Wetland Offset, Rehabilitation, and Management Plan

Erf 1486, Vermont, Western Cape Province

October 2024

Report Information

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Executive Summary

The owner of Erf 1486, Vermont proposes subdivision of the property to create several erven for single residential use and one erf in the south for group housing. The study area for this aquatic assessment is the extent of Erf 1486, located in Vermont within the Overstrand Local Municipality.

An aquatic biodiversity screening assessment of the proposed development site was conducted on the 17th of August 2018, a natural Unchanneled Valley-Bottom (UVB) wetland was confirmed and delineated onsite (EnviroSwift, 2018). The wetland was confirmed, and an updated delineation was undertaken during a site assessment by van Zyl *et al*. (Delta Ecology, 2023) on the 30th of May 2023. Although the site was found to be disturbed in nature, given the confirmed presence of an onsite wetland, which is likely to be impacted by the proposed development, the site was determined to be of "Very High" aquatic sensitivity.

The aquatic biodiversity impact assessment determined that given the implementation of the proposed development as planned, a portion of the delineated UVB wetland within Erf 1486 will be lost and offsetting will be required to stand a reasonable chance of securing a Water Use Authorisation (WUA) for the proposed development (van Zyl *et al*. 2023).

The delineated wetland within the proposed development site covers approximately 0,90 ha of the 1,50-ha site, leaving 0,60 ha of terrestrial ground. Various iterations of the site layout for the proposed housing development have been considered (van Zyl *et al*. 2023, 2024), resulting in a reduction of the proposed development footprint, with the primary objective of decreasing the amount of wetland loss.

In the current preferred layout, a relatively small portion of the UVB wetland coincides with proposed eastern and southern boundary access roads, resulting in the loss of approximately 0,024 ha (3 %) of the 0,90-ha wetland. However, the total development footprint of the proposed residential development cannot be accommodated within the proposed site without some level of wetland encroachment. It was noted in the van Zyl *et al*. (2023, 2024) Aquatic Biodiversity Impact Assessment that a reduction in the development footprint could not be viably implemented, and no other form of mitigation is available that could reduce wetland encroachment entirely since the wetland covers much of the site. It was therefore concluded that despite full application of the mitigation hierarchy, some level of wetland loss (which has been reduced as far as practically possible) is unavoidable for this project.

Delta Ecology has therefore been appointed to draft a detailed wetland offset, rehabilitation, and management plan for the proposed development. The current report identifies the preferred offset area on Erf 1486, provides an in-depth description of necessary wetland offset and restoration activities, and outlines a management plan for the identified offset area.

The wetland area that will be lost given the construction of the proposed development was evaluated by application of the Macfarlane *et al*. (2016) wetland offset guidelines and calculator to determine the functional and habitat value thereof in a currency known as Hectare Equivalents (HE). Maximum wetland offset within the proposed development site was further identified and evaluated to determine the wetland value that could be gained through maximum onsite rehabilitation, and management effort.

The total wetland loss was valued at 0,0139 HE of function and 0,1323 HE of habitat. The maximum potential wetland gain from onsite offset activities was valued at 0,1214 HE of function and 1,3841 HE of habitat. This resulted in a surplus of 0,1075 HE of function and 1,2518 HE of wetland habitat. This will satisfy the habitat offset requirements. The results of the offset calculations are presented in **Table i**.

Table i: Offset balance table indicating net results of the onsite offset feasibility study.

Offset Balance Table						
Wetland Name	**Area (ha)**		**Function (HE)**		**Habitat (HE)**	
	Losses	**Gains**	**Losses**	**Gains**	**Losses**	**Gains**
UVB Wetland (portion lost)	-0,0240	0,0000	-0,0139	0,0000	-0,1323	0,0000
UVB Wetland (remaining – rehabilitated)	0,0000	0,8760	0,0000	0,1214	0,0000	1,3841
Subtotal (HE)	-0,0240	0,8760	-0,0139	0,1214	-0,1323	1,3841
Balance (HE)	**0,8520**		**0,1075**		**1,2518**	

During the site assessment it was found that the identified offset wetland on Erf 1486 was in a largely modified state, largely due to the presence of foreign fill material and the presence of alien invasive vegetation. A detailed wetland rehabilitation plan was drafted to address these factors through the removal of foreign fill material, revegetation, and stormwater management, thereby achieving an increase in PES from category D to upper category C for the identified onsite offset wetland. A management plan was drafted thereafter to ensure that the gains achieved through rehabilitation are maintained or slowly increased.

This wetland offset, rehabilitation and management plan is practically implementable and will allow for the maximum onsite wetland offset possible without compromising the feasibility of the proposed development.

It is thus the opinion of the specialist that implementation of this plan would result in substantial biodiversity gains, and offset the loss incurred through construction and operation of the proposed development. It is therefore acceptable from a wetland and general biodiversity perspective to approve the proposed development with implementation of this offset, rehabilitation, and management plan as a condition of approval.

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Kimberley van Zyl is an ecologist and environmental scientist with over 7 years' experience in the environmental management field. She holds a MSc. degree in Water Resource Management from the University of Pretoria and her professional affiliations include the South African Council for Natural Scientific Professions (SACNASP) and the Southern African Society of Aquatic Scientists (SASAqS). Kimberley's work experience has exposed her to a range of projects across various business sectors such as mining, agriculture, and construction, as well as the public sector.

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Robyn Morton has a MSc. degree in Conservation Sciences from the Cape Peninsula University of Technology. Throughout her studies, internships, and consultancy experience, she has gained valuable and informed insight into the functioning of natural and socio-ecological systems, as well as many key research and monitoring skills. Prior to her consulting career, Robyn worked for Zandvlei Estuary Nature Reserve for 4 years and gained experience in the field of urban wetland and estuary management. Robyn specialises in aquatic ecology and is currently working for Delta Ecology as a junior associate under the guidance of Kimberley van Zyl.

A signed statement of independence will be provided as a separate document.

1. Introduction

The owner of Erf 1486, Vermont (**Figure 1-1**) proposes subdivision of the property to create several erven for single residential use and one erf in the south for group housing (**Figure 1-2**). The study area for this aquatic assessment is the extent of Erf 1486, located in Vermont within the Overstrand Local Municipality.

During an aquatic biodiversity screening assessment of the proposed development site on the 17th of August 2018, a natural Unchanneled Valley-Bottom (UVB) wetland was confirmed and delineated on the site (EnviroSwift, 2018). The wetland was confirmed, and an updated delineation (**Figure 1-3**) was undertaken during a site assessment by van Zyl *et al*. (Delta Ecology, 2023) on the 30th of May 2023. Although the site was found to be disturbed in nature, given the confirmed presence of an onsite wetland, which is likely to be impacted by the proposed development, the site was determined to be of "Very High" aquatic sensitivity.

The aquatic biodiversity impact assessment determined that given the implementation of the proposed development as planned, a portion of the delineated UVB wetland within Erf 1486 will be lost and offsetting will be required to stand a reasonable chance of securing a Water Use Authorisation (WUA) for the proposed development (van Zyl *et al*. 2023).

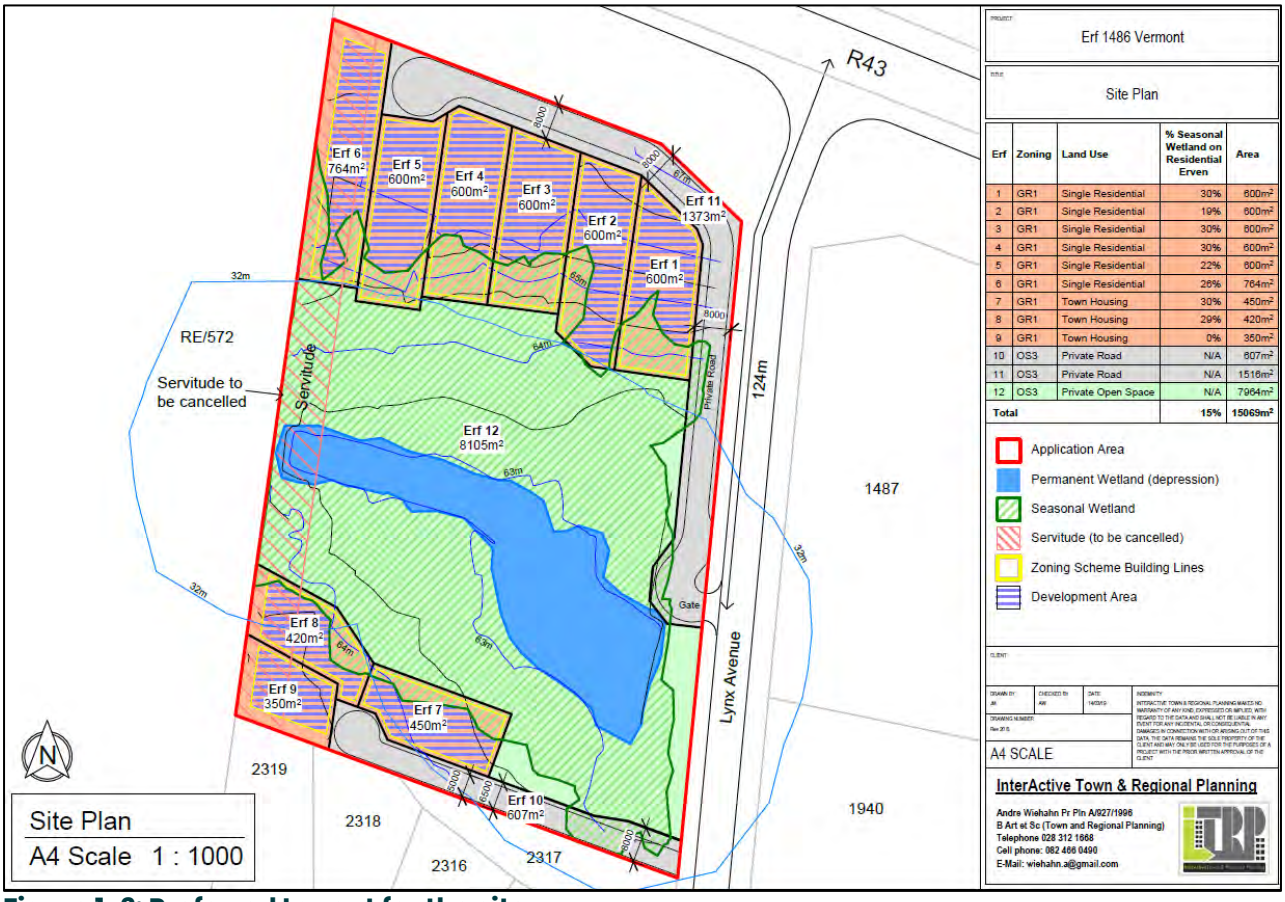
The delineated wetland within the proposed development site covers approximately 0,90 ha of the 1,50-ha site, leaving 0,60 ha of terrestrial ground. Various iterations of the site layout for the proposed housing development have been considered (van Zyl *et al*. 2023, 2024), resulting in a reduction of the proposed development footprint, with the primary objective of decreasing the amount of wetland loss.

