ecological connectivity and/or ecological disturbance impacts	Low	Low
OPERATIONAL PHASE (O1)		
O1 Direct physical loss or modification of wetland habitat	Low	Low
O2 Alteration of hydrological and geomorphological processes	Moderately Low	Low
O3 Impacts to water quality	Low	Low
O4 Impacts to ecological connectivity and/or ecological disturbance impacts	Low	Low

*For further details on impact assessment scores and ratings refer to **Annexure A** of this report.*

6.3 Risk Assessment to inform S21 c & i Water Use Licensing

It is our understanding that the purpose of the risk matrix tool developed by the DHSWS is to give a preliminary indication of the likely impact / degree of change (consequence) of activities (water uses) to local and regional water resource quality. For the purposes of this study, the degree of change is reflected in PES change and/or the change in the supply of regulating ecosystem services.

Possible activities, aspects (or stressors) and potential ecological risks associated with the planned BESS and reservoir, that could potentially manifest in impacts to the four drivers of wetland

condition/functioning as defined by the DWS have been identified in Section 6.2 (see Table 13) of this report, and include the following aspects/activities:

- Vegetation clearing and exposure of bare soils to erosive elements;
- Increased runoff from bare soils and open trenches;
- Concrete/cement mixing in the vicinity of watercourses;
- Management of waste and potential pollutants;
- Disturbance from machinery and labourers;
- Discharge of storm water runoff to the environment, leading to increased volumes and velocities of runoff water;
- Litter/waste entrained in storm water;
- Solid waste dumping;
- Potential for pollution caused by battery leakage due to damage/faulty BESS units; and
- Alien plants colonisation of disturbed areas.

A summary of the potential risk and impacts ratings for the proposed development activities is provided in Table 17 below. Given that the overall risk posed by the construction and operation of the proposed BESS and water reservoir is considered to be 'Low' where properly mitigated and managed, the development project can potentially be generally authorised under the GA for Section 21 c and i water uses, however this will still need to be confirmed by the Department of Water & Sanitation (DWS) at the relevant pre-application meeting for the WULA phase of the project.

Table 17. Summary of the risk matrix assessment scores and ratings for each activity and risk group.

Phase(s)	Activity	Aspect	Impact	Risk Rating
Construction	Establishment (construction) of all onsite infrastructure	Vegetation clearing and exposure of bare soils to erosive elements	C1: Direct physical loss or modification of wetland habitat	Low
		Increased runoff from bare soils and open trenches	C2: Alteration of hydrological and geomorphological processes	Low
		Concrete/cement mixing in the vicinity of watercourses & management of waste and potential pollutants	C3: Impacts to water quality	Low
		Vegetation clearing and exposure of bare soils to erosive elements & indirect disturbance from machinery and labourers	C4: Impacts to ecological connectivity and/or ecological disturbance impacts	Low
Operation	Operation of BESS and Water Reservoir	Discharge of storm water runoff to the environment, leading to increased volumes and velocities of runoff water	O1: Direct physical loss or modification of freshwater habitat	Low
			O2: Alteration of hydrological and geomorphological processes	Low

Phase(s)	Activity	Aspect	Impact	Risk Rating
		Litter/waste entrained in storm water & Potential for pollution due to battery leakage	O3: Impacts to water quality	**Low**
		Human activity & Alien plant colonisation of disturbed areas	O4: Impacts to ecological connectivity and/or ecological disturbance impacts	**Low**

*For further details on risk assessment scores and ratings refer to **Annexure B** of this report.*

7. IMPACT MITIGATION & MANAGEMENT

A strong legislative framework which backs up South Africa's obligations to numerous international conservation agreements creates the necessary enabling legal framework for the protection and management of freshwater resources in the country. Given the value of wetlands and other aquatic ecosystems (such as rivers and estuaries) and the fact that humans depend on aquatic resources, it is against the law to deliberately damage wetlands and rivers. The law therefore places, directly and indirectly, the responsibility on landowners and other responsible parties, to manage and restore wetlands where relevant.

According to the National Environmental Management Act No. 107 of 1998 (NEMA), sensitive, vulnerable, highly dynamic or stressed ecosystems, such as wetlands, rivers and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure. NEMA also requires "a risk-averse and cautious approach which takes into account the limits of current knowledge about the consequences of decisions and actions". The 'precautionary principle' therefore applies and cost-effective measures must be implemented to pro-actively prevent degradation of the region's water resources and the social systems that depend on it. ***Ultimately, the risk of water resource (wetland) degradation must drive sustainability in development design.***

Of particular importance is the requirement of 'duty of care' with regards to environmental remediation stipulated in Section 28 of NEMA (National Environmental Management Act No.107 of 1998):

> **Duty of care and remediation of environmental damage**: "(1) *Every person who causes has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot be reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.*"

7.1 The 'Mitigation Hierarchy' Best Practice Environmental Planning Framework

The protection of water resources such as wetlands begins with the avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the form of reactive practical actions that minimizes or reduces such impacts. Driver *et al.* (2011) recommend that the management of freshwater ecosystems should aim to prevent the occurrence of large-scale damaging events as well as repeated, chronic, persistent, subtle events which can in the long-term be far more damaging (e.g. as a result of sedimentation and pollution). 'Impact Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve biodiversity and prevent significant adverse impacts as a result of potentially harmful activities to natural ecosystems. The mitigation of negative impacts on aquatic resources is a legal requirement for authorisation purposes and must take on different forms depending on the significance of impacts and the particulars of the target area being affected. This generally follows some form of 'mitigation hierarchy' (see Figure 11, below) which aims firstly at avoiding disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided, to minimise, rehabilitate, and then finally offset any remaining significant residual impacts.

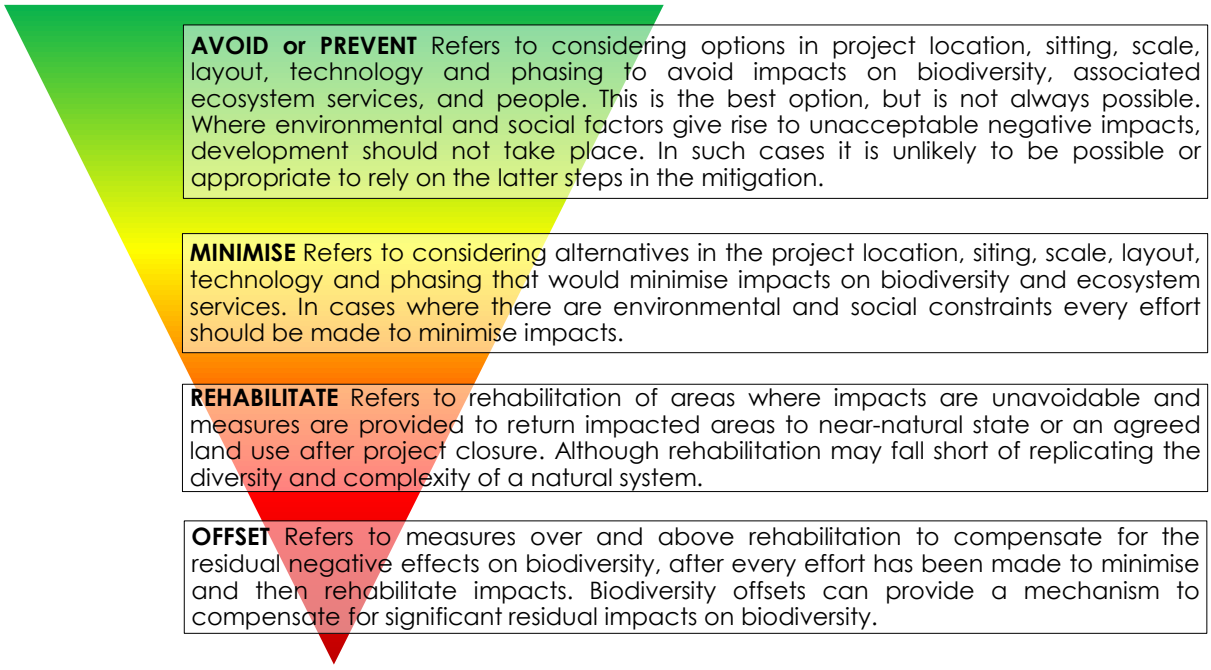


Figure 11 Diagram illustrating the 'mitigation hierarchy' (after DEA *et al.*, 2013).

The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives in terms of project location, siting, scale, layout, technology and phasing until the proposed development can best be accommodated without incurring significant negative impacts to the receiving environment. In cases where the receiving environment cannot support the development or where the project will destroy the natural resources on which local communities are wholly dependent for their livelihoods or eradicate unique biodiversity; the development may not be feasible and the more the developer is made aware of these risks, and can plan to avoid them, the better. In the case of

particularly sensitive ecosystems, where ecological impacts can be severe, the guiding principle should generally be "*anticipate and prevent*" rather than "*assess and repair*". This principle is also in line with the recommended management objective for the project and receiving aquatic environment, that being to '*maintain the current status quo of aquatic ecosystems without any further loss of integrity (PES) or functioning*'.

A stepped approach has therefore been followed in trying to minimize impacts, which included:

i. **Firstly, attempting to avoid/prevent impacts through appropriate project design and location:** *Development set-backs / wetland buffer zones recommended.*

ii. **Secondly, employing mitigation measures aimed at minimizing the likelihood and intensity of potential risks/impacts**: *Provision of construction and operation phase management and mitigation measures to avoid any unnecessary direct or indirect impacts to wetlands.*

iii. **Thirdly, addressing residual impacts to areas adjacent to the development site which may be impacted:** *A conceptual wetland rehabilitation strategy has been compiled.*

iv. **Lastly, compensating for any remaining/residual impacts associated with permanent habitat transformation:** *Not applicable to this project as no residual impacts to wetlands are anticipated given that layout planning will avoid direct impacts to wetlands.*

7.2 Planning & Design Measures

7.2.1 Buffer Zones

'Buffer zones' or 'buffers' (also termed "development set-backs") are essentially strips of vegetated undeveloped land typically designed to act as a protective barrier between human activities and sensitive habitats such as wetlands, rivers and forests. Research shows that buffer zones are useful at performing a wide range of functions such as sediment trapping and nutrient retention, and in doing so, play an important role in protecting water resources from the adverse impacts that are typically associated with various land-uses and developments. Although there are no legislative requirements regarding the establishment of buffers around water resources in the South African legislation, the application of buffers is aligned with the principles of the National Water Act (1998), which is to provide for the sustaining of water quality and preserving natural aquatic habitats and ecosystem functions.

According to the draft Guidelines for Biodiversity Impact Assessment in KZN (EKZNW, 2011), a standard buffer width of 30m from the outer edge of the delineated wetland areas in the Province of KZN, often irrespective of site conditions and development/land use type. The guideline document goes on to recommend that the determination of ecological buffers should rather be based on a number of site-specific factors. A national protocol for buffer determination around rivers, wetlands and estuaries has recently been developed (Macfarlane & Bredin, 2016) and represents emerging best-practice in aquatic buffer zone determination.

The national buffer zone determination tool for wetlands and rivers (Macfarlane & Bredin, 2016) was applied for the assessed wetlands. Potential risk to wetlands in terms of a range of criteria (see Table 18) are estimated by the buffer model and used to allocate suitable buffers based on the generic risk levels associated with the proposed development type (refined at a site level). The "*Service Infrastructure*" category was used to inform operational risks/threats in the buffer tool.

According to the Preliminary Guideline for the Determination of Buffer Zones (Macfarlane & Bredin, 2016), buffer zone requirements are only advocated where scientific studies have shown that they can be an effective mitigation measure. Table 18 (below) also highlights situations where the implementation of suitable aquatic buffer zones can have a potentially positive mitigating effect and should be considered in impact mitigation (e.g. water quality and sediment impacts) and those situations where buffers are not particularly suited at mitigating impacts/risks and where other forms of mitigation should be identified (e.g. water quantity impacts, including stream flow reduction activities).

Table 18. Preliminary desktop-level threats used in the aquatic buffer assessment and the best approaches for addressing these threats.

Threat Type	Preliminary Threat Ratings		Approach for Addressing Threats
	Construction Phase	Operation Phase	
1. Alteration to flow volumes	N/A	Moderate	• Source directed controls • Restricting surface flow requirement (SFR) activities
2. Alteration of patterns of flows (increased flood peaks)	Very Low	Moderate	• Control of water inputs
3. Increase in sediment inputs & turbidity	Moderate	Very Low	• **Buffer zones** • Other suitable on-site BMPs
4. Increased nutrient inputs	N/A	Very Low	
5. Inputs of toxic organic contaminants	Very Low	Moderate	
6. Inputs of toxic heavy metal contaminants	Low	Moderate	
7. Alteration of acidity (pH)	Low	Very Low	• On-site BMPs and other measures
8. Increased inputs of salts (salinization)	N/A	Very Low	
9. Change (elevation) of water temperature	N/A	Very Low	
10. Pathogen inputs (i.e. disease-causing organisms)	Very Low	Very Low	• **Buffer zones** • Other suitable on-site BMPs

Based on the threats posed by the proposed development, the buffer model calculated appropriate buffer widths under two scenarios:

1. With 'Standard' Mitigation; and
2. With 'Site-specific / Best Practical' Mitigation

With specific mitigation (focusing on the management of storm water runoff, erosion control and potential pollutants/contaminants), the model recommends a **20m wide buffer zone** for both wetlands W01 and W02, as per Table 19. The wetlands with recommended buffers are shown spatially on the map in Figure 12.

Table 19. Wetland buffer zone widths recommended to inform development planning.

Wetland Unit	Buffer Widths Recommended	
	Construction Phase	Operational Phase
W01	20m	**20m**
W02	20m	**20m**

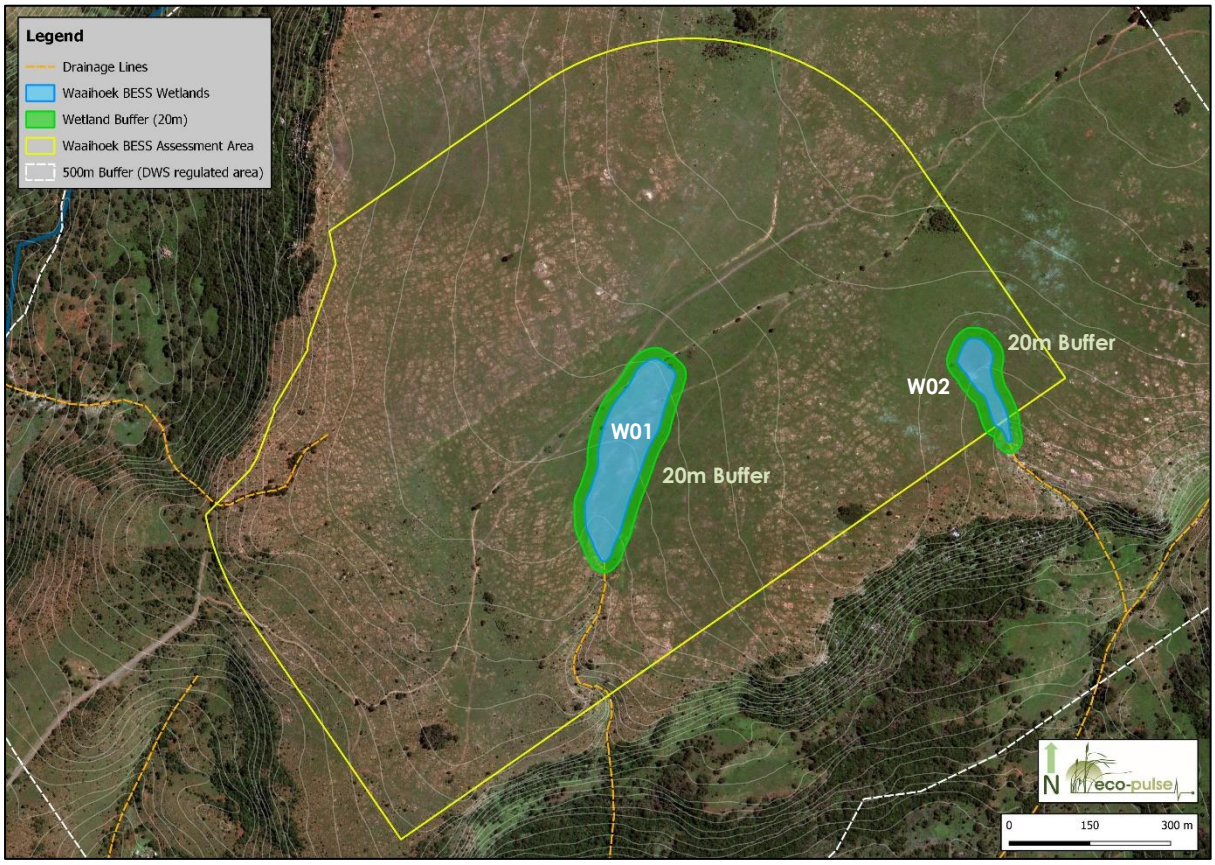


Figure 12 Map showing the recommended 20m wide 'buffer zone' for both wetlands (W01 & W02) used to inform the recommended placement of the proposed BESS and Water Reservoir.