In the current preferred layout (**Figure 1-2**), a relatively small portion of the UVB wetland coincides with proposed eastern and southern boundary access roads, resulting in the loss of approximately 0,024 ha (3 %) of the 0,90-ha wetland. However, the total development footprint of the proposed residential development cannot be accommodated within the proposed site without some level of wetland encroachment. It was noted in the van Zyl *et al*. (2023, 2024) Aquatic Biodiversity Impact Assessment that a reduction in the development footprint could not be viably implemented, and no other form of mitigation is available that could reduce wetland encroachment entirely since the wetland covers much of the site. It was therefore concluded that despite full application of the mitigation hierarchy, some level of wetland loss (which has been reduced as far as practically possible) is unavoidable for this project.

The Department of Water and Sanitation (DWS) who administer the National Water Act (NWA) (Act 36 of 2018) and its WUA process, apply a 'no net loss' policy to wetlands and will not authorise any development application that encroaches on a wetland unless an acceptable wetland offset plan forms part of the development application.

For this reason, Delta Ecology has been appointed to draft a detailed wetland offset, rehabilitation, and management plan for the proposed development. The current report identifies the preferred offset area on Erf 1486, provides an in-depth description of necessary wetland offset and restoration activities, and outlines a management plan for the identified offset area.

Figure 1-1: Location of the proposed site, Erf 1486, Vermont.



Erf	Zoning	Land Use	% Seasonal Wetland on Residential Erven	Area
1	GR1	Single Residential	30%	600m²
2	GR1	Single Residential	19%	600m²
3	GR1	Single Residential	30%	600m²
4	GR1	Single Residential	30%	600m²
5	GR1	Single Residential	22%	600m²
6	GR1	Single Residential	26%	764m²
7	GR1	Town Housing	30%	450m²
8	GR1	Town Housing	29%	420m²
9	GR1	Town Housing	0%	350m²
10	OS3	Private Road	N/A	807m²
11	OS3	Private Road	N/A	1516m²
12	OS3	Private Open Space	N/A	7964m²
Total			15%	15069m²

Figure 1-2: Preferred Layout for the site.

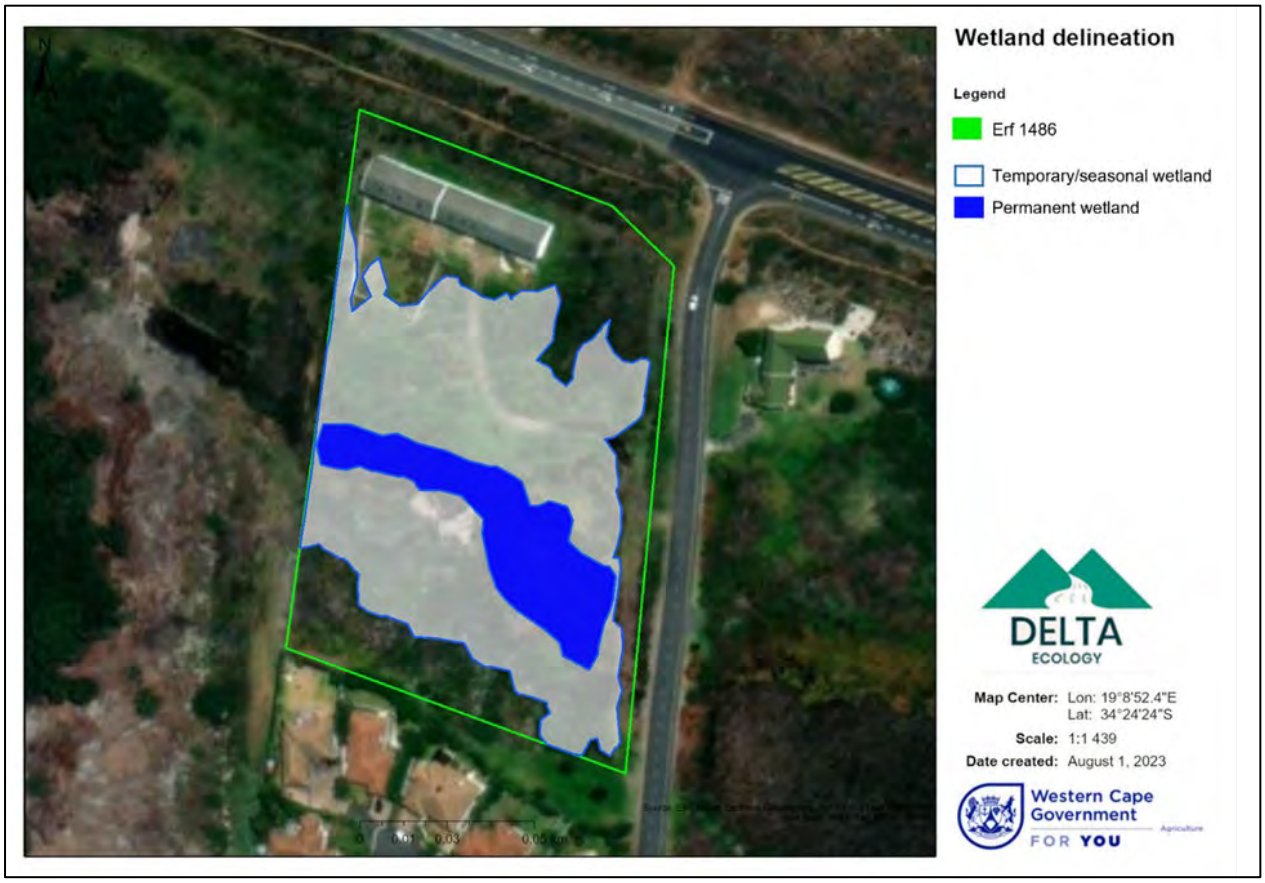


Figure 1-3: Delineated wetland within Erf 1486.

1.1. Terms of Reference

The terms of reference agreed upon for this report include:

1. Gathering of additional desktop information to inform the assessment.
2. Application of the Macfarlane *et al*. (2016) offset guidelines and calculator to determine wetland losses given the proposed development and the potential wetland gains from identified offset activities.
3. Develop a detailed rehabilitation strategy for the identified offset areas that will satisfy the offset requirements of the National Wetland Offset Guidelines (Macfarlane *et al*. 2016) as far as possible.
4. Provide detailed management and monitoring guidelines for the identified offset area to ensure the target ecological status of the onsite offset wetland area is met and maintained.

1.2. Limitations and Assumptions

The following limitations and assumptions apply to the Aquatic Biodiversity Impact Assessment (van Zyl *et al*. 2023) and extend into the current report:

- Site assessments were undertaken on the 30th of May 2023, during the winter season in the Western Cape Province. These assessments do not cover complete seasonal variation in conditions at the site. This will however not have a significant impact on the conclusion made regarding the aquatic features since soil and vegetation indictors were both present and adequate for delineation and assessment. The specialist is of the opinion that wetland

elements have been assessed at a level adequate to inform both the impact assessment and offset determination.

- The scope of this wetland offset rehabilitation and management plan is limited to the current extent of the wetland within Erf 1486 and does not include future possible wetland extents.
- The duration of the site assessments was cumulatively 4 hours which was sufficient to adequately assess wetland loss within the proposed site and the potential wetland gains from offset activities on the proposed site.
- The wetland edge was delineated using a Garmin E-trex 20 handheld GPS with an expected accuracy of 3 m or less at the 95% confidence interval. In the opinion of the specialist, this limitation is of no material significance to the assessment and all aquatic biodiversity constraints have been adequately identified.

Notwithstanding the above limitations, the specialist is of the opinion that the site assessments, together with the desktop assessment, provide adequate information to inform both the impact assessment and offset determination. No further site assessments or information is required.

2. Goals and Objectives

Clear goals and objectives are needed to inform and manage the planning and implementation of wetland offsets. The broad goal for a wetland offset is to ensure that residual impacts on water resources, biodiversity, and ecosystem services are appropriately compensated by developers in such a way that a material contribution is made to achieving water resource objectives and safeguarding valuable ecosystem services.

The specific objectives for the current wetland offset project are as follows:

1. Identify suitable wetland offset localities and activities that offer maximum onsite wetland gains to compensate for wetland losses due to the proposed development as far as possible.
2. Ensure that the wetland offset gains are maintained through appropriate instruments.
3. Ensure minimum loss of wetland habitat and function by providing maximum gains in wetland area and/or condition within the proposed development site:
   3.1. Conserve and rehabilitate remaining / existing wetland portion onsite.
   3.2. Achieve and maintain necessary PES targets through effective establishment, rehabilitation, management, and monitoring interventions.
4. Ensure formal protection of the wetland through establishment of a conservation servitude over the wetland area. This servitude is recorded as a title deed restriction, ensuring that no future development can occur within the wetland.

3. Methodology

The methodology used to develop the wetland offset, rehabilitation, and management plan is outlined in the subsections below. Please note that the methods used in the Wetland Risk and Impact Assessment, as detailed in van Zyl (2023), are not included in this report to avoid repetition.

3.1. Offset Determination

The Macfarlane *et al.* (2016) offset guidelines and calculator presents the current best practice methodology for evaluating wetland offset losses and gains. The method accounts for a variety of wetland metrics in determination of wetland value, including:

- Hydrological state.
- Geomorphological state.
- Water quality.
- Habitat quality.
- Importance in biodiversity planning.
- Conservation status.
- Presence of species of conservation concern.
- Change in present ecological state at the offset wetlands.

The calculator combines these metrics to produce a wetland value in a currency known as Hectare Equivalents (HE). Wetland habitat and function are assessed as separate modules to determine the HE of wetland habitat lost/gained and the HE of wetland function lost/gained. The habitat and function lost in the impacted wetland (s) and the habitat and function gained through offset activities are also assessed as separate modules.

3.2. Wetland Offset Strategy

A combination of desktop resources and information gained through site assessments was used to identify the preferable / feasible wetland offset locality. Wetland offsetting involves rehabilitating or reinstating an area of wetland equal to or greater than the wetland value lost. The offset strategy developed in this report involves reinstating and rehabilitating the remnant onsite UVB wetland within the development site to facilitate maximum onsite offset. The WET-Rehab tool developed by Russell (2009) was used to determine appropriate rehabilitation interventions.

4. Baseline Wetland Environment

The site under evaluation is located within the Breede-Olifants Water Management Area (WMA), quaternary catchment G40G. The applicable sub-quaternary catchment is demarcated as a Fish Support Area and Fish Sanctuary (CSIR, 2011). The regional setting, in terms of the Level 1 DWA (now Department of Water and Sanitation) Ecoregions, is within the Southern Coastal Belt.

Extending across much of the proposed site and the 500 m regulated area, the National Freshwater Ecosystem Priority Areas (NFEPA) wetland layer indicates the presence of a large unnatural Channelled Valley-Bottom (CVB) wetland system extending from the study area in a south-easterly direction and ultimately augmenting the Vermont Salt Pan. It was however the opinion of EnviroSwift (2018) and van Zyl *et al.* (2023), that the wetland is a natural UVB wetland system (**Figure 4-1**). In addition, the National Geospatial Information Service (NGI) topo-cadastral map indicates two non- perennial drainage lines within 500 m of the study area which are likely associated with the identified wetland system.

Within the proposed site, the Western Cape Biodiversity Spatial Plan (WCBSP) identifies an aquatic Ecological Support Areas (ESA) 2 associated with the CVB wetland indicated by the NFEPA dataset (WCBSP, 2017). The WCBSP identifies a range of aquatic and terrestrial Critical Biodiversity Areas (CBAs) 1 and ESA 2 within the 500 m regulated area, while located adjacent to the western boundary is the Hoek van de Berg Private Nature Reserve.

Vegetation within the study area was extensively disturbed, with a mixture of indigenous species such as *Senecio halimifolius* and the wetland obligate *Juncus kraussi* alongside alien invasive species such as Kikuyu grass (*Cenchrus clandestinum*) and pampas grass (*Cortaderia selloana*). While the latter species is not wetland obligate, it is commonly found in wetlands where it grows particularly densely (van Outshoorn, 2014). An additional wetland obligate species, *Typha capensis*, was also found in isolated patches during the site assessment.

The health of the UVB wetland within Erf 1486 was assessed as part of the Van Zyl *et al.* (2023) Aquatic Biodiversity Impact Assessment using the current best practice methods (Macfarlane *et al.* 2020 WET-Health Version 2.0). The UVB wetland was found to have a Present Ecological State (PES) within Category D, indicating that the wetland was in a largely modified condition at the time of assessment. In addition, the wetland has Moderate Ecological Importance and Sensitivity (EIS) and Wetland Ecosystem Service (WES) scores, which indicates that the wetland is moderately sensitive or important in terms of conservation planning or provision of ecosystem services (Van Zyl *et al.* 2023).

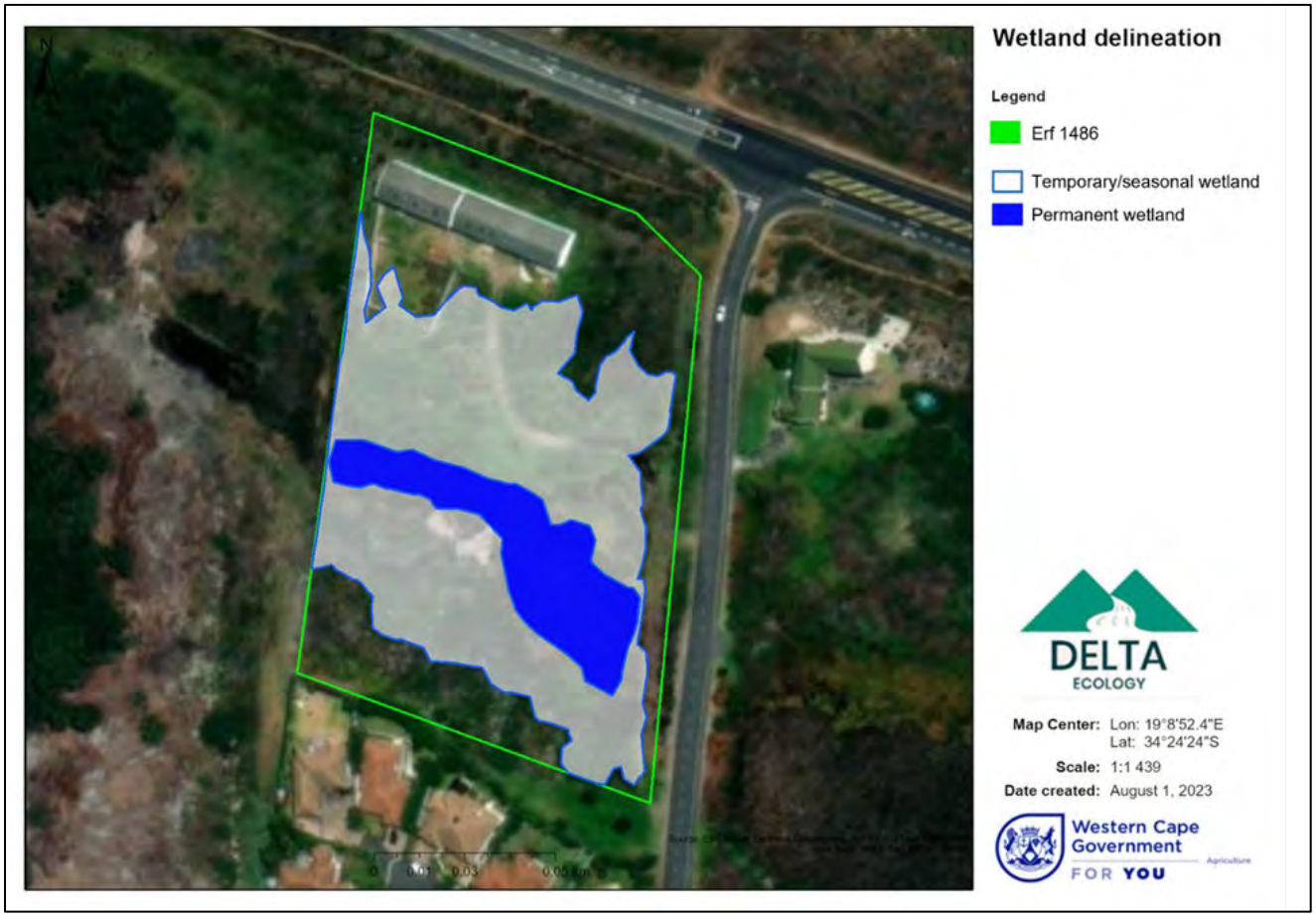


Figure 4-1: Delineated wetland within Erf 1486.

5. Wetland Loss and Mitigation Opportunities

The delineated wetland within the site boundary was found to cover approximately 0,90 ha (60%) of the approximate 1,50 ha development site. A total of 0,70 ha (47%) of the entire site will be required to establish the proposed development. A relatively small portion of the largely modified wetland will be lost, resulting in the loss of approximately 0,024 ha (3 %) of the 0,90 ha UVB wetland (**Figure 5-1**). Maximum wetland offsetting opportunities were thus identified within the proposed development site. The proposed development is split into 6 dwellings in the north and 3 dwelling in the south of the property. The remaining undeveloped area within the centre of the site consists of the permanent wetland zone and the remaining temporary/seasonal wetland zone, leaving a total of 0,74 ha of the wetland to be rehabilitated and used as the offset (**Figure 5-1**). The wetland was characterised by a mixture of alien and indigenous vegetation. The remaining wetland area thus offers good onsite wetland offsetting opportunities.

The identified offset area will require a combination of restoration and rehabilitation to allow for a functional wetland to be reinstated and retained within the site. The aim for the onsite wetland offset area will be to reinstate and restore the wetland from an upper category D (largely modified system) to a PES within upper category C (moderately modified system).

Figure 5-1: Wetland area to be lost and developed.

6. Evaluating Residual Wetland Loss

The proposed development will result in the loss of approximately 0,024 ha (3%) of the largely modified onsite UVB wetland. The Macfarlane *et al*. (2020) wetland offset calculator was applied to the wetland area that will be lost during development. The calculation yielded a total of 0,0139 HE of function and 0,1323 HE of habitat that will be lost and require offsetting. The results of the evaluation are presented in **Table 6-1** and **Table 6-2** below.

Table 6-1: Results of the evaluation of wetland function loss for the Erf 1486 wetland.

Wetland Functionality Targets			
Impact Assessment	**Prior to development**	Wetland size (ha)	**0,024**
		Functional value (%)	**58**
	Post development	Functional value (%)	**0**
		Change in functional value (%)	**58**
	Key Regulating and Supporting Services Identified		**Sediment trapping, Phosphate assimilation, Nitrate assimilation and Toxicant assimilation**
	Development Impact (Functional hectare equivalents)		**0,1**
Offset calculation	**Offset Ratios**	Triggers for potential adjustment in exceptional circumstances	**None**
		Functional Importance Ratio	**1,0**
	Functional Offset Target (Functional hectare equivalents)		**0,0139**
Further considerations	**Have other key Provisioning or Cultural Services Identified that require compensation?**		**No**
	Additional compensatory mechanisms proposed	N/A	

Table 6-2: Results of the evaluation of wetland habitat loss for Erf 1486 wetland.