Key assumptions and criteria considered in determining suitable buffers is provided below:

- Key construction phase risks linked with the proposed development type include increased sediment inputs and turbidity and possible water pollution from toxic organic and heavy metal contaminants.
- Key operation phase risks linked with development are likely to include increased flood peaks and water pollution.
- Buffers were informed by the Present Ecological State (PES) and Ecological Importance & Sensitivity (EIS) of the wetland and river units assessed.
- The model also considers the site-specific information and sensitivities of the water resource to the identified development threats. This includes additional information regarding the characteristics of the site which relate to the watercourse HGM type, channel width, system hydrology, soils characteristics, geology and geomorphology, topography (slope), runoff

characteristics, erosion vulnerability, inherent nutrient levels in the landscape, and vegetation characteristics.

- Buffers may be most effective at reducing pollutants in diffuse surface flow but are far less effective at addressing point-source pollution or concentrated flows and their role in mitigating pollution impacts associated with groundwater (subsurface flow) is not well documented.
- While buffer zones are known to work well at trapping sediments and nutrients, the potential to reduce impacts such as point source pollution and sedimentation is strongly dependent on the site-specific characteristics of the buffer (such as vegetation cover, slope of the buffer, etc.);
- For impacts involving the concentration of surface flow (e.g. storm water discharge, etc.), buffers have a limited capacity to function at attenuating flows and trapping sediment / nutrients / pollutants.
- In order to maximise their effectiveness, buffer zones will need to be established and maintained with indigenous vegetation cover (without erosion features/concentrated flow paths) as open space natural grassland areas with appropriate alien plant control and/or slashing to maintain grass cover.
- The proposed aquatic buffer zone widths do not specifically take into account biodiversity concerns related to fauna/flora, etc.

7.2.2 Recommended Site Planning (location of infrastructure)

Based on the spatial extent and location of the two wetlands and recommended 20m wide buffer zones (developed 'No-Go' areas), Eco-Pulse has proposed three alternative site location options, as shown on the map in Figure 13. *Note that whilst site access and topographical constraints have been taken into account, the recommended locations have been proposed largely in terms of avoiding impacts to wetlands and other site sensitivities have not been accounted here (terrestrial biodiversity sensitivities and heritage resources, for example)*.

Wetland/buffer area encroachment is not supported or recommended and should only be considered if a strong motivation or rationale for why the suggested locations identified in Figure 13 are not considered feasible and/why encroachment is unavoidable. It is important that the applicant and appointed Environmental Assessment Practitioner (EAP) keep a detailed record of the planning process in this regard so that evidence of due consideration of the impact mitigation hierarchy can be shown.

7.2.3 Stormwater Management

Although the volume of stormwater to be generated by the project is low, stormwater should still be formally managed through a formal storm water management plan, to ensure flows are attenuated to pre-development conditions (volumes and velocities) and that any storm water released to the environment is done so in a controlled manner that does not cause erosion. This includes runoff from new access roads.

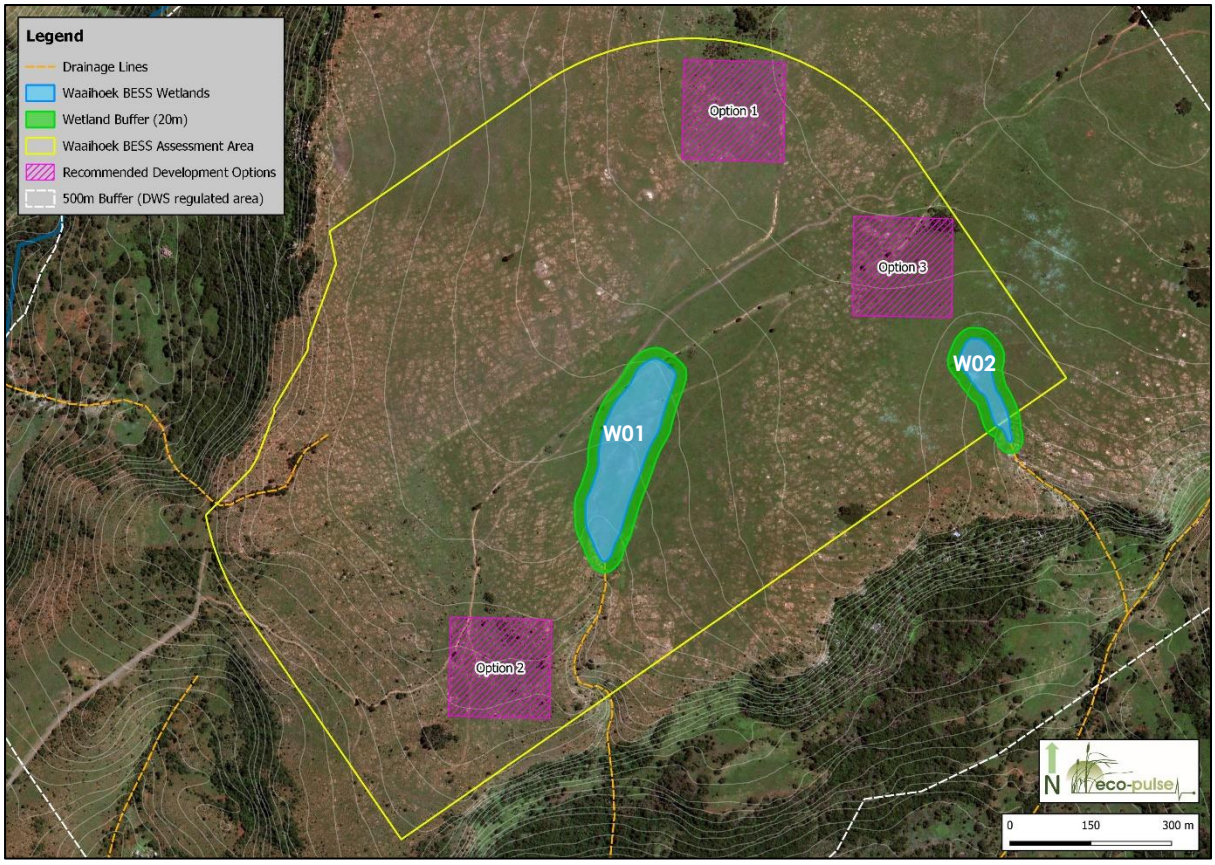


Figure 13 Map showing the recommended development site location alternatives relative to the delineated wetlands and recommended 20m buffer zones.

7.3 Construction Phase Mitigation and Management Measures

Impact mitigation measures and recommendations have been compiled based on specialist knowledge and experience in service (energy) infrastructure projects as well as a range of literature including:

- FERC (US Federal Energy Regulatory Commission), 2002. Wetland and Waterbody construction and mitigation procedures.
- DWAF (Department of Water Affairs and Forestry) 2005b. Environmental Best Practice Specifications: Operation. Integrated Environmental Management Sub-Series No. IEMS 1.6. Third Edition. DWAF, Pretoria.
- DWAF (Department of Water Affairs and Forestry) 2005c. Environmental Best Practice Specifications: Operation. Integrated Environmental Management Sub-Series No. IEMS 1.6. Third Edition. DWAF, Pretoria.
- CSIR, 2003. Guidelines for human settlement planning and design. Chapter 10: Sanitation. Revised August 2003.

7.3.1 Timing of construction

Where possible, it is recommended that construction be undertaken during the dry season/winter months (May to September generally) to reduce erosion and sedimentation risks associated with summer rainfall

in this region, especially given some of the steeper slopes present at the site where erosion and sediment risks are likely to be high.

7.3.2 Method Statements

Relevant Method Statement(s) for the construction activity must be compiled and appended to the construction (EMPr) prior to construction commencing.

7.3.3 Establishment and Management of Construction Site Camp, Materials Storage and Equipment Laydown Areas

Location:

- When locating the construction site camp and equipment yard, wetlands and areas susceptible to soil erosion and/or water contamination must be avoided. The construction site camp must be situated at least 20m away from the edge of the nearest delineated wetland.
- The camp should be established on level ground.
- The location of the site camp should be approved by the appointed Environmental Control Officer (ECO).

Site Ablutions:

- The Contractor shall make adequate provision for temporary chemical toilets (minimum 1 toilet per 10 users) for the use of their employees during the Construction Phase. Such facilities, which shall comply with local authority regulations, shall be maintained in a clean and hygienic condition. Their use shall be strictly enforced.
- Workers need to be encouraged to use these facilities and not the natural environment.
- Toilets must not be located within the recommended buffer of any wetlands.
- Waste from chemical toilets must be disposed of regularly (at least once a week) and in a responsible manner by a registered waste contractor.
- Toilet facilities must be serviced weekly and in a responsible manner by a registered waste contractor to prevent pollution and improper hygiene conditions.
- The location of the toilets should be approved by the appointed ECO.
- Contractors must ensure that no spillage occurs when chemical toilets are cleaned and that the contents are properly stored and removed off-site.

7.3.4 Access to construction areas

It is recommended that access to the construction sites by workers and construction machinery be via the existing dirt road network wherever possible. New access routes should only be established where necessary to complete the works and should remain outside of wetlands and the recommended buffer zones.

7.3.5 Sensitive area / working area demarcations

- The edges of the construction zone must be clearly staked-out by a surveyor and demarcated using highly visible material (e.g. danger tape) prior to construction commencing.
- The demarcation work must be signed off by the Environmental Control Officer (ECO) before any work commences.
- Demarcations are to remain until construction and rehabilitation is complete.
- All areas outside of this demarcated working servitude must be considered no-go areas for the entire construction phase.
- No equipment laydown or storage areas may be located within delineated wetlands or the recommended wetland buffer zones.
- Access to and from the development area should be either via existing roads or within the construction footprint.
- Any contractors found working inside the 'No-Go' wetland areas (areas outside the construction/ working servitude) should be fined as per a fining schedule/system setup for the project.

7.3.6 Temporary Diversions and Impoundments

Not applicable – construction of roads and development infrastructure is to take place outside of identified wetlands and buffer zones.

7.3.7 Runoff, erosion and sediment control

- Wherever possible, existing vegetation cover on the development site should be maintained during the construction phase (particularly the recommended wetland buffer zones). The unnecessary removal of groundcover from slopes must be prevented, especially on steep grassed slopes which will not be developed.
- Clearing activities must only be undertaken during agreed working times and permitted weather conditions. If heavy rains are expected, clearing activities should be put on hold.
- All bare slopes and surfaces to be exposed to the elements during clearing and earthworks must be protected against erosion using rows of hay-bales, sandbags and/or silt fences aligned along the contours and spaced at regular intervals (e.g. every 2m) to break the energy of surface flows.
- Once shaped, all exposed/bare surfaces and embankments must be re-vegetated immediately.
- If re-vegetation of exposed surfaces cannot be established immediately due to phasing issues, temporary erosion and sediment control measures must be maintained until such a time that re-vegetation can commence.
- All temporary erosion and sediment control measures must be monitored for the duration of the construction phase and repaired immediately when damaged. All temporary erosion and sediment control structures must only be removed once vegetation cover has successfully recolonised the affected areas.
- After every rainfall event, the contractor must check the site for erosion damage and rehabilitate this damage immediately. Erosion rills and gullies must be filled-in with appropriate material and silt

fences or fascine work must be established along the gulley for additional protection until vegetation has re-colonised the rehabilitated area.

7.3.8 Soil management

- Soil stockpiles must be established on flat ground and outside of wetlands and their buffer zones.
- Erosion/sediment control measures such as silt fences, low soil berms or wooden shutter boards must be placed around the stockpiles to limit sediment runoff from stockpiles.
- Subsoil and topsoil must be stockpiled separately. Stockpiled soil must be replaced in the reverse order as to which it was removed (subsoil first followed by topsoil).
- Stockpiles of construction materials must be clearly separated from soil stockpiles in order to limit any contamination of soils.
- The stockpiles may only be placed within demarcated stockpile areas, which must fall within the demarcated construction area. The contractor shall, where possible, avoid stockpiling materials in vegetated areas that will not be cleared.
- Stockpiled soils are to be kept free of weeds and are not to be compacted. The stockpiled soil must be kept moist using some form of spray irrigation on a regular basis as appropriate and according to weather conditions.
- If soil stockpiles are to be kept for more than 3 months, they must be hydroseeded.
- The slope and height of stockpiles must be limited to 1.5m and are not be sloped more than a ratio of 1:2 to avoid collapse.

7.3.9 Hazardous substances / materials management

- Construction of a high berm wall which prevents leakage of the electrolyte chemical into the surrounding environment.
- The proper storage and handling of hazardous substances (e.g. fuel, oil, cement, etc.) needs to be administered.
- Mixing and/or decanting of all chemicals and hazardous substances must take place on an impermeable surface and must be protected from the ingress and egress of stormwater.
- Drip trays should be utilised at all dispensing areas.
- No refuelling, servicing or chemical storage should occur within 50m of any wetlands.
- Hazardous storage and refuelling areas must be bunded prior to their use on site during the construction period. Bund walls should be high enough to contain at least 110% of any stored volume. The surface of the bunded surface should be graded to the centre so that spillage may be collected and satisfactorily disposed of.
- An emergency spill response procedure must be formulated for the site, and staff are to be trained in spill response.
- All necessary equipment for dealing with spills of fuels/chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil/material disposed of appropriately at a registered site.
- Drums must be kept on site to collect contaminated soil. These should be disposed of at a registered hazardous waste site.

- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at a registered hazardous landfill site.
- Vehicle maintenance should not take place on site unless a specific bunded area is constructed for such a purpose.

7.3.10 Solid waste management

- Litter generated by the construction crews must be collected in rubbish bins and disposed of at registered landfill sites
- Adequate rubbish bins and waste disposal facilities must be available on site and at the construction camp.
- Regular clearing/maintenance of bins is required.
- The contractor must clear and completely remove all general waste, construction plant, equipment, surplus rock, and other foreign materials from the site once construction has been completed.

7.3.11 Water abstraction and use

- There has been no indication of water abstraction to take place for the development.
- Should water be abstracted from any watercourses for use in construction activities, prior approval from the DHSWS is required, subject to acquiring a relevant Water Use License in terms of Section 21 (a) of the National Water Act for taking water from a water resource.
- Water abstraction is to be by suction pumps connected to water carts only. Water carts are to utilise existing access roads to abstraction points and are not to encroach into "no-go" areas.
- Care is to be taken not to disturb the channel bed of watercourses during abstraction of water using suction pumps.
- Employees are not to make use of any natural water sources for the purposes of swimming, bathing, or washing of equipment, machinery, or clothes.

7.3.12 Invasive Alien Plant Control

- All alien invasive vegetation that colonise the construction site must be removed, preferably by uprooting. The contactor should consult the ECO regarding the method of removal.
- All bare surfaces across the construction site must be checked for IAPs every two weeks and IAPs removed by hand pulling/uprooting and adequately disposed.
- Herbicides should be utilised where hand pulling/uprooting is not possible. ONLY herbicides which have been certified safe for use in wetlands by independent testing authority are to be used. The ECO must be consulted in this regard.
- No burning of vegetation to be permitted.

7.3.13 Construction phase monitoring measures

- The ECO must undertake regular compliance monitoring audits. Freshwater ecosystem aspects that must be monitored include:

- The condition of the temporary runoff, erosion and sediment control measures and evidence of any failures or sediment deposits within watercourses.
- Evidence of elevated water turbidity levels.
- Evidence of gully or bed/bank erosion.
- Visual assessment instream water quality.
- The condition of waste bins and the presence of litter within the working area.
- Evidence of solid waste within the no-go areas.
- Evidence of hazardous materials spills and soil contamination.
- Presence of alien invasive and weedy vegetation within the working area.
- Rehabilitation and re-vegetation success and failures.

7.4 Conceptual Wetland Rehabilitation Strategy

A broad conceptual level wetland rehabilitation strategy has been compiled to meet the minimum WULA requirements.

A detailed implementation plan will still need to be compiled based on this strategy should there be any direct or indirect impacts to wetlands resulting in damage/disturbance and requiring rehabilitation.

The rehabilitation strategy is depicted by the diagram in Figure 14.

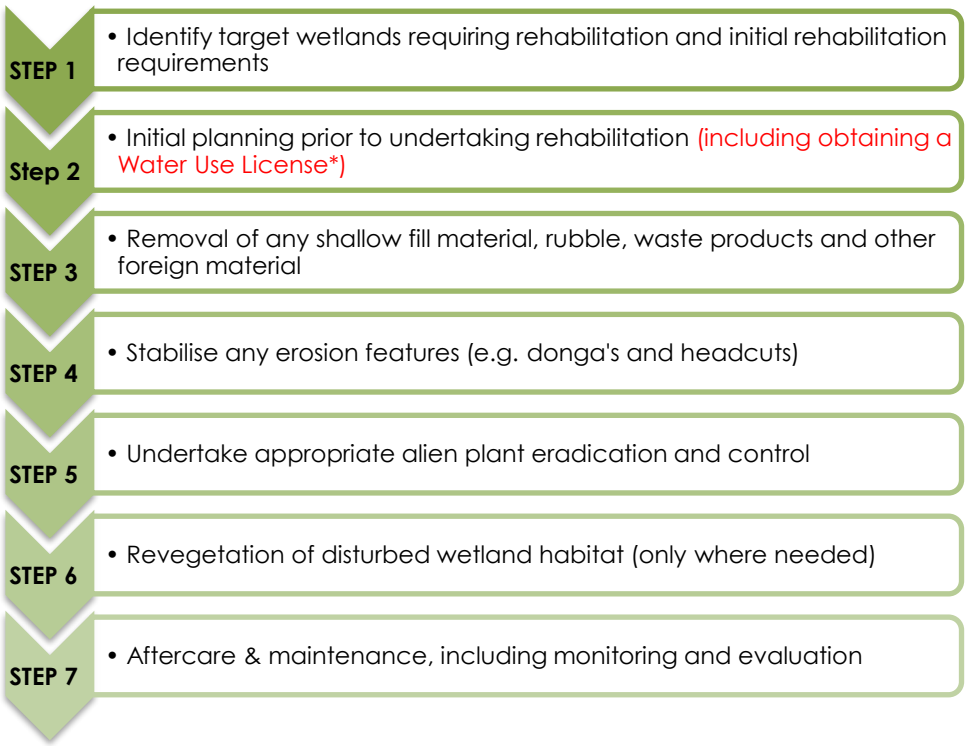


Figure 14 Diagram showing the conceptual rehabilitation process to be followed when implementing wetland rehabilitation.

Key actions should include (as deemed relevant / necessary):

- Proper planning for rehabilitation is considered critical for ensuring that rehabilitation is successful.
- Removal of all foreign debris, waste, cement/concrete, building materials and similar from the watercourse and dispose of properly at a suitable landfill site.
- **Any active erosion features (e.g. dongas) need to be fixed/stabilised. This is particularly relevant to seep wetland W02, where minor erosion was evident - with an 'active' headcut present. The potential of catchment hardening and discharge of storm water into this wetland is likely to exacerbate erosion. No hard structures are needed to deactivate the headcut, however it is important that erosion is monitored. Should the headcut display signs for scouring and cutting back upslope towards the head of the wetland, consulting an engineer to provide a practical solution is recommended. This may involve a drop-inlet weir and/or diversion berm and will require engineering input into the design of such a solution. Since the wetland that is vulnerable to further erosion is located on the property, it is the responsibility of the applicant to address the erosion risks and impacts prior to discharge of operational storm water into the head of this wetland where relevant.**
- Alien plants, particularly those considered invasive in terms of the National Environmental Management: Biodiversity Act (NEMBA) will need to be removed/eradicated should construction/operational activities create disturbance to wetland areas leading to the colonisation of alien plants in these areas.
- For buffers and dryland areas adjoining watercourses, any disturbed areas should be re-vegetated with a locally suitable grass mix that must be approved by the ECO or wetland specialist / ecologist / botanist.
- The re-vegetation should be timed to occur before the wet season (ideally at the onset of the wet season in early spring – August to October) so that watering requirements are minimized, and plant growth is most vigorous.
- Watering should be gentle so that rill erosion is avoided and minimised.
- Any erosion damage resulting from watering/irrigation must be repaired immediately.
- Aftercare, maintenance, monitoring and evaluation of rehabilitation and re-vegetation efforts must be undertaken during and after rehabilitation has been completed. The monitoring and evaluation of rehabilitation activities and outcomes is critical in assessing the extent to which the rehabilitation plan has achieved what it set out to accomplish. Thereafter, the rehabilitation must be signed off by the ECO.

7.5 Operational Phase Mitigation and Management Measures

7.5.1 Stormwater Infrastructure Maintenance

It is the applicant's responsibility to ensure the proper functioning of any stormwater systems associated with the operational development site. Importantly, the stormwater management system and related infrastructure is likely to require regular on-going maintenance in the form of the silt and debris clearing

and removal from catch pits, filtration devices and attenuation ponds, and maintenance and repair of stormwater outlets in order to ensure the optimal functioning of such systems.

In addition, it is important that the location and extent of the watercourses (wetlands) in the vicinity of stormwater infrastructure be incorporated into all formal maintenance and repair plans.

7.5.2 Hazardous Materials and Handling

Ensure that there are appropriate control measures in place for any contamination event:

- Establish appropriate emergency procedures for accidental contamination of the surroundings. Waste recycling should be incorporated into the facility's operations as far as possible. Designate a secured, access restricted, signposted for the Battery Energy Storage System (BESS). All hazardous waste (i.e. replacement of damaged batteries, etc.) may only be disposed of at an appropriate licensed waste-receiving facility.
- Rehabilitate contaminated areas a.s.a.p. in accordance with advice from appropriate contamination and environmental specialists.
- Educate workers regarding the working with the facility and about waste management and emergency procedures with regular training and notices and talks.

7.5.3 Freshwater Ecosystem Rehabilitation and Management

If any freshwater ecosystems are measurably impacted by the construction and operational activities of the project, these areas will need to be rehabilitated. Such rehabilitation should be informed by a suitably qualified and experienced freshwater ecologist.

In terms of management, the landowner is encouraged to ensure that negative impacts to the watercourses within the BESS property resulting from onsite activities are minimised and managed in perpetuity (while the owner).

At a minimum, long-term monitoring should involve alien invasive plant control. In line with the requirements of Section 2(2) and Section 3(2) the National Environmental Management: Biodiversity Act (NEM:BA), which obligates the landowner/developer to control IAPs on his property, all IAPs within the study area must be controlled on an on-going basis. The need for this exercise should be reviewed based on the presence of IAPs during the operational phase of the project.

7.5.4 Freshwater Ecosystem Monitoring

Periodic long-term monitoring of the stormwater management and the onsite wetland ecosystems should be undertaken. This can also be achieved through basic visual inspections by the ECO and support staff, documenting issues such as:

- Erosion and/or sedimentation below stormwater outlets or within wetland and/or channels.
- Leakages or issues with the reservoir.
- Invasive alien plant invasion and proliferation.

8. OPINION ON LEGISLATIVE IMPLICATIONS

8.1 National Water Act (No. 36 of 1998) ('NWA')

There are several reasons why water users are required to register and license their water use with the Department of Humans Settlements, Water & Sanitation (DHSWS), the most important being: (i) to manage and control water resources for planning and development; (ii) to protect water resources against over-use, damage and impacts and (iii) to ensure fair allocation of water among users (NWA, 1998). Water use must be licensed unless its use is excluded. There are no identified exclusions applicable to the property or planned development.

Water uses described under Chapter 4 and Section 21 of the National Water Act No. 36 of 1998 (NWA) that are associated with this project are listed in Table 21 and include Section 21 (c) and (i) water uses associated with the BESS development being in the vicinity (500m) of multiple wetlands. There will be no direct incursion into watercourses, thus no impeding or directing of flows. However, risk of indirect water quality and sediment/flow impacts could result in a change in the watercourse characteristics. As such this activity constitutes a Section (c) and 21(i) water use. The results of the DWS risk matrix assessment above (Section 6.3) indicates that the risks will be 'low' in terms of impacts to local water resource quality.

Notably, the onsite water reservoir will be positioned outside of any watercourse/channel, in this regard water use in terms of Section 21 (b): "*storage of wate within a watercourse*" is not deemed to be applicable to the project.

Furthermore, as risks all fall within the 'Low' risk category / class, and the significance of the impacts was assessed as being low with appropriate mitigation applied, a General Authorization (GA) in terms of Section 39 of the NWA is most likely to be applicable at the project level. The DHSWS will still need to be approached to confirm this is the case and any further WULA requirements.

Table 20. Summary water uses associated with the planned BESS facility and associated infrastructure.

Section 21 Water Use		Comment
Section 21 (c)	Impeding or diverting the flow of water in a watercourse.	Construction and operation phase activities take place within the DHSWS 'Regulated Area for Section 21 c & i, water use', i.e. within 500m of a wetland. There will be no direct impeding of flows as all infrastructure is to be positioned outside of watercourses (wetlands). Development may indirectly alter the characteristics of adjacent and/or downstream watercourses (wetlands).
Section 21 (i)	Altering the bed, banks, course or characteristics of a watercourse.	

8.2 NEMA EIA Requirements

From a wetland perspective, the project is unlikely to be associated with the NEMA: EIA listed activities concerning the excavation/infilling within a wetland since wetlands will be avoided through development planning and the adherence to the recommended wetland buffer zones.

9. CONCLUSION

The findings of the Specialist Wetland Assessment conducted by Eco-Pulse Consulting in October 2020, revealed that a total of two (2) wetlands (W01 & W02) are at risk of being potentially impacted during the construction and operational phases of the Waaihoek BESS development. The proposed development site falls within a freshwater ecosystem priority area (FEPA) quinary catchment (flagged in the DEFF screening tool), which implies that although the 'FEPA status' applies to the actual river reach within such a catchment, the shading of the whole catchment indicates that the surrounding land and smaller stream network need to be managed in a way that maintains the good condition of the main receiving FEPA river system. In this instance, since the development will not measurably impact on the FEPA river system but there is a risk of altered hydrology and sediment impacts occurring which could translate to the supporting stream network, the wetland specialist (Eco-Pulse) consulted the NFEPA ecosystem management guidelines contained in the NFEPA Implementation Manual (Driver *et al.*, 2011), and applied these where relevant to the development application. These include the following which has been addressed in the specialist wetland report through aligning mitigation recommendations accordingly:

- Unavoidable development must require special mitigation measures that would reduce the overall impact of the activity or development to low negative significance, or must require a biodiversity offset (*offset not required in this case*);
- Develop suitable and realistic mitigation measures;
- Determine rehabilitation requirements; and
- Design a monitoring programme that aims to track the impacts.

Due the nature and extent of the project (BESS and reservoir) the associated aquatic ecological risks and impacts have been assessed to be of 'low' ecological significance and are considered to be environmentally acceptable. Mitigation measures have been provided to reduce the risk of negatively impacting downstream watercourses (wetlands) which support downstream river FEPAs in the catchment, and with these implemented to specification, the risk of impacting on any river FEPAs will be negligible.

In terms of Strategic Water Source Areas (SWSAs), the DEFF screening tool also identified a 'Very High Sensitivity' in this regard. This is associated with the eastern portion of the site which is located within the 'Phongola-Drakensberg' area which has been identified as a SWSA. To provide some background: SWSA's are areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest and are considered national assets vital for South Africa's water security as they have the potential to contribute significantly to overall water quality and supply, supporting growth and

development needs and forming the foundational ecological infrastructure on which a great deal of built infrastructure for water services depends (Nel *et al*., 2013). The importance of managing this small fraction of land that contributes so vitally to our water security should be acknowledged at the highest level across all sectors as the deterioration of water quality and quantity in these areas can have a disproportionately large negative effect on the functioning of downstream ecosystems and the overall sustainability of growth and development in the regions they support. Investing in SWSA's is also an important mechanism for long-term adaptation to the effects on climate change on water provision, growth and development. According to Nel et al. (2013), appropriate management of these areas should include:

- Maintaining healthy functioning riparian zones and wetlands;
- Ensuring good agricultural management leads to soil conservation that supports the water cycle;
- Avoiding activities that reduce stream flow (e.g. irrigated agriculture and forestry plantations) and where this is not possible ensuring careful regulation of these activities;
- Minimizing ground water abstraction;
- Clearing invasive alien plants; and
- Restoring the hydrological functioning of degraded landscapes.

Given the location of the eastern wetland (W02) within a SWSA, the wetland ecologists have placed a particular emphasis in terms of managing and mitigating impacts through strict avoidance of direct impacts to wetlands, the provision of a rehabilitation strategy for wetlands should any accidental impacts take place and encouraging an approach to storm water management that reduced hydro-geomorphological risks through appropriate ecological guidance and best practice in storm water management.

It is recommended that all mitigation and management measure are adhered to, as per Chapter 7 of this report. Key mitigation recommendations include development layout recommendations to avoid wetlands and recommended buffer zones, best-practice management measures and controls to minimise impacts and reduce impact intensity where impacts cannot be avoided entirely and a rehabilitation strategy to rehabilitate any residual impacts to wetland habitat as a result of the proposed development.

The activities associated with the Waaihoek BESS project are considered Section 21(c) and 21(i) water use in terms of Section 21 and Chapter 4 of the National Water Act No. 36 of 1998 (NWA), and this is as a result of construction and operation phase activities set to take place within the DHSWS 'Regulated Area for Section 21 c & i, water use', i.e. within 500m of a wetland. As risks all fall within the 'Low' risk category / class, and the significance of the impacts was assessed as being low with appropriate mitigation applied, a General Authorization (GA) in terms of Section 39 of the NWA is most likely to be applicable at the project level. The DHSWS will still need to be approached to confirm this is the case and any further WULA requirements.

Please do not hesitate to contact Eco-Pulse Consulting directly should you have any queries or require further clarity on the findings and recommendations provided in this report.

Yours sincerely

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10. REFERENCES

CSIR (Council for Scientific and Industrial Research). 2010. National Freshwater Ecosystem Priority Areas (NFEPA). Council for Scientific and Industrial Research, Pretoria, South Africa.

Darwall, W.R.T., Smith, K.G., Allen, D., Seddon, M.B., Reid, G.M., Clausnitzer, V., Kalkman, V.J., 2009. Freshwater biodiversity: a hidden resource under threat. In: Vié, J.-C., Hilton-Taylor, C., Stuart, S.N. (Eds.), Wildlife in a Changing World. IUCN, Gland, Switzerland, pp. 43–54.

Driver, A., Nel, J.L., Snaddon, K., Murray, K., Roux, D.J., Hill, L., Swartz, E.R., Manuel, J. and Funke, N. 2011. Implementation Manual for Freshwater Ecosystem Priority Areas. Report to the Water Research Commission. 2011.

DWAF (Department of Water affairs and Forestry). 2005. A practical field procedure for identification and delineation of wetland and riparian areas. Edition 1, September 2005. DWAF, Pretoria.

EKZNW., 2007. Freshwater Systematic Conservation Plan: Best Selected Surface (Marxan). Unpublished GIS Coverage [Freshwater_cons_plan_2007], Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife, P. O. Box 13053, Cascades, Pietermaritzburg, 3202.

Jewitt, D. 2016. Conservation Targets and Status for Vegetation Types in KZN.

Kleynhans CJ, Louw MD, Graham M, 2008. Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity (Section 1, Technical manual) Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 377-08

Kotze, D. C., Macfarlane, D.M., & Edwards, R., 2020. A preliminary revision of the WET-EcoServices assessment tool for assessing the ecosystem services provided by wetlands and riparian areas. Unpublished report prepared by Eco-Pulse Environmental Consulting Services. Version 2.0.

Lawrence, D.P., 2007. Impact significance determination - Designing an approach. Environmental Impact Assessment Review 27 (2007) 730 - 754.