Ecosystem Conservation Targets				
Impact Assessment	Prior to development	Wetland size (ha)		0,024
		Habitat intactness (%)		70
	Post development	Habitat intactness (%)		0
		Change in habitat intactness (%)		70
	Development Impact (Habitat hectare equivalents)			**0,00168**
Determining offset ratios	Ecosystem Status	Wetland Vegetation Group (or type based on local classification)		Southwest Sand Fynbos
		Threat status of wetland	Threat status	CR
			Threat status Score	15
		Protection level of wetland	Protection level	Poorly Protected
			Protection level Score	1
		Ecosystem Status Multiplier		**15**
	Regional and National Conservation context	Priority of wetland as defined in Regional and National Conservation Plans	High Importance	0,75
		Regional & National Context Multiplier		**0,8**
	Local site attributes	Uniqueness and importance of biota present in the wetland	Moderate biodiversity value	0.75
		Buffer zone integrity (within 500m of wetland)	Buffer compatibility score	0,5
		Local connectivity	Moderate connectivity	0,75
		Local Context Multiplier		**0,7**
	Ecosystem Conservation Ratio			**7.88**
Offset Calculation	**Development Impact (Habitat hectare equivalents)**			**0,0168**
	Ecosystem Conservation Ratio			**7,9**
	Ecosystem Conservation Target (Habitat hectare equivalents)			**0,1323**

7. Evaluating Potential Wetland Offset

The proposed development will result in 0,024 ha of wetland loss, this leaves the remnant 0,876 ha of the UVB wetland available to be used as an offset for the development activities. This wetland offset was identified to be suitable for rehabilitation and protection in perpetuity (**Figure 7-1**).

Given that the identified offset area already possesses wetland hydrology, it is possible to improve wetland habitat and wetland function through rehabilitation/restoration activities.

The potential habitat and function gain from rehabilitation and protection of the identified onsite offset was assessed with the following key offset interventions assumed in the evaluation:

- Application of maximum viable rehabilitation effort to increase the PES of the onsite offset wetland area to upper category C with a minimum PES Score of 79 %.
- Removal of dumped rubble and fill material within the wetland. Reshaping of the wetland specifically in the areas where infill has been removed to ensure very slight gradual decline towards the permanent zone.
- Removal of all Alien Invasive vegetation Species (AIS) from this offset wetland area such as Kikuyu grass (*Cenchrus clandestinum*), Pampas grass (*Cortaderia selloana*), Australian myrtle (*Leptospermum laevigatum*), sweet needlebush (*Hakea drupacea*), Port Jackson (*Acacia saligna*) and rooikrans (*Acacia cyclops*), as well as all planted garden species in the southwest corner of the Erf coinciding with the wetland.
- Establishment of a healthy and moderately diverse indigenous vegetation community within any areas that have been cleared (areas historically cleared of indigenous vegetation and cleared of AIS) as well as the areas where infill / rubble has been removed within the offset wetland area. This would require planting of locally indigenous wetland vegetation (typically occurring in Southwest Sand Fynbos) throughout the wetland area at reasonable density (approximately 4 plants per m^2).
- Implementation of the Stormwater Mitigation measures outlined in this report.
- Ensuring that the onsite offset area is managed in accordance with this plan, such that the rehabilitated state is maintained in perpetuity.

The evaluation indicated that, given effective offset interventions as outlined in **Section 8,** 0,1214 HE of wetland function and 1,3841 HE of wetland habitat could be provided by the rehabilitation of the onsite wetland offset. The results of the assessment for the onsite wetland offset area is provided in **Table 7-1** and **Table 7-2**.

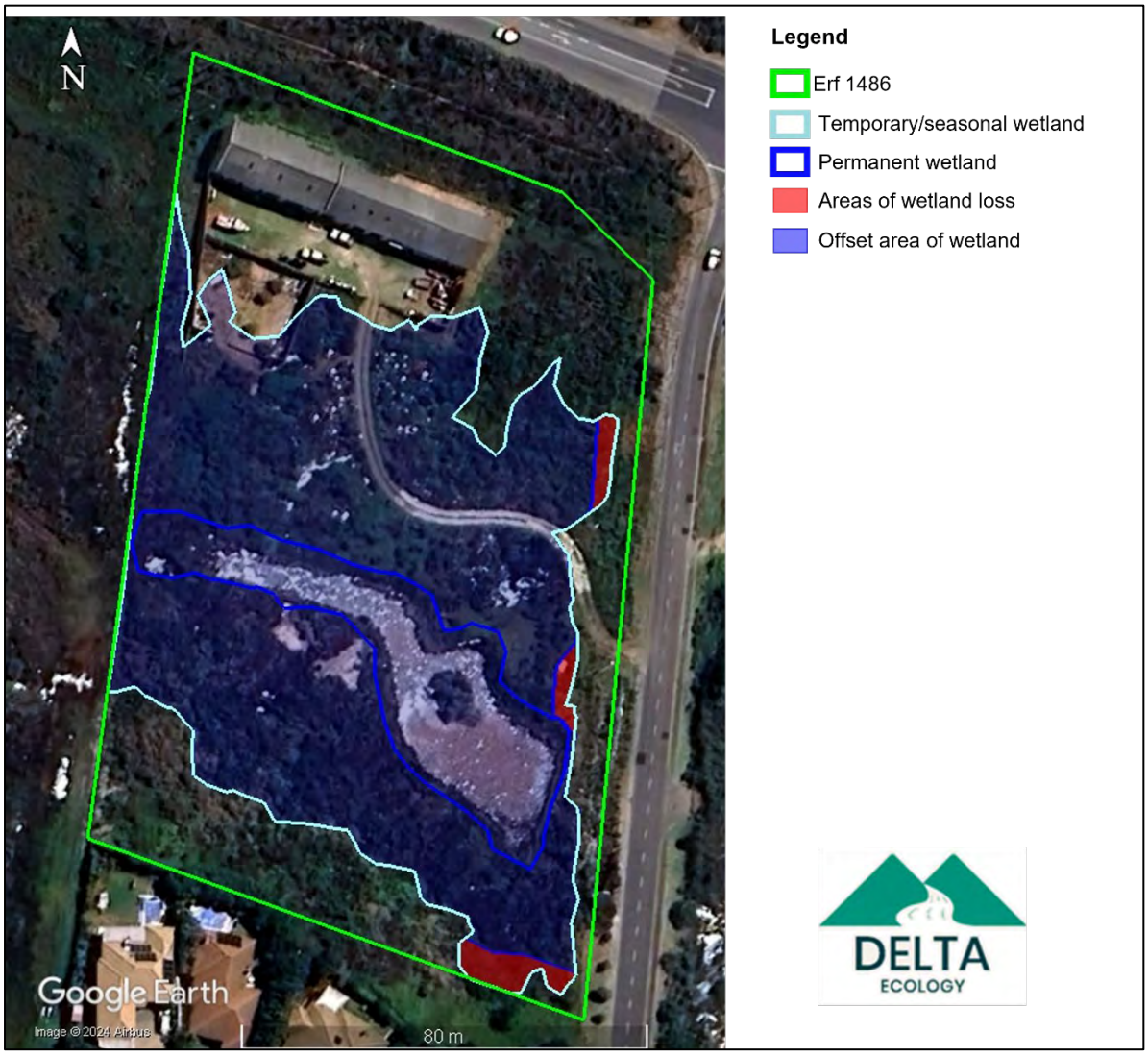


Figure 7-1: Map of the wetland offset area.

Table 7-1: Functional offset contribution results for the UVB wetland on Erf 1486.

Contribution Towards Wetland Functionality Targets				
Wetland attributes	Wetland Reference		**UVB wetland Erf 1486 (remaining - rehabilitated)**	
Alignment with site selection guidelines	**Criterion**	**Relevance**	**Site attributes**	**Acceptability Guidelines**
	Wetland type	Targeted wetlands should typically be of the same type to ensure that similar services to those impacted are improved through offset activities.	Wetland is of the same type as the impacted wetland.	Ideal
	Key services targeted	Targeted wetlands should be prioritised and selected based on their ability to compensate for key regulating and supporting services impacted by the proposed development.	Selected wetland is well placed to contribute meaningfully towards improving key regulating and supporting services identified.	Ideal

	Offset site location relative to impacted wetland	Targeted wetlands should ideally be located as close to the impacted site as possible.	Selected wetland is located within the same local catchment as the impacted wetland.	Ideal
	Overall comment on alignment with site selection guidelines	This is the remaining portion of the UVB wetland and therefore aligns very well with the priorities in the guidelines.		
Preliminary Offset Calculation	**Prior to offset activities**	Wetland size (ha)	0,876	
		Functional value (%)	58	
	Following sucessful offset implimentation	Functional value (%)	79	
		Change in functional value (%)	21	
	Preliminary Offset Contribution (Functional hectare equivalents)		**0,2**	
Final Offset Calculation	**Criterion**	**Relevance**	**Offset activity**	**Adjustment factor**
	Types of offset activities proposed	The risk of offset failure is linked to the type of offset activity planned with wetland establishment considered less preferable and more risky than rehabilitation or averted loss activities.	Rehabilitation & Protection	0,66
	Final Offset Contribution (Functional hectare equivalents)		**0,1214**	

Table 7-2: Habitat offset contribution results for the UVB wetland on Erf 1486.

Contribution Towards Ecosystem Conservation Targets				
Wetland attributes	Wetland Reference		UVB wetland Erf 1486 (remaining – rehabilitated)	
	Wetland Vegetation Group (or type based on local classification)		Southwest Sand Fynbos	
	Threat status of wetland		Threat status	**CR**
Alignment with site selection guidelines	**Criterion**	**Relevance**	**Site attributes**	**Acceptability Guidelines**
	Like for Like	Targeted wetlands should be aligned with "like-for-like" criteria to ensure that gains associated with wetland protection are commensurate with losses.	Wetland is of the same wetland type within the same wetland vegetation group	Ideal
	Landscape planning	To what degree is wetland selection aligned with Regional and National Conservation Plans	Wetlands have been identified as moderately important in landscape planning	Acceptable
	Wetland condition	The habitat condition of the wetland should ideally be as good / better that that of the impacted site prior to development (or at least B PES Category in the case of largely un-impacted wetlands)	Final habitat condition is likely to be better than that of the impacted wetland.	Ideal
	Local biodiversity value	Wetlands that are unique or that are recognised as having a high local biodiversity value should be prioritised for wetland protection.	The wetland is charachterised by habitat and / species of moderate biodiversity value.	Acceptable

	Viability of maintaining conservation values	Connectivity and consolidation with other intact ecosystems together with the potential for linkage between existing protected areas is preferable.	The wetland is well connected to other intact natural areas	Acceptable
	Overall comment on alignment with site selection guidelines	Generally, well aligned.		
Preliminary Offset Calculation	Wetland areas to be secured	Wetland size (ha)	**0,876**	
		Habitat intactness (%)	**79**	
		Wetland habitat contribution (hectare equivalents)	**0,6**	
	Buffer zones to be secured	Area of wetland buffer zone included in the wetland offset site	**0**	
		Integrity of buffer zone	**0,5**	
		Buffer zone hectare equivalents	**0,0**	
		Buffer zone contribution (hectare equivalents)	**0,0**	
Final Offset Calculation	**Criterion**	**Relevance**	**Site attributes**	**Adjustment factor**
	Security of tenure	Offset activities that formally secure offset areas for longer than the minimum requirement is more likely to be maintained in the long-term and are therefore preferred.	Highest possible level of protection permanently secured	2
	Offset Contributions	Wetland habitat contribution (hectare equivalents)	1,4	
		Buffer zone contribution (hectare equivalents)	0,0	
		Functional Offset Contribution (hectare equivalents)	**1,3841**	

8. Wetland Rehabilitation

8.1. Objectives

The vision for the identified onsite offset wetland is to improve and reinstate the range of wetland habitat and function to resemble semi-natural conditions and achieve the required increase in PES.

Effective rehabilitation of the onsite offset wetland will require achieving the following objectives:

- Removal of dumped rubble and fill material within the wetland. Reshaping of the wetland specifically in the areas where infill has been removed to ensure very slight gradual decline towards the permanent zone.
- Removal of all Alien Invasive vegetation Species (AIS) from this offset wetland area such as Kikuyu grass (*Cenchrus clandestinum*), Pampas grass (*Cortaderia selloana*), Australian myrtle (*Leptospermum laevigatum*), sweet needlebush (*Hakea drupacea*), Port Jackson (*Acacia saligna*) and rooikrans (*Acacia cyclops*), as well as all planted garden species in the southwest corner of the Erf coinciding with the wetland.
- Establishment of a healthy and moderately diverse indigenous vegetation community within any areas that have been cleared (areas historically cleared of indigenous

vegetation and cleared of AIS) as well as the areas where infill / rubble has been removed within the offset wetland area. Revegetate with indigenous wetland plant species based on the relevant species list (**Table 8-1**);

- Establish 80% total vegetation cover within the wetland system (except for open water as / where present);
- Appropriate stormwater, grey water and sewage management systems;
- Achieve a PES within upper category C.
- The onsite offset area is managed in accordance with this plan, such that the rehabilitated state is maintained in perpetuity.

Sections 8.2 to **8.6** below provide a detailed rehabilitation methodology for the onsite offset that includes the techniques involved to achieve each of these objectives. *All of the rehabilitation recommendations below must be overseen by a suitably qualified Aquatic Biodiversity specialist.*

8.2. Removal of fill material

Wetland infilling poses a direct threat to wetland habitat and function. Wetland infilling and the dumping of rubble and fill material buries hydric soils and causes aquatic habitat loss. Sections of the proposed development site has been historically impacted by infilling and currently contains foreign fill material.

To adequately restore wetland habitat and function, and to achieve PES targets, all foreign fill material (building rubble, fil material from dirt road etc.) must be removed from the onsite wetland prior to additional wetland rehabilitation interventions. The removal of infill must occur at the start of Summer, and not during the Winter rain season to prevent downstream sedimentation or erosion in this area. The substrate in the remnant wetland area should consist only of natural soils.

It is recommended that care must be taken to avoid disturbance of intact natural wetland habitat during the removal of rubble and infill and that removal should be overseen by a suitably qualified contractor. After the removal it is recommended that an aquatic biodiversity specialist should inspect the site to ensure all fill material has been removed.

All foreign fill material must be appropriately disposed of at a designated waste facility offsite. No building rubble/cleared plant material may be dumped within a natural area or within 200 m of any onsite watercourse. Once the fill material is removed from the wetland, reshaping and reprofiling should be done in the disturbed areas to ensure the wetland profile is stable and well-integrated. Once completed all cleared areas must be revegetated with appropriate indigenous species as per **Section 8.6**.

8.3. Appropriate stormwater management

Stormwater from the development will drain directly into the wetland, therefore appropriate stormwater management must be incorporated into development planning to ensure that the hydrology and water quality of the offset wetland is not negatively impacted by the proposed development. All stormwater management measures stipulated in the aquatic assessment report as well as the stormwater management plan for the development must be strictly implemented.

The proposed development will likely result in a slight increase in catchment hardening, potentially resulting in increased runoff and storm peak flows into the onsite wetland during both the

construction and operational phases. Stormwater runoff may also contain contaminants, and as such, could result in potential water quality impairment.

The following mitigation measures should be incorporated into the stormwater management design and implementation:

- Discharge stormwater from rooftops into rain harvesting tanks. This will limit the volumes of stormwater runoff that will reach the wetland. Where possible, water collected in rain harvesting tanks can be utilised for flushing of toilets, washing etc.
- Vegetated swales must be utilised rather than concrete drains or underground stormwater pipes in order to encourage infiltration, particularly next to roadways.
- Energy dissipaters / erosion protection measures (such as lining with stones, grass, reno-mattresses, or gabions) must be constructed where stormwater is released in order to reduce the runoff velocity and therefore erosion.
- Sheet runoff from hardened surfaces must be intercepted and the treatment and infiltration of runoff must be promoted.
- Sediment traps should be incorporated into stormwater drains / swales upstream of all discharge points into the wetland.
- All stormwater draining into the wetland must receive basic filtering and treatment prior to its release.
- Incorporate measures into the stormwater design to trap solid waste, debris and sediment carried by stormwater. Measures may include the use of curb inlet drain grates and debris baskets/bags.
- Stormwater generated from areas with a higher risk of contamination such as parking areas and roads must receive basic filtering and treatment prior to its release into surrounding areas. Treatment methods may include sand filter traps and oil-water separators which will require maintenance.
- The extent of hardened surfaces must be minimised. E.g. where required permeable paving must be used.
- Homeowners must be encouraged to landscape their gardens with the use of indigenous species to decrease the area of hardened surface and increase infiltration.
- Homeowners should store any potential pollutants in such a way that pollution will not occur to the wetland (such as any fuel, etc.). Potential pollutants should be stored in an adequately bunded area.
- The use of herbicides, pesticides and any other poisons within private gardens must be strictly prohibited. The home owner's association must be responsible for ensuring that residents are compliant with this.
- Backwashing of swimming pools directly into the wetland must be strictly prohibited. Backwash water can be collected in settling tanks where dirt and debris settle to the

bottom. The cleaner water can then be reused for non-potable purposes or even filtered back into the pool system. Backwash water can be diverted to greywater tanks.

- Monitor the proposed development and adjacent wetland for erosion and sedimentation after heavy rainfall events. Any erosion noted must be immediately addressed. Rehabilitation measures may include the removal of accumulated sediment by hand, filling of erosion gullies and rills, the stabilisation of gullies with silt fences, riprap, and the revegetation of stabilised areas.
- Stormwater systems will require ongoing maintenance. Any build-up of silt or debris within stormwater drains or swales will need to be cleared to ensure the continued functioning of the systems.
- Any damage to stormwater infrastructure, and any flaws identified in the functionality of stormwater infrastructure, must be rectified immediately.
- Stormwater systems must be monitored and maintained into perpetuity and collections of debris and solid waste removed from grates and baskets. The developer must confirm who will be responsible for this monitoring and maintenance as well as their roles.
- The stormwater system must be designed by a suitably qualified engineer with input from an aquatic specialist.

8.4. Removal of AIS

AIS within the offset wetland area include Kikuyu grass (*Cenchrus clandestinum*), Pampas grass (*Cortaderia selloana*), Australian myrtle (*Leptospermum laevigatum*), sweet needlebush (*Hakea drupacea*), Port Jackson (*Acacia saligna*) and rooikrans (*Acacia cyclops*), as well as planted garden species in the southwest corner of the Erf.

The dominant AIS in the wetland area include Kikuyu grass (*Cenchrus clandestinum*), Pampas grass (*Cortaderia selloana*), Port Jackson (*Acacia saligna*) and rooikrans (*Acacia cyclops*). Removal of these species has been described in more detail below, while the other species should be removed according to **Appendix A**.

8.4.1. Removal of alien invasive pampas grass

Cortaderia selloana (Pampas grass) poses a significant threat to aquatic ecosystems due to its classification as a NEMBA Category 1b invasive species. This classification mandates that pampas grass must be controlled and, wherever possible, removed and destroyed. Pampas grass is a prolific seed producer and an aggressive colonizer that can outcompete indigenous wetland plant species. Therefore, it is recommended that the Pampas Grass within the UVB wetland and the immediate surroundings be removed, and appropriate management must be in place to prevent reestablishment.

Effective methods for the removal of pampas grass include manual removal or a combination of chemical and manual methods. When removing pampas grass manually, protective gear should be worn because the flowers may cause respiratory tract irritation, and the sharp leaves can cut

the skin and cause irritation. The flower heads should be cut first and placed into a bag to prevent seed dispersal. The plant should then be cut down as close to the ground as possible, and the entire root system must be dug up to prevent resprouting.