Macfarlane, D. M., Ollis, D. J., Kotze, D. C. 2020. WET-Health (Version 2.0): Developing a refined suite of tools for assessing the Present Ecological State of wetland ecosystems (WRC Project No. K5/2549).

Mucina, L. and Rutherford, M. C. (eds) 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Nel, J. L., Murray, K. M., AM Maherry, A. M., Petersen, C. P., DJ Roux, D. J., Driver, A., Hill, L., van Deventer, H., Funke, N., Swartz, E. R., Smith-Adao, L. B., Mbona, N., Downsborough, L. and Nienaber, S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. Report to the Water Research Commission. WRC Report No. 1801/2/11.

Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. (2011). Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

Ollis, D., Snaddon, K., Job. N. and Mbona. N. 2013. Classification system for wetland and other aquatic ecosystems in South Africa. User manual: inland systems. SANBI biodiversity series 22. SANBI Pretoria.

Partridge, T. C., Dollar, E. S. J., Moolman, J. and Dollar, L. H. 2010. The geomorphic provinces of South Africa, Lesotho and Swaziland: A physiographic subdivision for earth and environmental scientists. Transactions of the Royal Society of South Africa, 65: 1, 1 — 47.

Rivers-Moore, N.A. and Goodman, P.S., 2009. River and wetland classifications for freshwater conservation planning in KwaZulu-Natal, South Africa. African Journal of Aquatic Science 2010, 35(1): 61-72. NISC (Pty) Ltd and Taylor & Francis.

Rountree, M. W. Malan, H. L. and Weston, B. C. 2013. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0), Resource Directed Measures for the Protection of Water Resources. Report to the Water Research Commission and Department of Water Affairs. WRC Report No.

1788/1/12.

Rountree, M., Thompson, M., Kotze, D. C., Batchelor, A., and Marneweck, G. C. 2009. WETPrioritise: Guidelines for prioritising wetlands at national, regional and local scales. Technical report no. TT 337/09. Water Research Commission, Pretoria, South Africa.

Russell, W.B., 2009. WET-Rehab Methods: National guidelines and methods for wetland rehabilitation. WRC Report No. TT 341/09. Water Research Commission, Pretoria.

Russi D., ten Brink P., Farmer A., Badura, T., Coates D., Förster J., Kumar R. and Davidson N. 2013. The Economics of Ecosystems and Biodiversity for Water and Wetlands. IEEP, London and Brussels; Ramsar Secretariat, Gland.

Scott-Shaw, C.R and Escott, B.J. (Eds) (2011) KwaZulu-Natal Provincial Pre-Transformation Vegetation Type Map – 2011. Unpublished GIS Coverage [kznveg05v2_1_11_wll.zip], Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife, P. O. Box 13053, Cascades, Pietermaritzburg, 3202.

11. ANNEXURES

ANNEXURE A: Impact Significance Assessment Summary

Construction Phase Impact Significance Assessment												
Realistic 'Poor' (standard) Mitigation Scenario												
No.	**Impact Type**	**Status**	**Ultimate Ecological Consequences: Impact Intensity Ratings**				**Intensity**	**Extent**	**Duration**	**Probability**	**Significance**	**Confidence**
			Water resource management	**Ecosystem Conservation**	**Species Conservation**	**Direct Use Values**						
C1	Direct physical loss or modification of freshwater habitat	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Low	Surrounding Area	Long-term	Possible	Low	High
C2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Low	Local	Long-term	Highly Probable	Moderately Low	Medium
C3	Impacts to water quality	Negative	Irrelevant	Irrelevant	Irrelevant	Irrelevant	Low	Local	Long-term	Probable	Low	Medium
C4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Irrelevant	Irrelevant	Irrelevant	Irrelevant	Low	Local	Medium-term	Probable	Low	Medium
Realistic 'Good' (best-practical) Mitigation Scenario												
No.	**Impact Type**	**Status**	**Ultimate Ecological Consequences: Impact Intensity Ratings**				**Intensity**	**Extent**	**Duration**	**Probability**	**Significance**	**Confidence**
			Water resource management	**Ecosystem Conservation**	**Species Conservation**	**Direct Use Values**						
C1	Direct physical loss or modification of freshwater habitat	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Low	Site	Short-term	Unlikely	Low	High
C2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Low	Surrounding Area	Short-term	Possible	Low	Medium
C3	Impacts to water quality	Negative	Irrelevant	Irrelevant	Irrelevant	Irrelevant	Low	Surrounding Area	Short-term	Unlikely	Low	Medium
C4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Irrelevant	Irrelevant	Irrelevant	Irrelevant	Low	Surrounding Area	Short-term	Unlikely	Low	Medium

Operational Phase Impact Significance Assessment												
Realistic 'Poor' (standard) Mitigation Scenario												
No.	**Impact Type**	**Status**	**Ultimate Ecological Consequences: Impact Intensity Ratings**				**Intensity**	**Extent**	**Duration**	**Probability**	**Significance**	**Confidence**
			Water resource management	**Ecosystem Conservation**	**Species Conservation**	**Direct Use Values**						
O1	Direct physical loss or modification of freshwater habitat	Negative	Secondary or indirect impact	Irrelevant	Irrelevant	Irrelevant	Low	Surrounding Area	Long-term	Probable	Low	High
O2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Secondary or indirect impact	Irrelevant	Irrelevant	Irrelevant	Low	Local	Long-term	Highly Probable	Moderately Low	Medium
O3	Impacts to water quality	Negative	Secondary or indirect impact	Irrelevant	Irrelevant	Irrelevant	Low	Local	Long-term	Probable	Low	Low
O4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Low	Local	Long-term	Probable	Low	Medium
Realistic 'Good' (best-practical) Mitigation Scenario												
No.	**Impact Type**	**Status**	**Ultimate Ecological Consequences: Impact Intensity Ratings**				**Intensity**	**Extent**	**Duration**	**Probability**	**Significance**	**Confidence**
			Water resource management	**Ecosystem Conservation**	**Species Conservation**	**Direct Use Values**						
O1	Direct physical loss or modification of freshwater habitat	Negative	Secondary or indirect impact	Irrelevant	Irrelevant	Irrelevant	Low	Site	Long-term	Unlikely	Low	High
O2	Alteration of hydrological and geomorphological processes (flow, erosion & sediment regime changes)	Negative	Secondary or indirect impact	Irrelevant	Irrelevant	Irrelevant	Low	Surrounding Area	Long-term	Possible	Low	Medium
O3	Impacts to water quality	Negative	Secondary or indirect impact	Irrelevant	Irrelevant	Irrelevant	Low	Surrounding Area	Long-term	Possible	Low	Low
O4	Impacts to ecological connectivity and/or ecological disturbance impacts	Negative	Indirect Impact	Irrelevant	Irrelevant	Irrelevant	Low	Surrounding Area	Long-term	Possible	Low	Medium

ANNEXURE B: DWS Risk Matrix Assessment Table

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and i Water Use Risk Assessment Protocol)

Project Name:	Waaihoek BESS Development and Water Reservoir		
Date:	29/10/2020		
Name of Assessor:	Ryan Kok (Pr.Sci.Nat.)	**SACNASP Registration No(s).**	122290
Name of Reviewer:	Adam Teixeira-Leite *(Pr.Sci.Nat.)*		400332/13

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

Phase(s)	Activity	Aspect	Impact	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence Level (%)	Control measures	PES & EIS of Affected Watercourse
Construction	Establishment (construction) of all onsite infrastructure	Vegetation clearing and exposure of bare soils to erosive elements	C1: Direct physical loss or modification of wetland habitat	0	1	2	1	**1**	1	1	**3**	1	1	5	1	**8**	**24**	**Low**	80	• Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to buffer zones for wetlands, with planned development infrastructure to remain outside of the recommended wetland buffer zones. • Demarcate the edge of wetland buffers on the ground to avoid incursions into these areas. • Restrict access to wetland areas beyond the development footprint. • Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands, riparian areas and buffer zones and in accordance with the conceptual 'Wetland Rehabilitation Strategy'. • Implement appropriate ecological monitoring during construction and use findings to inform site management. • Construction phase method statement(s) to be developed and finalised prior to construction taking place, taking into consideration the wetland impact mitigation measures and requirements of the EMPr to be developed.	Wetland W01: 'B' PES, 'Moderately Low' EIS Wetland W02: 'B' PES, 'Moderately Low' EIS
		Increased runoff from bare soils and open trenches	C2: Alteration of hydrological and geomorphological processes	2	1	2	0	**1,25**	2	1	**4,25**	1	2	5	1	**9**	**38,25**	**Low**	60	• Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to buffer zones for wetlands, with planned development infrastructure to remain outside of the recommended wetland buffer zones. • Limit construction activities to the dry (winter) season where possible, to reduce erosion and sediment risks. • Address potential construction-phase erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control. • Temporary erosion and sediment control measures are to be implemented, with a greater level of need if construction proceeds into the summer (wet/rainy) period. Temporary erosion/sediment control to remain in place until construction has been completed and operational storm water management infrastructure is suitably in place and operating correctly. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible and in accordance with the conceptual 'Wetland Rehabilitation Strategy'. • Implement appropriate ecological monitoring during construction and use findings to inform site management. • Construction phase method statement(s) to be developed and finalised prior to construction taking place, taking into consideration the wetland impact mitigation measures and requirements of the EMPr to be developed.	

Phase(s)	Activity	Aspect	Impact	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence Level (%)	Control measures	PES & EIS of Affected Watercourse
		Concrete/cement mixing in the vicinity of watercourses & management of waste and potential pollutants	C3: Impacts to water quality	0	3	2	1	**1,5**	2	1	**4,5**	1	2	5	2	**10**	**45**	**Low**	60	• Limit construction activities to the dry (winter) season where possible, to reduce erosion and sediment risks. • Address potential erosion and sedimentation risks on site through the implementation of Best Management Practices (BMPs) in erosion and sediment control. • Sediment controls (e.g. silt fences/berms) should be implemented to reduce sediment inputs to the nearby wetlands. • Address potential spill and pollution risks on site through the implementation of Best Management Practices (BMPs) in spill and pollution control and hazardous substances management. • Rehabilitate any spill related impacts as soon as practically possible. • A suitable spill response and remediation plan is to be developed for the construction phase. • Implement appropriate ecological monitoring during construction and use findings to inform site management. • Construction phase method statement(s) to be developed and finalised prior to construction taking place, taking into consideration the wetland impact mitigation measures and requirements of the EMPr to be developed.	
		Vegetation clearing and exposure of bare soils to erosive elements & indirect disturbance from machinery and labourers	C4: Impacts to ecological connectivity and/or ecological disturbance impacts	0	0	1	2	**0,75**	2	1	**3,75**	1	2	5	2	**10**	**37,5**	**Low**	70	• Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to buffer zones for wetlands, with planned development infrastructure to remain outside of the recommended wetland buffer zones. • Demarcate the edge of wetland buffers on the ground to avoid incursions into these areas. • Restrict worker and machinery access to the active construction site and construction site camp areas only. • Prohibit the poaching of animals and/or collection of plants and biota from natural areas, including wetlands. • Temporary erosion/sediment control to be removed only once construction has been completed and operational storm water management infrastructure is suitably in place and operating correctly. • Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands, riparian areas and buffer zones and in accordance with the conceptual 'Wetland Rehabilitation Strategy'.	
Operation	Operation of BESS and Water Reservoir	Discharge of storm water runoff to the environment, leading to increased volumes and velocities of runoff water	O1: Direct physical loss or modification of freshwater habitat	0	0	2	1	**0,75**	1	2	**3,75**	2	1	5	1	**9**	**33,75**	**Low**	70	• Appropriate storm water management to be implemented with a focus on reducing erosion risk. • No solid waste dumping to take place within wetlands or buffers. • Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands, riparian areas and buffer zones and in accordance with the conceptual 'Wetland Rehabilitation Strategy'.	
			O2: Alteration of hydrological and geomorphological processes	2	1	3	0	**1,5**	2	2	**5,5**	2	2	5	1	**10**	**55**	**Low**	70	• Appropriate Storm Water Management Plan (SMWP) to be implemented with a focus on reducing downstream erosion risk. • Monitoring plan to be implemented for water quality and erosion/sediment. • Maintain storm water infrastructure as necessary through unblocking of drains, desilting where required, etc. • Implement and adhere to the recommended buffer zones for wetlands. • Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible and in accordance with the conceptual 'Wetland Rehabilitation Strategy'.	
		Litter/waste entrained in storm water & Potential for pollution due to battery leakage	O3: Impacts to water quality	0	3	2	2	**1,75**	2	2	**5,75**	1	1	5	2	**9**	**51,75**	**Low**	60	• Implement best practice stormwater management design. • Design the facility to contain any potential leakages from battery units and prevent environmental pollution risk. • Water pipelines associated with the water reservoir to be buried below ground to prevent exposure and damage.	
		Human activity & Alien plant colonisation of disturbed areas	O4: Impacts to ecological connectivity and/or ecological disturbance impacts	0	0	2	2	**1**	2	2	**5**	3	1	5	2	**11**	**55**	**Low**	70	• Strict avoidance of the delineated wetlands is to be made a priority and implement and adhere to buffer zones for wetlands. • Restrict worker and machinery access to the BESS facility and planned access roads only. • Eradicate and/or control Invasive Alien Plant species as necessary. • Should accidental/intentional incursions into or direct disturbance of wetlands occur, rehabilitate wetlands, riparian areas and buffer zones and in accordance with the conceptual 'Wetland Rehabilitation Strategy'.	

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Waaihoek Battery Energy Storage System and reservoir, south-east of Utrecht, Kwa-Zulu Natal

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

Details of Specialist, Declaration and Undertaking Under Oath

Page 1 of 3

1. SPECIALIST INFORMATION

Specialist Company Name:	Eco-Pulse Consulting cc			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	N/A
Specialist name:	Ryan Kok			
Specialist Qualifications:	B3c Environmental, B3c Hon & M3c Biological and Ecological Sciences			
Professional affiliation/registration:	Professional Natural Scientist - SACNASP, Reg. No.: 122290			
Physical address:	3 2nd Avenue, Hilton, 3245			
Postal address:	26 Mallory Road, Hilton, 3245			
Postal code:	3245	Cell:	072 507 7868	
Telephone:	033 343 3651	Fax:	N/A	
E-mail:	rkok@eco-pulse.co.za			

2. DECLARATION BY THE SPECIALIST

I, Ryan Kok, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

Eco-Pulse Consulting cc

Name of Company:

12/11/2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, RYAN KEK, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

Eco-Pulse Consulting

Name of Company

12/11/2020

Date

Signature of the Commissioner of Oaths

2020/11/12

Date

SOUTH AFRICAN POLICE SERVICE
2020 -11- 12
HILTON
KWAZULU-NATAL

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

CURRICULUM VITAE

Ryan Bradley Kok

Eco-Pulse Consulting

eco-pulse
environmental consulting services
26 Mallory Road, Hilton
3245, South Africa

PERSONAL DETAILS

Date of Birth: 1 March 1991
Identity Number: 9103015100087
Nationality: South African
Languages: English (Primary), Afrikaans (Secondary)

TERTIARY QUALIFICATIONS

Attendance	Certificate / Qualification
2014 - 2016	**Masters of Science (M.Sc.) Biological Science,** University of KwaZulu-Natal, Graduated *Summa Cum Laude* (Finishing Top 1% of the University), Specialized in Biodiversity and Conservational Research; Environmental Niche Modelling; and Ecology
2013	**Bachelor of Honours (B.Sc. Hon.) Biological Science,** University of KwaZulu-Natal, Specialized in Ecology (Certificate of Merit for Conservation Ecology).
2010 - 2012	**Bachelor of Science (B.Sc.) Environmental Science,** University of KwaZulu-Natal.

RECORD OF EMPLOYMENT

Year(s)	Position	Company
2017 – 2018	Intern	Eco-Pulse Consulting
2018 – 2020	Junior Scientist	Eco-Pulse Consulting
2018 – Present	Scientist	Eco-Pulse Consulting

POSITION AND RESPONSIBILITIES

Junior scientist and wetland ecologist at Eco-Pulse Consulting, with >3.5 years' experience in environmental consulting and undertaking specialist wetland/aquatic assessments biodiversity assessments. Current responsibilities include:

- Undertaking specialist wetland, river and biodiversity related assessments
- Specialist reporting
- Terrestrial ecological/biodiversity surveys
- Compiling Water Use License Applications (WULAs)
- Ecological monitoring (biomonitoring, water quality)
- Geographic Information Systems (GIS) analysis for range of strategic projects

RELEVANT EXPERTISE

Project Experience in the Environmental Sciences, Specialist Aquatic/Wetland Science/Ecology and Environmental Management fields:

- **Wetland related assessments and research:** Experience in wetland related studies, wetland delineation, present ecological state (PES) ecosystem services and ecological importance and sensitivity (EIS) assessments for wetland systems in KwaZulu-Natal.

- **Water Use Licensing:** Experience in assisting and completing numerous WULAs in KZN.
- **River-related studies:** Involved in projects where specialist fluvial geomorphology assessments were required; responsible for conducting baseline riparian vegetation (VEGRAI) and riparian habitat (IHI) for the R61 road development project between Margate and Port Shepstone.
- **Aquatic Bio-monitoring**: Involved/assisting in surveying of river channels, geomorphology assessments, water-quality monitoring and analysis, as well as wetland assessments for the various river and wetland systems impacted.
- **Biodiversity Assessments**: Involved/assisting in undertaking desktop and field-based terrestrial biodiversity studies for various project in KZN and Eastern Cape; part of the team responsible for assessment around KZN and Mpumalanga.
- **Invasive Alien Plants (IAPs) surveys**: Involved field surveys required for eThekwini's selected open spaces managed areas.
- **Development of EMFs** (Environmental Management Framework) for the Msunduzi Municipality (and the Msunduzi Municipality (Biodiversity and wetlands).
- **Geographic Information Systems (GIS):** Experienced in undertaking large GIS studies and analysis, for example undertaking wetland inventory and prioritization exercise for the City of Mbombela Municipality (4-year project) as well as a desktop PES assessment for the Ekurhuleni Bioregional Plan.

PROFESSIONAL MEMBERSHIPS AND AFFILIATATIONS

- Registered **Professional Natural Scientist** (*Pr. Sci. Nat*.) with SACNASP (South African Council for Natural Scientific Professions) under the following fields of practice: Ecological Science; Reg. No.: 122290
- Member of the **South African Wetland Society (SAWS)**; membership No. 941381
- Member of the **Society of Wetland Scientists** membersip No. 084810
- Member of the **Society for Ecological Restoration**
- Member of the **KZN Wetland Forum**
- Member and regular participant of the **Pickersgill's Reed Frog Forum**
- Part of the Provincial and SANParks working group for the National Wetland Database

HONOURS, AWARDS AND SPECIAL ACHIEVEMENTS

- Graduated Masters (MSc) *Summa Cum Laude* and in the Top 1% of UKZN in 2016 (final year mark 93%)
- Presented Masters work at The 12th African Small Mammals Symposium 2015 (Mantasoa, Madagascar) (2015)
- Attended and presented Masters work at the Zoological Society of Southern Africa Conference 2015 – ZSSA/ESSA Conference (Grahamstown, South Africa) (2015)
- Received the University of KwaZulu-Natal College Postgraduate Bursary (2014 - 2015)
- Received the NRF Innovation bursary (2013)
- Awarded Certificate of Merit for Conservation Ecology (2013)
- Awarded KwaZulu-Natal Colours by Mind Sports South Africa (2012)
- Awarded best environmental impact assessment group project submitted for Environmental Management course, book prize (2012)
- Awarded Olaf Wirminghaus commemorative award: for submitting the best project, awarded a Certificate of Merit for Behavioral and Reproduction Ecology, coupled a book prize and bursary (2012)

OTHER RELEVANT INFORMATION (E.G. PUBLICATIONS & CONFERENCES)

Publications include:

- Kok, R.B. et al. (2017). Does the removal of finder's share influence the scrounging decisions of herbivores?. Animal Behaviour. 133. 10.1016/j.anbehav.2017.09.023.

Conferences, Training and Workshops attended:

- Wetland Legislation Law application in wetland management (2020)
- An Introduction on How to Map and Groundtruth Wetlands (2020)
- How to align existing policies and green infrastructure for climate consciousness (2020)
- Pickersgill's Reed Frog Forum meeting held at Ushaka Education Centre, KZN (2019)

- Hakskeenpan and surrounding Kalahari pans tour facilitated by Betsie Milne, Northern Cape (2018)
- National Wetlands Indaba – 3-day conference held at Mittah Seperepere Convention Centre, Kimberley, Northern Cape (2018)
- Pickersgill's Reed Frog Forum meeting held at Twinstreams Environmental Education Centre, KZN (2018)
- One-day tree identification and forest ecology course run by Prof Eugene Moll, Hawaan Forest, Umhlanga, KZN (2018)
- WET-EcoServices field assessment held at the new Mpophomeni Tourism Centre, KZN (2018)
- Training course on the Department of Environmental Affairs Screening tool held at Ezemvelo KZN Wildlife Auditorium PMB, Queen Elizabeth Park, Pietermaritzburg, KZN (2018)
- WET-EcoServices seminar given by Donovan Kotze held at UKZN Main Campus, Pietermaritzburg, KZN (2018)
- World Wetlands day Workshop at the Esihle Science Discovery Centre, Northern KZN (2018)
- Training course on Soil Classification and Land Capability held at Cedara College, KZN (2018)
- National Wetlands Indaba – 4-day conference held at the Wild Coast Sun, KZN (2017)

Other skills (e.g. computer literacy, etc.):

- GIS Systems: Very Competent in ArcGIS 10, QGIS and Google Earth – Mapping, modelling and data analysis.
- Microsoft Windows: Highly competent – Full functionality and file storage.
- Microsoft Excel: Competent – Data handling & manipulation. Calculations, Pivot tables, Graphs, higher level functionality.
- Microsoft Word: Very competent – Report writing skills including general documentation, scientific reports and popular publications (Graphs, graphics, tables).
- Microsoft Power Point: Highly competent – Good presentation skills.
- Competent in topographic surveying using a standard dumpy level and staff.

RELEVANT PROJECT EXPERIENCE

PROJECT	TASKS/RESPONSIBILITIES & DELIVERABLES	Date Completed
OR Tambo Biodiversity Sector Plan – Eastern Cape	• Data collection • GIS specialist support and analysis • GIS mapping and collaboration	Ongoing
Western Waste Management Facility – Specialist Aquatic Studies	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	Ongoing
Ethekwini IAP Survey 2020	• Field based surveys • Invasive plant identification • Data capture • GIS data capture	Ongoing
Ethelbeth Rd Development Water Use Licence Application	• Public Participation Process • Information Gathering & Compilation of Outstanding Environmental Specialist Studies • Completion of Relevant WULA Forms • Compilation of the IWWMP	Ongoing
Umlaas Gate Development Water Use Licence Application	• Public Participation Process • Information Gathering & Compilation of Outstanding Environmental Specialist Studies • Completion of Relevant WULA Forms • Compilation of the IWWMP • Surface and ground water monitoring programme • Environmental Contingency Plan	Ongoing

PROJECT	TASKS/RESPONSIBILITIES & DELIVERABLES	Date Completed
Greenlands Water Use Licence Application	• Public Participation Process • Information Gathering & Compilation of Outstanding Environmental Specialist Studies • Completion of Relevant WULA Forms • Compilation of the IWWMP • Surface and ground water monitoring programme • Environmental Contingency Plan	Ongoing
SANRAL R61 Road Upgrade - WULA	• Water Use License Application for R61 Road upgrade	Ongoing
Waaihoek Battery Storage Facility – Freshwater Impact Assessment	• Wetland zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Setting management objectives for water resources/ freshwater ecosystems. • Identification, description and assessment of freshwater ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2020
Engen Cato Ridge Development	• Wetland and river/riparian zone delineation and classification.	2020
Transnet Pipeline Kendal 3 Diesel Spill – Wetland Assessment	• Infield environmental impacts and extent • Data capture • Wetland impact summary report • Wetland rehabilitation plan and method statements	2020
Transnet Pipeline Balfour ULP Spill – Wetland Assessment	• Infield environmental impacts and extent • Data capture • Wetland impact summary report • Wetland rehabilitation plan and method statements	2020
Transnet Pipeline Grey 2 Diesel Spill – Wetland Assessment	• Infield environmental impacts and extent • Data capture • Wetland impact summary report • Wetland rehabilitation plan and method statements	2020
Transnet Pipeline Kibler Diesel Spill – Wetland Assessment	• Infield environmental impacts and extent • Data capture • Wetland impact summary report • Wetland rehabilitation plan and method statements	2020
Conduct A Wetlands Inventory and Ecological Integrity Assessment for The City of Mbombela (Phase 4)	• Desktop Wetland Mapping • Characterise and Classify Wetlands • Wetland PES, EIS and Ecosystem Services Assessment • Wetland Prioritisation for Rehabilitation • Provision of Landownership Information • Identify areas for Possible Community-Based Adaptation Projects and/or Partnerships	2020
SANRAL N2 Mthatha Community Access Road Upgrades	• Project Leader • Wetland delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2020
Mthlathuze Foskor Gypsum Spill Wetland Rehabilitation Plan	• Water and soil sampling & reporting • Infield environmental impacts and extent • Data capture • Wetland and terrestrial impact summary report • Wetland and terrestrial rehabilitation plan and method statements	2020
Brookdale Housing Project – Wetland Assessment (Section 24G)	• Wetland zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Section 24G application in terms of rectification of illegal listed activities under NEMA. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction and monitoring guidelines • Conceptual Rehabilitation and Management Plan.	2020
Ekurhuleni Bioregional Plan	• GIS support • Desktop Wetland PES, EIS and Ecosystem Services Assessment	2020
Supporting investment in wetland rehabilitation in the City of Kigali (Rwanda)	• GIS support	2020

PROJECT	TASKS/RESPONSIBILITIES & DELIVERABLES	Date Completed
oHlanga Catchment Management Plan	• Desktop landcover mapping • GIS support	2020
Conduct A Wetlands Inventory and Ecological Integrity Assessment for The City of Mbombela (Phase 3)	• Desktop Wetland Mapping • Characterise and Classify Wetlands • Wetland PES, EIS and Ecosystem Services Assessment • Wetland Prioritisation for Rehabilitation • Provision of Landownership Information • Identify areas for Possible Community-Based Adaptation Projects and/or Partnerships	2020
Mondi Underground Fire Procedure	• Document review	2020
Cotswold Square Retail Centre Wetland Study	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2020
Proposed Expansion of Parks Paddock Farm in Fort Nottingham, KwaZulu-Natal	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2020
Wetland Rehabilitation Offset for TradeZone 2 Mapping	• GIS support	2019
Kindlewood Estate Ecological Assessment	• Ecological Audit and Environmental Recommendation • Presentation to the Client and Committee	2019
DTP ASP Wetland Rehabilitation Plan & Offset Support	• GIS Support	2019
Specialist Wetland Delineation Study and Risk Assessment for the property Rem of Portion 444 and Portion 442 of 862, at Tongaat, eThekwini Municipality, KwaZulu-Natal	• Wetland and river/riparian zone delineation and classification. • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning guidelines	2019
Water Use Licence Application (WULA) for the Existing One Logix WWTW At Umlaas Road, KZN	• Public Participation Process • Information Gathering & Compilation of Outstanding Environmental Specialist Studies • Completion of Relevant WULA Forms • Compilation of the IWWMP • Surface and ground water monitoring programme • Environmental Contingency Plan	2019
Tronox Everglades Expansion	• Wetland delineation and classification. • Frog surveys	2019
Hazelmere Water & Sanitation Project	• Field Work • Wetland and river/riparian zone delineation and classification.	2019
Specialist Freshwater Ecosystem and Terrestrial Vegetation Impact Assessments to Inform The BA/WULA for the Proposed Nonoti Coastal Beach Resort Between Blythedale And Zinwazi, KZN North Coast	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2019
Adam's Mission Ecological Assessment (EWT)	• Vegetation survey plots	2019
Specialist Freshwater Wetland & Riparian Habitat Delineation Study	• Wetland and river/riparian zone delineation and classification. • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2019

PROJECT	TASKS/RESPONSIBILITIES & DELIVERABLES	Date Completed
Specialist Aquatic Risk Assessment to Inform WULA Requirements for the Existing Gravel Quarry at Ashburton, KZN	• Wetland and river/riparian zone delineation and classification. • DWS Risk Matrix Assessment	2019
Simuma Oil Spill Aquatic Biomonitoring	• River biomonitoring • Reporting	2019
Vulindlela Draft Status Quo	• POC assessment • GIS checking and Mapping • Analysis & Draft SEA Report • Data Refinement	2019
Conduct A Wetlands Inventory and Ecological Integrity Assessment for The City of Mbombela (Phase 2)	• Desktop Wetland Mapping • Characterise and Classify Wetlands • Wetland PES, EIS and Ecosystem Services Assessment • Wetland Prioritisation for Rehabilitation • Provision of Landownership Information • Identify areas for Possible Community-Based Adaptation Projects and/or Partnerships	2019
SANRAL R61 Road, between (1) Mthamvuna River & Port Edward, (2) Port Edward & Mpenjati River & (3) Mpenjati River & Mbizana River within the KwaZulu-Natal Province	• Wetland and river/riparian zone delineation and classification. • Rapid wetland assessment (PES, ecosystem services and EIS). • Rapid river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2019
Improving the management of peatlands in the Zululand / Maputaland coastal region - Peatland Fire Management	• Field Work • Updating Trench/Drain Map and Database • Defining Preliminary Management Prescriptions for Peatlands	2018
Conduct A Wetlands Inventory and Ecological Integrity Assessment for The City of Mbombela (Phase 1)	• Desktop Wetland Mapping • Characterise and Classify Wetlands • Wetland PES, EIS and Ecosystem Services Assessment • Wetland Prioritisation for Rehabilitation • Provision of Landownership Information • Identify areas for Possible Community-Based Adaptation Projects and/or Partnerships	2018
Greenlands Wetland & Aquatic Assessment	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2018
Umlaas Road Development Wetland & Aquatic Assessment	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2018
726 Town Bush Road Oak Park Parkview Estate	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2018
La Mercy Cemetery Wetland Assessment	• Wetland delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Setting management objectives for wetlands. • Identification, description and assessment of aquatic ecological impacts. • Provision of planning, construction, operation, rehabilitation and monitoring guidelines.	2018
KSIA Emergency Access Roads Ecological Impact Assessment	• Wetland delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Setting management objectives for wetlands. • Identification, description and assessment of aquatic ecological impacts.	2018

PROJECT	TASKS/RESPONSIBILITIES & DELIVERABLES	Date Completed
	• Provision of planning, construction, operation, rehabilitation and monitoring guidelines.	
Buffelsdraai Biodiversity Assessment 2018	• Field Work • Vegetation surveys • Invertebrate surveys	2018
ERF746 Queensburgh Wetland Report Update	• Updating the wetland report to include aquatic impact assessment and DWS Risk Matrix	2018
Draycott Roads Wetland Assessment	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2018
Durnacol Dannhauser Pipeline Wetland Demarcation	• Demarcation of all wetlands along the construction route	2018
Darvill WWTW Constructed Wetland Specialist Freshwater Assessment	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines • Frog Surveys	2018
Collisheen Estate Wetland Delineation	• Detailed wetland and river/riparian zone delineation and classification.	2018
OneLogix_ERF 30 Umlaas Rd Wetland Assessment	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2018
Wetland Habitat Impact Assessment to inform the requirements of the Directive issued by eThekwini Municipality for Southway Freight concerning unauthorized activities within a watercourse (wetland) in the Prospecton area (south Durban basin), eThekwini Municipality, KZN.	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of offset requirements	2018
Specialist Wetland Assessment and Protected Plant Survey for the Crude Import Pipeline Replacement at South Durban, eThekwini Municipality, KZN	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2018
Verulam Mall	• Wetland and river/riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline river/ aquatic assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts • Provision of planning, construction, operation, rehabilitation and monitoring guidelines	2018
THD Open Plan Master Plan	• Desktop Wetland Mapping • Characterise and Classify Wetlands • Integration of wetland data	2018
Triple A Beef	• Field Work • Assisting with fish surveys • Water sampling • Wetland delineation and classification	2018