8.4.2. Removal of alien invasive Kikuyu grass

Cenchrus clandestinus (Kikuyu) is an alien invasive grass which can out-compete indigenous wetland plant species. Therefore, it is recommended that the Kikuyu within the UVB wetland, and the immediate surrounds, should be removed.

The most effective method for Kikuyu removal is by the application of herbicide. The selective herbicide Focus Ultra, can be used to target the Kikuyu vegetation which is immediately surrounding the wetland without significantly affecting non-target indigenous plant species. **Herbicide should not be applied in wet conditions / during winter**. Herbicide should only be conducted during summer months under dry conditions.

Other control methods such as ecological burns and hand clearing may not be as effective. Burning and hand pulling can stimulate Kikuyu to grow. However, during summer, in areas that are still saturated, hand pulling should be conducted:

- The plants should be removed by digging out all rhizomes / stolons.
- Care should be taken to remove all rhizomes / stolons to prevent the kikuyu from re-sprouting.

8.4.3. Removal of alien invasive Acacia saligna and A. cyclops

Acacia saligna and *A. cyclops* both grow as small, dense, spreading trees which colonize disturbed soils. *Acacia saligna* has the ability to grow in soil with low levels of nutrients, has an early reproductive maturity and large quantity of seeds are produced. The seeds survive fire and have the ability to germinate after cutting or burning. Thus, they have displaced native indigenous fynbos vegetation through changing fire regimes. The plants have an extensive root system. It is essential to remove any individuals of these species, and ideally when they are young. *A. cyclops* is problematic in coastal and lowland parts of the Cape Provinces and has invaded roadsides and waterways.

The following recommendations are made for removing these AIS:

Hand Pulling

Use: Seedlings with a stem diameter of <5cm

Hand pulling should be implemented as the preferred clearing technique as far as possible. When implemented correctly, this method is extremely effective, yet its application is limited to seedlings. Thus, regular monitoring and follow-up treatments are important to ensure successful and economical eradication using this technique. The procedure to be implemented is as follows:

1. Wearing gloves, grip the plant firmly at the base of the stem and pull hard to remove the entire plant, including the rootstocks.
2. If the roots of the plant break off during removal, use a spade to dig them out.
3. Shake the plant to remove excess soils and dispose of the plant material at an appropriate waste disposal site.

Tree Popping

Use: Seedlings/Saplings with a stem diameter of approximately 5 cm

This technique is used for medium tree specimens and involves the use of an implement referred to as a "Tree-Popper". This tool consists of a base plate and a leaver that are joined to form a small pair of jaws (**Figure A1**). The tree is placed in the jaws of the tool and the leaver is used to pull the entire tree, including the roots, out. This tool is extremely useful for trees that are too large to be effectively removed by hand pulling yet are not yet large enough to require felling. The method to be used is similar as outlined for hand pulling, however the Tree-Popper is used instead of pulling.

Figure A1: Tree-Popper

Felling

Use: Trees with a stem diameter of >5 cm

Once the stems of trees reach a diameter of greater than 5 cm felling will need to be implemented to remove the individual. Felling can be undertaken using chain saws and bow saws. It is important that trees are cut with a neat straight cut to reduce the chance of resprouting and improve the effectiveness of stump herbicide treatment. Trees must be cut down as close to the ground as possible (between 5cm and 30cm above the ground). Felling must be undertaken by appropriately trained individuals that possess and make use of the required Personal Protective Equipment (PPE) for the task at hand.

Herbicide Stump Treatment

Use: Resprouting species that have undergone felling treatment

Port Jackson requires the use of poisan, whilst the Rooikrans usually dies when cut below the lowest branch. To prevent resprouting of Port Jackson, a herbicide treatment needs to be applied post felling. Once the tree has been cut down to create a smooth surface that exposes the outer rings of the stem where the trunk grows (the cambium) a 3% Tryclopyr herbicide solution must be applied to the freshly cut surface. All side branches should also be removed and treated with herbicide. The herbicide treatment should be applied as soon as possible after felling (preferably

within 3 minutes) to ensure effective treatment. Where trees with a diameter of greater than 10cm are felled, only the outer rings need to be treated with herbicide. Due to the potentially hazardous nature of herbicides, the precautions outlined in the *Foliar Treatment* section above should also be applied during herbicide stump treatment.

Herbicides can kill indigenous plant species, and some are toxic to people and animals. It is therefore important to **prevent environmental contamination with herbicide**. The following measures are therefore recommended:

- Do not apply herbicide while it is raining and take care to prevent it from spilling, spraying, or spreading onto the ground or onto non-target species.
- Rain may wash herbicide into watercourses and spread it downstream, or across banks that need to be revegetated.
- Never wash herbicide equipment or dispose of waste spray mixture in or near watercourses where contamination can occur.

The introduction of the acacia gall rust fungus *(Uromycladium tepperianum),* can be introduced onsite if the Port Jackson trees persist to be a problem. Consultation with a Botanist and/or Entomologist prior to introduction is recommended.

8.5. Revegetation

Revegetation must be undertaken under the guidance of a suitably qualified landscaper / professional. Vegetation is a key component of the functioning of wetland systems and affects not only habitat quality but also geomorphology, hydrology, and water quality. Revegetation is thus essential for successful wetland rehabilitation.

Vegetation provides numerous functions that facilitate the formation and maintenance of healthy wetland systems:

- Vegetation reduces the risk of erosion and promotes sediment deposition by slowing the flow of water and holding soil together;
- Vegetation assists in improving water quality by increasing the ability of wetlands to assimilate phosphates, nitrates, and toxicants;
- Wetland vegetation provides habitat for wetland biota;
- Vegetation minimizes the impacts of catchment hardening by increasing surface roughness and therefore the capacity of the wetland to attenuate flow; and
- Established indigenous vegetation prevents the regrowth of AIS.

The identified onsite offset wetland is located within Vermont and although the area is surrounded by residential areas; there is connection to natural areas upstream and downstream. Therefore, natural recruitment of indigenous wetland plants into the offset wetland may take place, although slowly. Thus, active revegetation in the form of manual planting should be implemented to ensure that required restoration targets are effectively met. It is highly likely that establishment of natural vegetation at the scale of the proposed offset is economically feasible through planting.

The aim in terms of onsite offset wetland revegetation is to reach 80% total natural wetland vegetation cover within 8-12 months after revegetation interventions have been completed. The species and general techniques to be used for revegetation are outlined in the subsections below.

8.5.1. Procurement

Successful rehabilitation requires the use of healthy, genetically sound, and locally appropriate plant material. Seed and plants for rehabilitation purposes must be procured from nurseries with due regard for the source of the genetic stock. Specialists from nurseries should be able to advise on this.

Bagged plants of appropriate genetic stock of the required species can be purchased in limited quantities either from the Kraaibosch Nursery (+27 44 889 0092), Fynbos Life Nursery (082 378 9445) or from the Kirstenbosch Botanical Gardens nursery (021 797 1305). Intaba, a company specialising in rehabilitation and indigenously landscaped gardens, also has a healthy indigenous plant nursery from which plants could potentially be obtained (087 943 4524).

The nurseries will require sufficient notice to secure the required plant material. Sufficient quantities of the required species should ideally be ordered at least 12 months (6 months minimum) prior to when planting is scheduled to commence.

8.5.2. Species for revegetation

The vegetation within the wetland portion located on Erf 1486 was moderately modified at the time of the site assessments. According to the Botanist appointed for the proposed project, at least one plant SoCC (*Disa hallackii*) may be present in low numbers (Nick Helme Botanical Surveys, 2023). Care must be taken to avoid any further indigenous vegetation disturbance during rehabilitation activities.

A list of indigenous wetland plant species which should be used for revegetation of the onsite offset wetland has subsequently been compiled (**Table 8-1**). This species list was developed based on the wetland plant species identified within the Vermont salt pan which share the same wetland vegetation type as the onsite wetland, along with specialist knowledge of the wetland vegetation type (**Table 8-1**). Additional plant species can be obtained from the appointed landscaper.

A minimum of six species from this species list must be introduced to the wetland. Species selection can be guided by availability provided that species from all hydrological zones are represented. It should further be noted that although *Typha Capensis* occurs naturally in the region, this species can become problematic and should not be used for revegetation purposes.

Wetland species should be planted in the correct hydrological zones (temporary, seasonal, permanent). The remnant UVB wetland within Erf 1486 exhibits permanent zonation in the central depression onsite and seasonal / temporary zonation around the central depression. Rapidly growing species that tend to stabilise soil are best for areas vulnerable to erosion.

Table 8-1: List of indigenous plant species that can be introduced to the offset wetland.

Family	Species	Status	General information	Wetland Plant Type	Hydrological Zone
Asteraceae	*Senecio halimifolius*	LC	Indigenous	Facultative wetland	Temporary
Cyperaceae	*Bolboschoenus maritimus*	LC	Indigenous	Obligate wetland	Permanent
Cyperaceae	*Cyperus textilis*	LC	Endemic	Obligate wetland	Permanent/seasonal
Cyperaceae	*Cyperus thunbergii*	LC	Endemic	Obligate wetland	Seasonal/temporary

Cyperaceae	*Hellmuthia membranaceae*	LC	Endemic	Facultative wetland	Permanent/seasonal
Cyperaceae	*Ficinia nodosa*	LC	Indigenous	Obligate wetland	Permanent/seasonal
Poaceae	*Pennisetum macrourum*	LC	Indigenous	Obligate wetland	Permanent/seasonal
Restionaceae	*Elegia capensis*	LC	Endemic	Obligate wetland	Permanent
Rosaceae	*Cliffortia strobilifera*	LC	Indigenous	Obligate wetland	Permanent/seasonal
Dennstaedtiaceae	**Pteridium aquilinum*	LC	Indigenous	Facultative wetland	Seasonal/temporary

*Can be used to stabilise soils. Can invade disturbed areas and therefore should be monitored.