PROJECT	TASKS/RESPONSIBILITIES & DELIVERABLES	Date Completed
Mvoti River Sand Mining Wetland Aquatic Assessment	• Field Work • Assisting with fish surveys • Wetland delineation and classification.	2018
DTPC Offset Planning Support for the TradeZone 2 development	• Field Work • GIS mapping	2018
P125 Road Upgrade	• Wetland delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Setting management objectives for wetlands. • Identification, description and assessment of aquatic ecological impacts. • Provision of planning, construction, operation, rehabilitation and monitoring guidelines.	2018
South Africa-Swaziland-Mozambique Border Patrol Road Aquatic & Terrestrial Ecological Assessments	Potential Occurrence Assessment	2018
Portion 377 of 247 Cottonlands Wetland Assessment	• Wetland and river/ riparian zone delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS). • Baseline aquatic/ river assessment (PES and EIS). • Setting management objectives for water resources/ aquatic ecosystems. • Identification, description and assessment of aquatic ecological impacts. • Provision of planning, construction, operation, rehabilitation and monitoring guidelines.	2018
Tongaat Hulett Inyaninga Wetland Offset Site	• Wetland delineation and classification. • Well Monitoring • Frog surveys	2018
LAB Wetlands SA Implementation Project Amathole	• Desktop GIS analysis	2018
Improving the management of peatlands in the Zululand / Maputaland coastal region	Consolidate and expand on the available baseline dataset on peatland distribution, fire disturbance history and the distribution of drains in wetlands to inform further planning. • Initial mapping of fires and drains in open areas • Undertaking a benchmarking field trip • Consolidation of field data and reporting • Wetland delineation and classification	2018
National Wetland Indaba Case Study	• Wetland delineation and classification. • Baseline wetland assessment (PES, ecosystem services and EIS).	2017
Msunduzi EMF	• Land-cover mapping and development of species layers. • GIS mapping and interpretation. • Liaising with specialists and compiling updated species data. • Assistance in the conservation planning process. • Report production.	2017

CURRICULUM VITAE

Adam Teixeira-Leite, *Pr.Sci.Nat*

Eco-Pulse Consulting

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environmental consulting services

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3245, South Africa
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ateixeira@eco-pulse.co.za

PERSONAL DETAILS

Date of Birth:	9 March 1984
Identity Number:	8403095097083
Nationality:	South African
Languages:	English, Afrikaans (second language), German (third language)

TERTIARY QUALIFICATIONS

Degree(s) obtained	Institution/Date
BSc Envs: Degree in Environmental Science (Earth Sciences Stream)	University of KwaZulu-Natal (2003 – 2006)
BSc Hons Envs: Honours degree in Environmental Science (wetland ecology and management) *(Graduated Cum Laude)*	University of KwaZulu-Natal (2007)
MSc Environmental Science (in prep). *Thesis deals with monitoring of wetland rehabilitation outcomes at a biodiversity offset site in northern KZN.*	University of KwaZulu-Natal (2019 - current)

RECORD OF EMPLOYMENT

Year(s)	Position	Company
2008 – 2010	Environmental Consultant	Institute of Natural Resources
2010 – 2011	Contracted Consultant	Institute of Natural Resources
2011 – 2012	Part time lecturer	University of KZN (Edgewood)
2011 - Present	Senior Scientist	Eco-Pulse Consulting

POSITION AND RESPONSIBILITIES

Senior scientist and wetland/terrestrial ecologist at Eco-Pulse Consulting, with 12 years' experience in environmental consulting and undertaking specialist wetland/aquatic assessments and terrestrial biodiversity assessments. Current responsibilities include:

- Undertaking specialist wetland, river and biodiversity related assessments for a range of clients
- Specialist reporting
- Drafting rehabilitation plans for wetlands, rivers/riparian areas and terrestrial habitat types
- Terrestrial ecological/biodiversity, invasive alien plant and vegetation surveys
- Wetland and biodiversity offsets
- Compiling Water Use License Applications (WULAs)
- ECO compliance monitoring work (Environmental Control Officer)
- Environmental Auditing
- Ecological monitoring (biomonitoring, water quality)
- Liaising with clients

- Project management
- Review of reports and deliverables
- Peer reviews
- Supervising and mentoring of junior scientists (>6 years' experience)
- Facilitating workshops and presenting on outcomes of projects

RELEVANT EXPERTISE

Project Experience in the Environmental Sciences, Specialist Aquatic/Wetland Science/Ecology and Environmental Management fields:

- **Wetland related assessments and research:** Extensive experience in wetland-related studies for a number of wetland systems in KwaZulu-Natal, Eastern Cape and Gauteng including: wetland delineation, Wet-Health functional assessments, Wet-Ecoservices assessments, compilation of wetland management plans (for Mount Moreland wetland system for example) and involvement in the 'quantifying the benefits of wetlands in the upper Orange Senqu Basin' as part of the EU funded NeWater study. Wetland rehabilitation planning for SANBI: Working for Wetlands in KZZ and Free State Provinces. Involved with other wetland rehabilitation and management projects (e.g. Fairbreeze Mine Biodiversity Offset Management Plan, Edendale Business/Industrial Park).
- **Wetland rehabilitation:** Extensive experience in planning wetland rehabilitation projects for various developers as well as the wetland ecologist for SANBI Working for Wetlands Programme (in KZN and Free State between 2012 to 2016).
- **Wetland & Biodiversity Offsets:** Experience in the application of biodiversity offsets to compensate for environmental loss related to large-scale mining projects (eg. Tronox Fairbreeze Mine Biodiversity Offset Management and Rehabilitation Plan, DubeTradePort Wetland Offset Strategy, DTP ASP Illovo Wetland Offset Plan).
- **Water Use Licensing:** Experience in leading and completing numerous WULAs in KZN and the Eastern Cape.
- **Environmental Auditing:** Environmental auditor for the King Shaka International Airport during the construction phase of the project; Environmental auditor for the SANRAL N2 Interchange development linking to the King Shaka International Airport - including report back to relevant environmental authorities and stakeholders (Construction Monitoring Committee and Swallows/Wetland Forum). Auditor responsible for auditing environmental and economic/social compliance with the PCIS (Procedures, Criteria, Indicators and Standards) for sustainable forestry management for a range of Department of Forestry (DAFF) managed forestry plantations in KZN and EC provinces. Environmental Auditor for NPC InterCement rock quarries in KZN.
- **River-related studies:** Various projects where specialist fluvial geomorphology assessments were required (for example: work done for the Lesotho Highlands Development Agency pertaining to the Senqu River and Katse Dam); part of team involved in River Reserve assessment for the uMzimkhulu River; responsible for conducting baseline riparian vegetation (VEGRAI) and riparian habitat (IHI) for the R61 road development project between Umthatha and Port St Johns, Eastern Cape.
- **Aquatic Bio-monitoring**: involved in surveying of river channels, geomorphology assessments, water-quality monitoring and analysis, as well as wetland assessments for the various river and wetland systems impacted by the King Shaka International Airport project
- **Biodiversity Assessments**: involved in undertaking desktop and field-based terrestrial biodiversity studies for various project in KZN and Eastern Cape; part of the team responsible for developing a Biodiversity Sector Plan for the Ugu District Municipality, KZN. Extensive experience in undertaking municipal invasive alien plant surveys, prioritization studies and audits.
- **Development of EMFs** (Environmental Management Framework) for the Umshwathi Municipality (and the Msunduzi Municipality (Biodiversity and wetlands).
- **WRC projects** (for example project on National Wetland Buffers Guidelines and Wetland Offsets guidelines).
- **Forestry Audits:** auditor responsible for auditing compliance of DAFF managed plantations against the PCI&S framework in KZN and Eastern Cape.
- **Project Management:** including management of team involved in bio-monitoring at King Shaka International Airport and management of specialist aquatic monitoring team for Umgeni Bulk Water Transfer Project. Management and mentoring of junior scientists for a number of recent projects in KZN and the Eastern Cape Province, South Africa.

- **Mentorship & training**: >6 years' experience in mentoring and training junior scientists in the field of wetland science and terrestrial ecological assessments.

PROFESSIONAL MEMBERSHIPS AND AFFILIATATIONS

- Registered **Professional Natural Scientist** (*Pr. Sci. Nat.*) with SACNASP (South African Council for Natural Scientific Professions) under the following fields of practice: Ecological Science and Environmental Science since 2013
- Founding member of the **South African Wetland Society (SAWS)**; membership No. 7OY8XFWD
- Current board member and trustee of the SAWS for the period 2019-2020
- Member of the KZN Wetland Forum
- Member of the eThekwini Biodiversity Forum
- Member of the National Business and Biodiversity Offsets Forum
- Member of the KZN Forest Conservation Network
- Member of the Freshwater Ecosystem Network
- Member of WESSA (Wildlife & Environment Society South Africa), Member No. MB1242036
- Volunteer member of Green Peace, South Africa (Durban)
- Supporter of 'A Rocha': International Christian Conservation NGO/NPO

HONOURS, AWARDS AND SPECIAL ACHIEVEMENTS

- Finished in the Top 20 in the greater Durban region for Matric Finals in 2001
- Scholarship for outstanding achievement received in 2005
- Scholarship based on merit obtained in 2007 towards an Honours degree in Environmental Science
- Graduated with dean's commendation (final year mark 85%) in 2006
- Graduated Honours Cum Laude in 2007

OTHER RELEVANT INFORMATION (E.G. PUBLICATIONS & CONFERENCES)

Publications include:

- Sullivan, CA, Macfarlane, D, Dickens, C, Mander, M, Bonjean, M, Teixeira-Leite, A & Pringle, C 2008. *Keeping the benefits flowing and growing: quantifying the benefits of wetlands in the upper Orange-Senqu Basin*. Report to NeWater, a project funded under the Sixth Research Framework of the European Union, Institute of Natural Resources, Pietermaritzburg, South Africa. Paper available online at: http://www.newater.info/index.php?pid=1065

Conferences, Training and Workshops attended:

- 5 day National Wetlands Indaba held in Kruger National Park (2008)
- 2 day Workshop on Habitat Creation as Offset for Coastal Development held in Richard's bay (2009)
- 1 day IAIA (International Association of Impact Assessment) annual conference held in Ballito (2009)
- 2 day course on the advanced use of Wet-Health in wetland functional assessment held at CEAD (Centre for Environment and Development), University of KwaZulu-Natal (Pietermaritzburg Campus (2009)
- 2 day Eskom Distribution Environmental Screening Document Course (DESD), Eskom Department of Land Development, New Germany, Durban (2009)
- 1 day NFEPA (National Freshwater Ecosystem Priority Areas) workshop at Ezemvelo KZN Wildlife Offices, Queen Elizabeth Park, Pietermaritzburg, KZN (2011)
- 3 day Wetlander Workshop at the Zaalklapspruit wetland (Mpumalanga) as part of the SANBI Working for Wetland Programme to discuss approaches to wetland health and functional assessment as well as monitoring recovery of wetland post-rehabilitation (2014)
- 1 day workshop: Business and Biodiversity Network in Mount Edgecombe, Durban, KZN (2015)
- 3 day advanced and speiclaist training in the application of the AWS (Alliance for Water Stewardship) International Water Stewardship Standard (2016)
- 2 day course through ALUT on grassland species identification and veld condition assessment (2017)
- 4 day National Wetlands Indaba held at the Wildcoast Sun in KZN (2017)

Other skills (e.g. computer literacy, etc.):

- GIS Systems: Competent in Arc View, ArcGIS 9 and 10, QGIS and Google Earth – Mapping, modelling and data analysis.
- Microsoft Windows: Competent – Basic functionality and file storage.
- Microsoft Excel: Very Competent – experience in data handling & manipulation. Calculations, Pivot tables, Graphs, higher level functionality.
- Microsoft Word: Highly competent – Excellent report writing skills including general documentation, scientific reports and popular publications (Graphs, graphics, tables).
- Microsoft Power Point: Highly competent – Excellent presentation skills.
- Competent in topographic surveying using a standard dumpy level and staff

PAST AND EXISTING CLIENTS

	Client Name	Location	Contact	Contact Details
1	**GIBB**	Westville, eThekwini, KZN	Ms. Robin Phillips	rphillips@gibb.co.za 084 695 1648
2	**Thorn EX**	Hilton, KZN	Ms. Marita Thornhill	thornhillm@thorn-ex.co.za 084 5014665
3	**SRK Consulting**	Westville, eThekwini, KZN	Ms. Phillipa Emanuel	PEmanuel@srk.co.za 083 651 3462
4	**Ground Water Consulting Services (GCS)**	Kloof, eThekwini, KZN	Mr. Chris Wright	chris@gcs-sa.biz 031 764 7130
5	**Afzelia Environmental Consulting**	Morningside, eThekwini, KZN	Mr. Andrew Batho	andrew@afzelia.co.za 083 601 9411
6	**Tronox KZN Sands**	Mtunzini, KZN	Mr. Nick Okello	Nick.Okello@tronox.com 072 133 5466
7	**Aurecon**	Cape Town, Western Cape	Mr. Fareed Nagdi	Fareed.Nagdi@aurecongroup.com 083 792 0872
8	**Kerry Seppings (KSEMS)**	Hillcrest, eThekwini, KZN	Mr. Colin Holmes	colin@ksems.co.za 072 291 2313
9	**Department of Forestry & Fisheries (DAFF)**	Pretoria, Gauteng	Ms. Makhwena	073 652 4040
10	**SANBI,DEA**	Free State	Mr Andre Beetge	ABeetge@environment.gov.za
11	**Zululand Anthracite Colliery (ZAC)**	Ulundi, KZN	Mr Isaac Dindi	isaacd@zulac.co.za 071 021 0444
12	**eThekwini Municipality (EPCPD)**	eThekwini, KZN	Mr Bheka Nxele	Bheka.Nxele@durban.gov.za 027 82 7809 499
13	**Guy Nicholson Consulting**	Kloof, eThekwini, KZN	Mr Guy Nicholson	guyn@saol.com 082 772 9941
14	**E&D Consulting**	Empangeni, KZN	Mr Paul Scherzer	paul@edcs.co.za 084 207 6031
15	**Metamorphosis Environmental Consulting**	Hillcrest, eThekwini, KZN	Ms. Vicki King	vicki@metamorphosisdbn.co.za 076 420 1441
16	**Synergistics Environmental Consulting**	Howick, KZN	Mr. Matthew Hemming	matthew@synergistics.co.za
17	**Mhlathuze Water**	Richards Bay, KZN	Ms. Nonhle Makhayna	nmakhanya@mhlathuze.co.za +27 35 902 1016
18	**Ezemvelo KZN Wildlife**	Pietermaritzburg, KZN	Mr. Boyd Escott	escottb@kznwildlife.com
19	**NCC Environmental Services**	Western Cape	Mr. Christian Gerhardt	christiang@ncc-group.co.za 072 261 0301
20	**Terreco**	Eastern Cape	Ms. Jaclyn Smith	smithj@terreco.co.za 072 555 0464 / 043 721 2344
21	**Triplo 4 Consulting**	Ballito, KZN	Ms. Chen Read	chen@triplo4.com 072 049 0888
22	**Janet Edmonds Consulting**	Pietermaritzburg, KZN	Ms. Janet Edmonds	janet@jecenviro.co.za 082 828 7953
23	**Wildlands Conservation Trust**	Hilton, KZN	Mr. Andrew	andreww@wildlands.co.za