8.5.3. Planting and seeding techniques

Planting

To ensure adequate rehabilitation, planting must be done at a reasonable density of approximately 4 plants per square meter. Vegetation that has recently been planted is generally susceptible to being washed away until it has become well established. Transplanting of whole plants with well-established roots in a growing medium is one of the most reliable revegetation techniques. While several species suggested for revegetation can be grown from seeds and propagules, it is recommended that the majority of revegetation activities are focused on the introduction of whole plants, particularly into areas that are vulnerable to erosion.

The recommended general planting procedures are as follows:

- Use a spade to dig a square hole that is 1.5 times the depth and 2 times the width of the bag containing the plant.
- Remove the plant from its container and carefully loosen the soil by hand, being careful to not damage the roots and maintain as much of the soil as possible.
- Place the plant and associated soil in the hole.
- Replace the soil originally removed and ensure that it forms a slight depression (1-3 cm below the level of the surrounding soil) with the plant in the centre of the depression.
- Compress the soil firmly by hand.
- For plants placed in the temporary zone watering should be done approximately once every three days for the first six months after planting unless rain has fallen within the preceding 24 hours. Rainfall during the winter months (June – August for the proposed site) can substantially reduce the required watering effort. However, given that revegetation within the onsite offset wetland needs to be undertaken as rapidly as possible planting should be initiated as soon as the infill has been removed from the wetland area, and the remnant wetland has been appropriately shaped along with sufficient watering efforts.
- The best time for planting is autumn (March-May). This allows for the plants to establish roots before being subjected to heavy rains. Planting in autumn therefore reduces the risk of erosion / sedimentation, having plants wash away and will reduce watering requirements.

Procedure for sowing seeds:

- Use a rake to lightly disturb areas of bare soil.
- Spread seeds from indigenous wetland plant species evenly across prepared soil.
- The best time to sow the seeds is in autumn.
- Conduct maintenance on the areas where the seeds were sown, carefully remove any weeds.

Procedure for planting propagules:

- Obtain healthy adult plants with sufficient plant material to generate propagules.
- Neatly cut the stem based on individual species requirements using pruning shears.
- Plant propagules as per the general planting protocol. A 20 cm wide by 20 cm deep hole should be sufficient for the cutting. Ensure that approximately half of the cutting is below ground while the other half is above ground.

Inspection and Follow-up:

Prior to revegetation, the onsite offset wetland and UVB wetland must be inspected and photographed to serve as a record for the pre-planting condition of the area. Following the implementation of revegetation interventions, monitoring must be undertaken to determine the relative success of revegetation:

- The wetland area must be inspected by a freshwater specialist after planting has been conducted and thereafter every 6 months until the required cover (80%) has been achieved. Photographs must be taken of the planted areas to document the revegetation process.
- The site must be inspected by a SACNASP registered freshwater specialist 12 months after the revegetation plan has been completed to determine whether the required degree of cover (80%) has been achieved.
- If the required 80% total cover has not been achieved, recommendations from the SACNASP registered freshwater specialist to improve cover must be provided.

8.5.4. Residential landscaping

Indigenous plant species must be used for residential landscaping, this promotes local biodiversity and protects the wetlands ecosystem. Residents are prohibited from utilising alien grasses, such as Kikuyu. Instead, indigenous grasses like Buffalo grass (*Bouteloua dactyloides*) should be used. Native species are better adapted to local climate conditions, require less water and maintenance, and support local wildlife.

9. Role Players

Wetland rehabilitation has significant labour and specialist requirements, and the implementation of the wetland rehabilitation plan will require the collaboration of several role players. The responsibility of each entity is outlined in **Table 9-1** below.

The practical and financial aspects pertaining to the required offset activities are the responsibility of the Water Use Licence (WUL) holder, in this case, the owner of Erf 1486. Given the scale of the

proposed offset, several commercial entities are potentially available to conduct the required rehabilitation activities. It is the WUL holders' responsibility to ensure that they appoint appropriate implementing agents based on the size and level of project complexity for the site in question. The project must be managed by a suitably qualified freshwater specialist / landscaper with experience in wetland rehabilitation.

Table 9-1: Responsibilities of key role players in wetland rehabilitation.

Role Player	Responsibility
WUL Holder	Implementation of the wetland offset plan. Appoint appropriate implementing agents.
Construction Implementing Agent	Remove foreign fill material from the proposed offset wetland (where applicable).
Rehabilitation Implementing Agent (Suitably qualified freshwater specialist and landscaper with experience in wetland rehabilitation)	Plant, seed, and propagule procurement. Implement propagation, seeding and planting at appropriate plant densities.

10. Monitoring and Management Plan

Monitoring must be conducted during wetland rehabilitation to ensure that the relevant aims and objectives are met, and that ecological functionality is restored to target levels. Once target levels are reached, long-term management activities are necessary to ensure that the offset UVB wetland is maintained at the target ecological status (PES of Upper Category C). The implementation of these management interventions will further be monitored to determine effectiveness and can be adapted as needed.

10.1. Desired State

The desired state for the offset UVB wetland located on Erf 1486 is to improve the PES to an upper category C with a minimum PES Score of 79 %.

Once the PES target has been achieved through implementation of the wetland rehabilitation plan, the wetland on the site needs to be managed in such a way that the PES target is either maintained in perpetuity or gradually improved.

10.2. Monitoring

10.2.1. Rehabilitation Phase

A minimum of two site visits from a freshwater specialist will be required to ensure rehabilitation success:

- A site visit after the removal of fill material, rubble, etc. from the onsite wetland has been completed to ensure that the final result is in line with the requirements of this management plan.
- A site visit 12 months after planting has taken place.

If the PES target for the onsite wetland has not been met, an annual site visit must be conducted until such time as the required PES score has been obtained. The site visits must include an estimate of vegetation cover and species assemblage. Based on these findings, the freshwater specialist must provide recommendations on any potential interventions needed to achieve the required PES target. A present ecological state assessment will not be necessary as the wetland will have reached the target PES if the rehabilitation objectives have been achieved. Annual site visits during rehabilitation should include fixed point photography (**Section 10.2.3**).

10.2.2. Post Rehabilitation Phase

Once rehabilitation has been completed and signed off, by a freshwater specialist an audit must be conducted once every 5 years from the date of commencement of the initial wetland rehabilitation. The owner of Erf 1486 must appoint an independent environmental auditor with specialist knowledge of wetland ecology, or a freshwater specialist, to conduct these audits.

The auditor must evaluate compliance with the management plan and applicable environmental legislation. The auditor must evaluate management effectiveness by assessing:

- The PES of the offset wetland area using the WET-Health Version 2 (Macfarlane *et al.* 2020) method.
- Changes in estimated vegetation cover, presence of erosion, and presence of alien vegetation, based on past photography and aerial/satellite photography available from, the Chief Directorate, National Geospatial Information and/or Google Earth, and informed by a site inspection.

In addition, the auditor should note any significant emerging ecological problems observed during the site inspection that may affect PES over the next 5 year such as the emergence of new alien or significant indigenous species and senescence. Recommendations must be provided for addressing these issues such that the PES is maintained.

10.2.3. Fixed point photography

Fixed point photography is useful to monitor the overall wetland rehabilitation progress. Fixed-point photography provides an indication of where management interventions may be needed, serves as a record of where management interventions have been implemented, and can be used to assess the general success of these interventions.

During the rehabilitation of the wetland, fixed-point photography must be conducted annually in the same month as the first fixed point photographs are taken. This can be reduced to once every 5 years once rehabilitation has been completed.

A minimum of four fixed photograph points must be implemented to ensure the majority of the wetland is recorded. GPS coordinates should be taken for each point to ensure precise location accuracy. Photos must be taken from exactly the same point. Install a permanent marker at each point to guarantee consistent photo capture from the exact point. Photos must be taken facing the same direction. Photographs must be taken at a height of 1.5 m while standing at each position. A wide-angle lens of 25mm to 32 mm, or equivalent, must be used such that the field of view remains largely consistent. Photographs are to be kept by the applicant and should be stored in an organised database for presentation to auditors at each subsequent audit.

10.3. Management Interventions

Minimal management interventions will be required to maintain the PES of the onsite watercourse. The following issues should be addressed as soon as possible, should they be detected.

10.3.1. Erosion control

Erosion may occur in the onsite wetland due to stormwater peak flows. Signs of erosion should be checked monthly. Erosion should be addressed as soon as possible after detection.

Advice on how to address the observed erosion must be sought from a freshwater specialist but generally the following is recommended:

- Soft engineering approaches are generally encouraged over hard engineering approaches, although they will not always be appropriate or cost effective depending on the situation. Soft stabilization techniques include geotextiles, fibre mats / nets / blankets / bags, brush mattresses, sandbags, and live staking.
- Cover affected portions with a geotextile fabric, secured with stakes. Cut holes in the fabric for planting. Plant a mixture of the plants recommended as per Section 8.6. Gradually remove the fabric as plants become established.
- Erosion rills and gullies must be filled with rocks of between 5cm and 20 cm diameter and silt fences or fascine work must be established along the gulley for additional protection until vegetation has established.
- Rip / loosen compacted surfaces to a depth of approximately 30 cm to improve infiltration and reduce runoff.

10.3.2. Alien Invasive Species

Maintenance of the required PES targets will require effective ongoing alien vegetation control to ensure no alien vegetation re-establishes over time. Pampas grass is currently the greatest priority alien invasive species onsite. This species produces vast amounts of seed and will likely have a well-established seed bank within the offset wetland. During the rehabilitation phase continued monthly alien invasive monitoring and clearing must take place. Once the rehabilitation has been concluded, quarterly clearing must be conducted for 5 – 10 years. This can be reduced to yearly inspections and clearing only once two consecutive quarterly inspections do not reveal a single invasive individual. All alien and invasive species must be gradually removed from the property in order to ensure compliance with the NEM:BA (Act no. 10 of 2004). This act states that all landowners must control listed alien and invasive plant species on their property according to the NEM:BA: Alien and Invasive Regulations (2014) and associated Alien Species List (2020).