Client Name		Location	Contact	Contact Details
			Whitley	071 875 7241
24	**Green Door Environmental**	Hilton, KZN	Ms. Rebecca Bowd	rebecca@greendoorgroup.co.za 072 181 4263
25	**Enviro Edge**	Kloof, eThekwini, KZN	Mr. Steven Whitaker	steven@enviroedge.co.za 071 140 8350
26	**RHDHV**	Pinetown, eThekwini, KZN	Ms. Humayrah Bassa	Humayrah.Bassa@rhdhv.com 031 719 5551 / 083 642 7077
27	**Graham Projects**	Ballito, KZN	Mr. Mike Graham	grahamprojects@mweb.co.za 083 456 8787
28	**Isolendalo**	Margate, KZN	Mr Welcome Nogobela	wnogobela@isolendalo.co.za 039 315 0437 / 083 408 5737
29	**K2M Consulting**	eThekwini, KZN	Ms. Simitha Bechan	simitha@k2m.co.za 072 602 7669
30	**Green Scene Environmental**	eThekwini, KZN	Ms. Felicity Swanepoel	felicity@green-scene.co.za 071 355 0266
31	**Savannah SA**	Richards Bay, KZN	Ms. Dilona Simoai	dilona@savannahsa.com 011 656 3237
32	**Dube TradePort**	eThekwini, KZN	Mr Zama Dlamini	Zama.Dlamini@dubetradeport.co.za
33	**Transnet**	Richards Bay, KZN	Ms. Nkuli Hadebe	Nonkululeko.Hadebe@transnet.net 035 9053849
34	**Natal Portland Cement (NPC) / InterCement**	eThekwini, KZN	Ms. Avanti Maharaj	AAMaharaj@intercement.com 062 514 0058
35	**OneLogix (PTY) Ltd**	Camperdown, KZN	Mr Dawie van der Merwe	Dawie.VanDerMerwe@onelogix.com 076 812 3702
36	**Goswell Developments**	Cato Ridge, KZN	Mr Douglas Goswell	GD@goswell.co.za 031 782 1957
37	**BGES**	KZN	Ms. Nonku Mbasane	Nonku.mbasane@beyondges.co.za 072 172 8374
38	**Golder**	Gauteng	Ms Riana Munnik	RMunnik@golder.co.za 082 809 2341

RELEVANT PROJECT EXPERIENCE

Project Name	Client	Location	Date Complete	Project Description
NPC Margate Quarry Environmental Audit	NPC / InterCement	Margate, KZN	Current Project	Environmental Compliance Audit against the EMPr for NPC's tillite quarry operation at Margate.
DTP ASP Illovo Wetland Offset Plan	Dube TradePort Corporation (DTPC)	Illovo, KZN	Current Project	Wetland assessment and wetland offset plan for Automotive Supplier Park development.
One Logix WWTW WULA	OneLogix	Camperdown, KZN	Current Project	Water Use License Application for mini sewer treatment plant (WWTW).
Wildcoast Stone Quarry Aquatic Assessment + WULA	SLR Consulting	Eastern Cape	Current Project	Wetland/aquatic baseline assessment and impact assessment and WULA.
Sterkspruit Aggregates WULA	Natal Portland Cement	eThekwini KZN	Current Project	Water Use License Application for existing quarry site.
South Coast Stone Crushers WULA	Natal Portland Cement	Margate, KZN	Current Project	Water Use License Application for existing quarry site.
Fairbreeze Mine Siyaya Wetland Offset	Tronox KZN Sands	Mtunzini, KZN	Current Project	Wetland offset and rehabilitation plan.
Goswell Industrial Development	Goswell Developments	Cato Ridge, KZN	Current Project	Wetland/aquatic and terrestrial biodiversity assessment for new industrial platforms development.
Simuma oil spill biomonitoring	NPC / InterCement	Port Shepstone, KZN	2019	Aquatic Biomonitoring (SASS5 and fish) for recent oil spill on the Mzimkhulwana at InterCement's

Project Name	Client	Location	Date Complete	Project Description
				Simuma Factory.
Mdloti River Sand Mining	BGES	Verulam, KZN	2019	Specialist aquatic assessment to inform sand minign application on the Mdloti River.
Sundumbili WWTW Upgrade	RHDHV	Mandeni, KZN	2019	Specialist Wetland/aquatic and terrestrial biodiversity assessment for the upgrading of the regional WWTW at Sudumbili, Mandeni.
NPC Sterkspruit Quarry Environmental Audit	NPC / InterCement	Cliffdale, eThekwini, KZN	2019	Environmental Compliance Audit against the EMPr for NPC's quartzite quarry operation at Sterkspruit, Cliffdale.
Fairbreeze Mine Baseline Monitoring Report	Tronox KZN Sands	Mtunzini, KZN	2019	Undertaking baseline ecological monitoring to inform wetland offset planning.
ERF30 Umlaas Road WULA	OneLogix	Camperdown, KZN	2019	Water Use License Application for new OneLogix vehicle logistics facility.
DTP Hlawe Trunk Sewer Line Audit	Dube TradePort Corporation (DTPC)	KSIA / DTP, eThekwini, KZN	2019	Undertaking environmental audit (wetlands) for the Hlawe Trunk Sewer Pipeline at DTPC / KSIA.
Widenham WULA	Hibiscus Retirement Village	Widenham, eThekwini, KZN	2018	Specialist wetland/aquatic assessment and Water Use License Application for retirement village.
Hillside Aluminium Smelter WULA	Golder	Richards Bay, KZN	2018	Wetland assessment to inform WULA for Hillside Alumnimium Smelter
ERF 104/105 Drummond WULA	TJ Architects	Drummond, eThekwini, KZN	2018	Specialist wetland/aquatic assessment and Water Use License Application for mixed-use development.
Richlands Estate WULA	Delcairn Investments	Kloof, eThekwini, KZN	2018	Specialist wetland/aquatic assessment and Water Use License Application for housing estate development.
Fairbreeze Mine Biodiversity Offset Management Plan	Tronox KZN Sands	Mtunzini, KZN	2018	Development of a biodiversity offset plan, from strategic level to conceptual and detailed rehabilitation plans, operational management plans and monitoring schedules.
Umgeni Water Pipeline Aquatic and Wetland Assessment: Mhlabatshane	SiVEST/Procura	KZN	2017	Wetland and aquatic assessment and impact assessment.
Umgeni Water Pipeline Aquatic and Wetland Assessment: Mhshwathi	SiVEST/Procura	KZN	2017	Wetland and aquatic assessment and impact assessment.
Hilcove Hills Wetland and Aquatic Assessment for WULA	Guy Nicolson Consulting	Pietermaritzburg, KZN	2017	Wetland and aquatic assessment and impact assessment.
Wildcoast stone quarry wetland and terrestrial ecological assessment	SLR Consulting	Eastern Cape	2017	Terrestrial ecological and wetland/aqautic assessment for EIA and WULA (scoping and EIA phase).
Wildcoast Stone Quarry Ecological Assessment	SLR Consulting	Eastern Cape	2017	Terrestrial ecological assessment and vegetation survey with impact assessment.
Mondi-WWF Water Stewardship Pilot Project	WWF	Zululand, KZN	2017	Piloting the AWS international water stewardship standard for selected Mondi plantations in Zululand.
Cato Ridge SDP Aquatic Assessment	NS Environmental	Cato Ridge, eThekwini, KZN	2017	Wetland/aquatic baseline assessment and impact assessment.
Mondi Richards Bay Mill AWS Pilot Study	Mondi-WWF	Richards Bay, KZN	2017	Piloting the AWS international water stewardship standard for Mondi's Pulp and Paper Mill in Richards Bay.
RBT Extension Wetland Assessment	SRK Consulting	Richards Bay, KZN	2017	Wetland/aquatic baseline assessment and impact assessment.

Project Name	Client	Location	Date Complete	Project Description
Access World Sulphur Spill Wetland Rehabilitation & Management Plan	Metamorphosis	Richards Bay, KZN	2017	Development of a wetland rehabilitation and planting plan.
RHDHV Boutique Hotel Wetland Assessment	RHDHV	Pietermaritzburg, KZN	2017	Wetland/aquatic baseline assessment and impact assessment.
RHDHV Boutique Hotel Terrestral Ecological Assessment	RHDHV	Pietermaritzburg, KZN	2017	Terrestrial ecological assessment and vegetation survey with impact assessment.
N2-N3 Road Upgrade Wetland & Aquatic Assessment	ACER AFRICA / SANRAL	eThekwini, KZN	2017	Wetland/aquatic baseline assessment and impact assessment, biomonitoring plan and wetland rehabilitation plan.
Wewe-Driefontein Mixed-Use Development Wetland Assessment	Guy Nicolson Consulting	eThekwini, KZN	2017	Wetland/aquatic baseline assessment and impact assessment, contingency plan, biomonitoring plan.
Wetland Rehabilitation Planning for Working for Wetlands (Free State)	Working for Wetlands (SANBI)	Free State	2016	Identifying, prioritizing and assessing wetlands to inform rehabilitation planning across a range of project areas in the Free State.
Hilton-Mondi Wetland & Aquatic Assessments	Arctic Sun Property Developments	Hilton, KZN	2016	Full aquatic/wetland baseline ecological assessment, development of a rehabilitation plan for wetlands, contingency plan and wetland management and monitoring programme.
Transnet RB South Dunes Lease WULA Wetland Assessment	KSEMS	Richards Bay, KZN	2016	Wetland baseline assessment, management plan, rehabilitation plan and monitoring protocol.
Grindrod Gypsum Spill Wetland Assessment	uMhlathuze Water	Richards Bay, KZN	2016	Wetland rehabilitation plan.
Ballito Housing Development Wetland Assessment	CENPROP DEVELOPMENTS, AF Planning	Ballito, KZN	2016	Full aquatic/wetland baseline ecological assessment, development of a rehabilitation plan for wetlands, contingency plan and wetland management and monitoring programme.
La Maine Adventure Valley Wetland Assessment	La Maine	Ballito, KZN	2016	Full aquatic/wetland baseline ecological assessment, development of a rehabilitation plan for wetlands, contingency plan, storm water management plan and wetland management and monitoring programme.
Barrier Lane Sheffield Ecological Scan		Ballito, KZN	2016	Ecological scan (aquatic).
D2283 & L1346 Roads Terrestrial Vegetation Assessment	RHDHV	KZN	2016	Terrestrial vegetation survey and impact assessment.
D2283 & L1346 Roads Wetland and Aquatic Assessment	RHDHV	KZN	2016	Wetland/aquatic baseline assessment and impact assessment.
Mfolozi River Bridge Aquatic and Terrestrial Vegetation Assessment	RHDHV	Mfolozi/Hluhluwe, KZN	2016	Terrestrial vegetation survey and impact assessment.
P236 Road Upgrade Ubombo Aquatic and Terrestrial Assessment	RHDHV	Ubombo, KZN	2016	Terrestrial vegetation survey and impact assessment.
Impendle Waste Sorting/Recycling Facility Wetland Screening Assessment	GIBB	Bulwer, KZN	2016	Wetland screening assessment.
Mshwathi Waste	GIBB	Mswathi, KZN	2016	Terrestrial ecological survey of faun and flora.

Project Name	Client	Location	Date Complete	Project Description
Sorting/Recycling Facility Wetland Screening and Terrestrial Ecological Assessment				
Richards Bay IDZ Phase 1F Gas Power Plant EIA: Terrestrial Ecological Assessment	Savannah Environmental	Richards Bay, KZN	2016	Terrestrial vegetation and habitat assessment and impacts assessment, development of a plant rescue and translocation programme.
Springvale Estate Wetland Rehabilitation Planning & Support	DG Investments	Ballito, KZN	2016	Full aquatic/wetland baseline ecological assessment, development of a rehabilitation plan for wetlands, contingency plan, storm water management plan and wetland management and monitoring programme.
La Maine Valley Wetland Rehabilitation Planning & Support	La Maine	Ballito, KZN	2016	Support for rehabitation planning with Working for Water.
Umgeni Water: Bruynshill Pipeline Wetland and Aquatic Assessment	Procura Management	Wartburg, KZN	2016	Wetland/aquatic baseline assessment and impact assessment.
Umgeni Water: South coast Pipeline Wetland and Aquatic Assessment	Procura Management	Kelso, KZN	2016	Wetland/aquatic baseline assessment and impact assessment.
Banana City Housing Development: Ecological Study	SRK	Westville, KZN	2016	Full aquatic/wetland ad terrestrial biodiversity baseline ecological assessment, development of a rehabilitation plan for wetlands, contingency plan, storm water management plan and wetland management and monitoring programme.
Rotenburg Development: Wetland, Aquatic and Terrestrial Ecological Impact Assessment	Green Scene	Shelly Beach, KZN	2016	Full aquatic/wetland ad terrestrial biodiversity baseline ecological assessment, development of a rehabilitation plan for wetlands, contingency plan, storm water management plan and wetland management and monitoring programme.
Blythedale Beach Vegetation Survey and Assessment	Enviro Edge	Blythedale, Kwadukuza, KZN	2016	Terrestrial vegetation survey and impact assessment.
Mandawe Cemetery Aquatic/Terrestrial Ecological Screening	E&D Consulting	Mhlathuze, KZN	2016	Ecological screening assessment (terrestrial and aquatic).
DTP Tradezone 2 Wetland Support	DTPC	La Mercy, KZN	2016	Development of a conceptual storm water treatment wetlands rehabilitation plan for the TradeZone2 development project.
Total PFS Wetland Rehabilitation Plan eSikhaweni	Kantey & Templer	eSikhaweni, KZN	2016	Development of a wetland rehabilitation plan.
Reynolds Farm Wetland and Aquatic Assessment	Reynolds	Ballito, KZN	2016	Wetland and aquatic assessment and impact assessment.
Mngazi River Bridge Aquatic Assessment	Terreco	Eastern Cape	2016	Aquatic assessment (SASS, fish, water quality, IHI) and impact assessment.
Trogon Raw Water Pipeline Construction and Operational Compliance Audit		Tronox KZN Sands	2016	Compliance auditing of the raw water supply pipeline to Fairbreeze Mine during the pre-construciton, construction and post-construction phases.
Somkhele Esinyambeni Support	Tendele Mining	Zululand, KZN	2016	Support for wetland assessment.

Project Name	Client	Location	Date Complete	Project Description
P449 & P230 culvert replacement wetland & aquatic assessment	RHDHV	Zululand, KZN	2016	Wetland/aquatic baseline assessment and impact assessment.
P237 Road and Walkway Protected Plant Survey	RHDHV	Zululand, KZN	2016	Protected plant survey.
Peat mining court case: wetland support to defense	Middleground Trading	Potchefstroom, North West Province	2016	Provision of wetland technical support and advice to the defense (advocate Barry Roux) for a peat mining court case for the Gerhard Minnebron wetland, located near Potchefstroom.
Mandlazini Waste Water Pipeline: Construction Support	E & D Consulting	Richards Bay, KZN	2015	Providing on-site construction support during the implementation of a waste water pipeline project in the vicinity of wetlands/rivers.
SANRAL: N2 Wildcoast Highway: Aquatic Assessment	SANRAL	Eastern Cape	2015	Delineating and assessing wetlands/riparian areas and undertaking baseline wetland and aquatic for a large/extensive toll road development project. Also involved the assessment of impacts and recommendation of impact management and mitigation measures, the development of an Environmental Management Programme (EMPr) and application for a Water Use License.
DAFF: PCI&S Forestry Audits	DAFF	KZN and Eastern Cape	2015	Auditing compliance with sustainable forestry management for DAFF managed plantations and natural forests.
Dube Tradeport Tradezone Conceptual Wetland Offset Plan	Dube Tradeport Corporation	eThekwini, KZN	2015	Development of a conceptual wetland offset/rehabilitation plan for the TradeZone2 development project.
Waaifontein-Kokstad Wetland Assessment	Egg Piping/Green Scene	Kokstad, KZN	2015	Wetland delineation and functional assessment.
Margate Quarry Wetland Assessment	SRK	Margate, KZN	2015	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts.
Thokoza Road Wetland Assessment	Triplo 4	Mandeni, KZN	2015	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts.
Mpumalanga Waste Centre Vegetation Survey	Enviro Edge	eThekwini, KZN	2015	Baseline terrestrial vegetation survey.
L1524 Road Upgrade Aquatic Assessment	Afzelia	Ladysmith, KZN	2015	Aquatic ecological and biodiversity assessment of river channels and riparian habitat.
P187 Road Upgrade Aquatic Assessment	Afzelia	Ladysmith, KZN	2015	Aquatic ecological and biodiversity assessment of river channels and riparian habitat.
Rushbrook Ecological Rehabilitation Plan	Jeremy Ridl	eThekwini, KZN	2015	Development of an ecological rehabilitation plan and alien plant management plan for a retail centre development.
Buffelsdraai Reforestation Project Terrestrial Biodiversity Assessment	Wildlands Conservation Trust	eThekwini, KZN	2015	Undertaking a follow-up terrestrial biodiversity assessment including vegetation, invertebrates, mammals and avifauna.
Kwadukuza Landfill Wetland Delineation	Metamorphosis	eThekwini, KZN	2015	Wetland delineation study.
Harrismith Railway Terminals Habitat Screening	GIBB	Harrismith, Free State	2015	Ecological habitat screening assessment (including terrestrial and freshwater habitat and vegetation).
York Farm Cultivation Wetland Assessment	JEC	New Hanover, KZN midlands	2015	Wetland delineation, functional assessment and recommendation of aquatic buffer zones for a mixed-crop cultivation project.
Buffelsdraai Weir Construction: Aquatic Biomonitoring	eThekwini Municipality	eThekwini, KZN	2015	Aquatic biomonitoring for the construction of a flow-guaging weir for the Buffelsdraai Landfill Reforestation Project, including SASS, fish, diatoms and water chemistry

Project Name	Client	Location	Date Complete	Project Description
				monitoring/analysis.
Aquatic Habitat Assessment for the L2842, D991 and L723 Causeways	Kerry Seppings (KSEMS)	eThekwini, KZN	2015	Aquatic habitat impact assessment (rivers and wetlands) for proposed upgrading of culverts in eThekwini.
Erf 6936 Pinetown Wetland Assessment	Isolendalo	eThekwini, KZN	2015	Wetland delineation, functional assessment and recommendation of aquatic buffer zones for a residential development project.
Maclear WWTW Wetland Assessment	Terreco	Maclear, Eastern Cape	2015	Wetland assessment to inform the decommissioning of WWTW oxidation ponds and provide input into site rehabilitation.
GJ Crookes Pedestrian Bridge: Aquatic Assessment	KSEMS	Scottburgh, KZN	2015	Wetland and river assessment including delineation, functional assessment, impact assessment and rehabilitation/management planning.
Kwadukuza Landfill Wetland Functionality Assessment	Metamorphosis Environmental Consultants	KwaDukuza, KZN	2015	Wetland and river assessment including delineation, functional assessment, impact assessment and rehabilitation/management planning.
Hilton-Mondi Desktop Wetland Mapping	Guy Nicolson Consulting	Hilton, KZN	2015	Desktop wetland mapping and risk screening assessment to inform WULA.
P112 Wetland Rehabilitation Plan	Isolendalo	Ixopo, KZN	2015	Wetland assessment including delineation, functional assessment, impact assessment and rehabilitation/management planning.
Birdhaven Wetland Assessment and Rehab Plan	Graham Projects	KwaDukuza, KZN	2015	Wetland assessment including delineation, functional assessment, impact assessment and rehabilitation/management planning.
Ntatshana Road & Bridge Aquatic Assessment	RHDHV	KZN	2015	Wetland and river assessment including delineation, functional assessment, impact assessment and rehabilitation/management planning.
R102 Interchange Wetland Assessment	RHDHV	eThekwini, KZN	2015	Wetland and river assessment including delineation, functional assessment, impact assessment and rehabilitation/management planning.
Dunkirk Clubhouse Risk Screening Assessment	Triplo 4	KwaDukuza, KZN	2015	Desktop wetland mapping and risk screening assessment to inform WULA.
Lovu Landfill Wetland/Aquatic Assessment	Metamorphosis Environmental Consultants	eThekwini, KZN	2015	Wetland and river assessment including delineation, functional assessment, impact assessment and rehabilitation/management planning.
Paddock Wetland-Aquatic Assessment	Buist Investments	Port Shepstone, KZN	2015	Wetland and river assessment including delineation, functional assessment, impact assessment and rehabilitation/management planning.
Birdhaven Country Estate Wetland Rehab Plan	Graham Projects	KwaDukuza, KZN	2015	Wetland and river assessment including delineation, functional assessment, impact assessment and rehabilitation/management planning.
R102 Interchange Vegetation Assessment	RHDHV	eThekwini, KZN	2015	Terrestrial vegetation survey and impact assessment.
Birdhaven Surface Water Monitoring Plan	Graham Projects	KwaDukuza, KZN	2015	Surface water monitoring and plan development
ZAC Mine: Wetland Assessment	ZAC	Ulundi, KZN	2015	Wetland and river assessment including delineation, functional assessment, impact assessment and rehabilitation/management planning.
Eastern Cape Bridges Aquatic Assessment	EIMS	Port St Johns/Mthatha, Eastern Cape	2014	Aquatic (river assessment) for bridge development. Included baseline assessment of riparian habitat, vegetation, invertebrates and fluvial geomorphology, impact assessment and recommendations to manage/mitigate ecological impacts.

Project Name	Client	Location	Date Complete	Project Description
Keystone Industrial Park: Aquatic Assessment	Rokwil	Hammarsdale, KZN	2014	Wetland/river ecological assessment to inform a large Industrial Park development.
Lions River Pipeline: Wetland Assessment	Synergistics	Howick, KZN	2014	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with a proposed bulk water pipeline project.
Dassenhoek waste water pipeline terrestrial ecological assessment	SRK Consulting	Dassenhoek, eThekwini, KZN	2014	Assessing terrestrial biodiversity for a proposed waste water pipeline development project. Involved undertaking baseline ecological assessments, the assessment of impacts and recommendation of impact management and mitigation measures.
Dassenhoek waste water pipeline aquatic ecological assessment	SRK Consulting	Dassenhoek, eThekwini, KZN	2014	Delineating and assessing wetlands/riparian areas for a proposed waste water pipeline development project. Involved undertaking baseline ecological assessments, the assessment of impacts and recommendation of impact management and mitigation measures.
Bhambayi Phase 1 Housing Project: Aquatic Assessment	GIBB	eThekwini, KZN	2014	Delineating and assessing wetlands/riparian areas for a proposed housing upgrade development project. Involved undertaking baseline ecological assessments, the assessment of impacts and recommendation of impact management and mitigation measures.
eThekwini Alien Invasive Plant Survey and Prioritization Project	eThekwini Municipality	eThekwini, KZN	2014	Survey of over 120 eThekwini Municipality managed Reserves and Open space areas in terms of invasive alien plant species status and densities. Development of a prioriitisation model for prioritising open spaces for alien clearing/management operations.
Weenen Piggery: Wetland Assessment	Janet Edmonds Consulting	Weenen, KZN	2014	Delineating and assessing wetlands for a proposed piggery development project. Involved undertaking baseline ecological assessments, the assessment of impacts and recommendation of impact management and mitigation measures.
Queensburgh Wetland Assessment	NS Environmental	Queensburgh, eThekwini, KZN	2014	Delineating and assessing wetlands/riparian areas for a proposed housing development project. Involved undertaking baseline ecological assessments, the assessment of impacts and recommendation of impact management and mitigation measures.
eThekwini Alien Invasive Plants: Parks and Nurseries Compliance Audits	eThekwini Municipality	eThekwini, KZN	2014	Compliance auditing of 10 selected nurseries and 10 selected parks/gardens managed by eThekwini Municipality with regards to CARA/NEMBA alien plant requirements.
RBIDZ: Phase 2A: Wetland and Biodiversity Assessment	GIBB	Richards Bay, KZN	2014	Delineating and assessing wetlands/riparian areas and undertaking baseline wetland and biodiversity assessments for a proposed Industrial Development. Also involved the assessment of impacts and recommendation of impact management and mitigation measures.
Foxhill wetland assessment	Triplo 4	Ballito, KZN	2014	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts.
Birdhaven Wetland Delineation	Graham Projects	Ballito, KZN	2014	Wetland delineation study.
Kloof extension aquatic assessment	SRK Consulting	KwaDabeka, eThekwini, KZN	2014	Delineating and assessing wetlands/riparian areas for a proposed housing upgrade development project. Involved undertaking baseline ecological assessments, the assessment of impacts and recommendation of impact management and mitigation measures.
Froes Estate: Terrestrial Biodiversity Assessment	K2M Consulting	Queensburgh, eThekwini, KZN	2014	Terrestrial biodiversity of a coastal forest ecosystem for a planned housing estate development.

Project Name	Client	Location	Date Complete	Project Description
La Maine Farm Wetland Delineation	Infuse Projects	Shakaskraal, KZN	2014	Wetland delineation study.
Dunkirk Forest Clubhouse: Wetland Assessment	Triplo 4	Ballito, KZN	2014	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts.
Dokodweni Forest Survey	Triplo 4	Dokodweni, KZN	2014	Vegetation survey of a coastal dune forest system.
Wood Limpus Road Sewer Line: Aquatic Assessment	GIBB	Queensburgh, eThekwini, KZN	2013	Riparian delineation, functional assessments, impact assessment and recommendations to manage/mitigate impacts associated with a proposed waste water pipeline project.
Ugu Biodiversity Sector Plan	Ezemvelo KZN Wildlife	Ugu District, KZN	2013	Development of a Biodiversity Sector Plan for the Ugu District Municipality on behalf of Ezemvelo KZN Wildlife.
Mpophomeni Pipeline Wetland Assessment	Synergistics	Mpophomeni, KZN	2013	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with a proposed bulk water pipeline project.
Copesville Wetland Assessment	Green Door Environmental	Msunduzi, KZN	2013	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with a proposed bulk water pipeline project.
RBIDZ Ecological Sensitivity Mapping	Thorn EX	Richards Bay, KZN	2013	Desktop ecological sensitivty mapping of aquatic and terrestrial features to inform development planning within the Richards Bay Industrial Development Zone.
Woodburn Wetland Delineation	Bokamoso	Msunduzi, KZN	2013	Wetland delineation study.
Thina River Dams Desktop Survey	Green Door Environmental	Thina River, Eastern Cape	2013	Desktop study aimed at assessing the viability of a number of sites for a proposed dam on the Thina River. Involved sensitivty mapping and analyses of aquatic and terrestrial features and comparison of the various options to inform site selection.
Darvill waste water treatment works upgrade: terrestrial biodiversity assessment	Umgeni Water/Afzelia	Msunduzi, KZN	2013	Terrestrial biodiversity assessment to inform WWTW upgrade project.
Darvill waste water treatment works upgrade: wetland assessment	Umgeni Water/Afzelia	Msunduzi, KZN	2013	Wetland delineation and functional/impact assessment to inform WWTW upgrade project.
Somkhele Coal Mine Expansion Project: Terrestrial and Aquatic Biodiversity Assessment	Ground Water Consulting Services	Mthubathuba, KZN	2013	Surface water and terrestrial biodiversity assessment for large proposed coal mining areas in Zululand. Involved undertaking baseline ecological assessments, sensitivity mapping, the assessment of impacts and recommendation of impact management and mitigation measures.
Richards Bay Temporary Coal Storage Facility: Wetland Assessment	GIBB	Richards Bay, KZN	2013	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with a proposed coal storage facility at the Port of Richards Bay.
Mandlazini Waste Water Pipeline: Wetland Assessment	E & D Consulting	Richards Bay, KZN	2013	Delineating and assessing wetlands/riparian areas for a proposed waste water upgrade project. Involved undertaking baseline ecological assessments, the assessment of impacts and recommendation of impact management and mitigation measures.
Buffelsdraai Reforestation Monitoring	Wildlands Conservation Trust	eThekwini, KZN	2013	Forest surveys (plots) and analyses to determine the effectiveness of reforestation activities.

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RAMSAR Wetland Management Plans	DEAT	Various across SA	2012	Development of management plans for a selection of RAMSAR wetlands of international importance across South Africa.
Edendale Tannery Wetland Rehabilitation & Management Plan	Jeffares & Green	Msunduzi, KZN	2012	Development of a wetland management and rehabilitation plan at Edendale Tannery.
Ntibane Water Abstraction: Specialist Aquatic Assessment	Environment and Rural Solutions	Kokstad, KZN	2012	River assessment (water quality, vegetation survey and fluvial geomorphology) to inform a water abstraction project.
Lusikisiki Wetland Assessment	Terreco	Lusikisiki, Eastern Cape	2012	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with a proposed waste water treatment works development project.
Richards Bay Wetland Assessment: Extension of Eastern Arterial Road to RBM	GIBB	Richards Bay, KZN	2012	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with a proposed road upgrade development project.
Mthatha Airport Expansion: Wetland Assessment	Ndodana Consulting Engineers	Mthatha, Eastern Cape	2012	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with the proposed upgrading of Mthatha Airfield.
Ludidi Wetland Delineation	Sigwela & Associates	Eastern Cape	2012	Wetland delineation study.
Zululand Anthracite Colliery mine, aquatic assessment to inform WULA	Ground Water Consulting Services	Ulundi, KZN	2012	Wetland/river assessment to inform Water Use License Application (WULA) for a coal mine in Zululand.
Siyathuthuka housing development: Wetland Management Plan	Makhosi Nyoka & Associates	Richmond, KZN	2012	Development of a wetland management plan to inform housing development in a rural area.
Kokstad N2 Interchange Wetland Assessment	GIBB	Kokstad, KZN	2012	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with a proposed road interchange development project.
Ladysmith-Spionekop dam Bulk Water Pipeline Terrestrial Ecological Assessment	Jeffares & Green	Ladysmith, KZN	2012	Terrestrial ecological assessment, impact assessment and recommendations to manage/mitigate impacts associated with a proposed bulk water pipeline project.
Ladysmith-Spionekop dam Bulk Water Pipeline Wetland Assessment	Jeffares & Green	Ladysmith, KZN	2012	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with a proposed bulk water pipeline project.
Marburg Asphalt Plant: wetland and forest assessment	Green Door Environmental	Port Shepstone, KZN	2012	Wetland delineation and functional/impact assessment as well as assessment of coastal forest habitat to inform an Asphalt plant development project.
Mdloti Waste Water Pipeline EIA: Specialist Aquatic Assessment	GIBB	Mount Moreland, eThekwini, KZN	2011	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), vegetation survey, biodiversity assessment, impact assessment and recommendations to manage/mitigate impacts associated with a proposed waste water pipeline development project in the vicinity of the Mdloti River and Mount Moreland wetlands.
eThekwini Reforestation Strategy	Wildlands Conservation Trust	eThekwini, KZN	2011	Study aimed at identifying sites to form part of eThekwini Municipality's reforestation programme and including preliminary rehabilitation strategy and recommendations.
Ntiszwa Weir Water Supply Scheme: Specialist Aquatic Assessment	Environment and Rural Solutions	Kokstad, KZN	2011	Annual bio-monitoring programme to monitor the status of rivers affected by a water supply scheme in the Eastern Cape. Included baseline monitoring of a range of indicators of river health

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				and functioning, including riparian and instream vegetation assessments (VEGRAI), invertebrates and fish and fluvial geomorphology assessments. Impacts and appropriate mitigation measures were also assessed.
Eastern Cape SANRAL N2 Road Bypasses	Terreco	Eastern Cape	2011	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with a proposed road development project.
Paddock Wetland Assessment	Greene Land: Land & Planning Law	Port Shepstone, KZN	2011	Wetland delineation, functional assessments (WET-Health, WET-Ecoservices), impact assessment and recommendations to manage/mitigate impacts associated with a proposed housing development project.
La Mercy Wetland Delineation	LRI	eThekwini, KZN	2011	Wetland delineation study.
Western Cape Wetland Verification Assessment	NCC Environmental	Beaufort West, Western Cape	2011	Wetland delineation study.
King Shaka International Airport/Dube Trade Port – Aquatic Biomonitoring Programme	ACSA/DTP	eThekwini, KZN	2010	Annual bio-monitoring programme to monitor the status of rivers and wetlands downstream of the King Shaka International Airport development. Included monitoring using a range of indicators of river/wetland health and functioning, including WET-Health, WET-Ecoservices, vegetation assessments, topographic surveys/profiles, invertebrates and fish and water chemistry/quality sampling and analyses during the construction phase of the KSIA.
King Shaka International Airport/Dube Trade Port – Construction Auditing	ACSA/DTP	eThekwini, KZN	2010	Monthly independent environmental compliance audits of the KSIA/DTP project during the construction phase.
Lesotho Highlands Development Agency – Katze dam review of flow release policy	LHDA	Lesotho	2009	Desktop and field study aimed at updating flow release policies at Katze dam from the perspective of protecting and maintaining the fluvial geomorphological template and processes in the downstream river system.
Mzimkhulu River Reserve determination	DWAF	Mzimkhulu River, KZN	2009	River reserve determination for the Mzimkhulu River (fluvial geomorphology component).
Baynes tributary canalisation scheme: specialist fluvial geomorphology assessment	Terratest	Msunduzi, KZN	2009	Assessment of fluvial geomorphology for a stream rehabilitation project.
NeWater project: quantifying the benefits from wetlands in Orange/Senqu River basin	NeWater (EU funded)	Gauteng	2008	Baseline wetland assessment for the Klip River and Rietspruit wetland systems to inform the economic valuation of wetland ecosystem goods and benefits.