If any of the alien invasive species listed in **Appendix A** are noted within the wetland offset, they must be removed timeously using the methods indicated in this Appendix.

11. Conclusion and Recommendations

The UVB wetland area that will be lost due to proposed development was evaluated by application of the Macfarlane et al. (2016) wetland offset guidelines and calculator to determine the functional and habitat value thereof in a currency known as Hectare Equivalents (HE). The maximum wetland offset within the site was further identified and evaluated to determine the wetland value that could be gained through maximum onsite rehabilitation, and management effort.

The total wetland loss was valued at 0,0139 HE of function and 0,1323 HE of habitat. The maximum potential wetland gain from onsite offset activities was valued at 0,1214 HE of function and 1,3841 HE of habitat. This resulted in a surplus of 0,1075 HE of function and 1,2518 HE of wetland habitat. This will satisfy the habitat offset requirements. The results of the offset calculations are presented in **Table 11-1**.

Table 11-1: Offset balance table indicating net results of the onsite offset feasibility study.

Offset Balance Table						
Wetland Name	**Area (ha)**		**Function (HE)**		**Habitat (HE)**	
	Losses	**Gains**	**Losses**	**Gains**	**Losses**	**Gains**
UVB Wetland (portion lost)	-0,0240	0,0000	-0,0139	0,0000	-0,1323	0,0000
UVB Wetland (remaining – rehabilitated)	0,0000	0,8760	0,0000	0,1214	0,0000	1,3841
Subtotal (HE)	-0,0240	0,8760	-0,0139	0,1214	-0,1323	1,3841
Balance (HE)	**0,8520**		**0,1075**		**1,2518**	

During the site assessment it was found that the identified offset wetland on Erf 1486 was in a largely modified state, largely due to the presence of foreign fill material and the presence of alien invasive vegetation. A detailed wetland rehabilitation plan was drafted to address these factors through the removal of foreign fill material, revegetation, and stormwater management, thereby achieving an increase in PES from category D to upper category C for the identified onsite offset wetland. A management plan was drafted thereafter to ensure that the gains achieved through rehabilitation are maintained or slowly increased.

This wetland offset, rehabilitation and management plan is practically implementable and will allow for the maximum onsite wetland offset possible without compromising the feasibility of the proposed development.

It is thus the opinion of the specialist that implementation of this plan would result in substantial biodiversity gains, and offset the loss incurred through construction and operation of the proposed development. It is therefore acceptable from a wetland and general biodiversity perspective to approve the proposed development with implementation of this offset, rehabilitation, and management plan as a condition of approval.

References

CSIR. 2011. Freshwater Priority Areas.

Delta Ecology. 2023. Aquatic Biodiversity Impact Assessment Erf 1486 Vermont. Delta Ecology. RSA

DFFE. 2023. National Web based Environmental Screening Tool.

Enviroswift. 2018. Freshwater Screening of Erf 1486, Vermont, Western Cape Province. RSA.

GAPP Architects & Urban Designers. 2023. Lansdowne Affordable Housing. Status Quo and Urban Design Concepts Erf 62594.

Kotze D, Macfarlane D, Mander M, Collins N, Texeira-Leite A, Lagesse J, Pringle C, Marneweck G, Batchelor A, Lindley D. 2020. WET-EcoServices (Version 2) A technique for rapidly assessing ecosystem services supplied by wetlands and riparian areas.

Macfarlane D, Holness S, von Hase A, Brownlie S, Dini J, Kilian V. 2016. Wetland offsets: A best practice guideline for South Africa.

Macfarlane D, Ollis D, Kotze D. 2020. WET-Health (Version 2.0) A Refined Suite of Tools for Assessing the Present Ecological State of Wetland Ecosystems.

NASA SRTM30 DEM. 2013. NASA Shuttle Radar Topography Mission (SRTM) Global. Open Topography.

Russell W. 2009. WET-Rehab Methods: National guidelines and methods for wetland rehabilitation. Available from http://wetlands.sanbi.org.

SANBI. 2018. VegMap. Available from https://gis.elsenburg.com/apps/cfm/.

Schulze R. 2009. South African Atlas of Agrohydrology and Climatology. Water Research Commission, WRC (TT82-96).

Schulze R, Hallowes L, Horan M, Lumsden T, Pike A, Thornton-Dibb S, Warburton M. 2007. South African Quaternary Catchments Database. WRC Report 1489/1/06, Section 2.3. Pretoria.

Van Ginkel CE, Glen RP, Gordon-Gray KD, Cilliers CJ, Muasya M, van Deventer PP. 2011. Easy identification of some South African wetland plants. Water Research Commission.

Van Oudtshoorn, F. 2014. Third Revised Edition, Second Print. Guide to Grasses of South Africa. Briza Publications, Pretoria, RSA.

Van Zyl, K., Morton, R., & Gericke, J. 2023. Aquatic Biodiversity Impact Assessment Erf 1486 Vermont V2.0. Delta Ecology. RSA

Wetland Solutions. 2012. Invasive Alien Species Clearing Guidelines for The Upper Palmiet River Catchment.

Appendix A: Invasive Species

Invasive vegetation can have a profoundly negative impact on aquatic systems and can threaten their ecological integrity. Invasive alien species tend to become dominant and can outcompete native plants by forming dense stands. This can result in a reduction of overall biodiversity of the system. When woody alien invasive species occur in high densities near aquatic systems it causes reduced average flow, decreased aquatic biodiversity, and increased erosion and sedimentation. Several invasive species are present in semi natural to disturbed areas within the wetland currently, or close to the wetland on the proposed development site. These could potentially impact the offset areas in the future and will require monitoring as mentioned in **Section 10.3.3** of this report. The appearance of the main invasive species of concern are indicated in **Table A** below. This table serves as a guideline to assist with species identification for monitoring and clearing operations.

Table A: Relevant invasive species of concern.

Species	Species Appearance
Cenchrus clandestinus (Kikuyu grass)	 
Solanum mauritianum (Bugweed)	  © Invasives.org.za

Solanum sisymbriifolium (Red Buffalo-Bur)	  © Invasives.org.za
Plantago lanceolata (Buckhorn Plantain)	   © https://www.wildwales-seeds.co.uk/product/ribwort-plantain-plantago-lanceolata/ © Petr Harant © Sandy Wolkenberg
Acacia saligna (Port Jacksons willow)	  © Invasives.org.za

Pinus pinaster (Cluster Pine)	  © Invasives.org.za
Pinus radiata (Radiata Pine)	  © Invasives.org.za
Pinus halepensis (Aleppo Pine)	  © Invasives.org.za

Populus deltoides (Eastern Cottonwood)	  © Janet and Phil inaturalist databse © Karen Scopel

Methods for removal of invasive plants species of concern

The effective eradication and control of invasive plants requires initial clearing as well as follow-up interventions and continued monitoring. There are several initial clearing methods that can be implemented to remove invasive species of concern found on the identified offset wetlands. It is equally important for erosion control and to keep alien species suppressed, that the cleared areas be planted with locally indigenous wetland species. This is however dealt with in Section 8 above.

Hand Pulling

Use: Seedlings with a stem diameter of <5cm

Hand pulling should be implemented as the preferred clearing technique as far as possible. When implemented correctly, this method is extremely effective, yet its application is limited to seedlings. Thus, regular monitoring and follow-up treatments are important to ensure successful and economical eradication using this technique. The procedure to be implemented is as follows:

4. Wearing gloves, grip the plant firmly at the base of the stem and pull hard to remove the entire plant, including the rootstocks.
5. If the roots of the plant break off during removal, use a spade to dig them out.
6. Shake the plant to remove excess soils and dispose of the plant material at an appropriate waste disposal site.

Tree Popping

Use: Seedlings/Saplings with a stem diameter of approximately 5 cm

This technique is used for medium tree specimens and involves the use of an implement referred to as a "Tree-Popper". This tool consists of a base plate and a leaver that are joined to form a small pair of jaws (**Figure A1**). The tree is placed in the jaws of the tool and the leaver is used to pull the entire tree, including the roots, out. This tool is extremely useful for trees that are too large to be effectively removed by hand pulling yet are not yet large enough to require felling. The method to be used is similar as outlined for hand pulling, however the Tree-Popper is used instead of pulling.

Figure A1: Tree-Popper

Felling

Use: Trees with a stem diameter of >5 cm

Once the stems of trees reach a diameter of greater than 5 cm felling will need to be implemented to remove the individual. Felling can be undertaken using chain saws and bow saws. It is important that trees are cut with a neat straight cut to reduce the chance of resprouting and improve the effectiveness of stump herbicide treatment. Trees must be cut down as close to the ground as possible (between 5cm and 30cm above the ground). Felling must be undertaken by appropriately trained individuals that possess and make use of the required Personal Protective Equipment (PPE) for the task at hand.

Herbicide Stump Treatment

Use: Resprouting species that have undergone felling treatment

To prevent resprout from the stump after felling, an herbicide treatment needs to be applied post felling. Once the tree has been cut down to create a smooth surface that exposes the outer rings of the stem where the trunk grows (the cambium) a 3% Tryclopyr herbicide solution must be applied to the freshly cut surface. All side branches should also be removed and treated with herbicide. The herbicide treatment should be applied as soon as possible after felling (preferably within 3 minutes) to ensure effective treatment. Where trees with a diameter of greater than 10cm are felled, only the outer rings need to be treated with herbicide. Due to the potentially hazardous nature of herbicides, the precautions outlined in the *Foliar Treatment* section above should also be applied during herbicide stump treatment.

Herbicides can kill indigenous plant species, and some are toxic to people and animals. It is therefore important to **prevent environmental contamination with herbicide**. The following measures are therefore recommended:

- Do not apply herbicide while it is raining and take care to prevent it from spilling, spraying, or spreading onto the ground or onto non-target species.

- Rain may wash herbicide into watercourses and spread it downstream, or across banks that need to be revegetated.
- Never wash herbicide equipment or dispose of waste spray mixture in or near watercourses where contamination can occur.

Disturbed areas from which alien plant species have been removed must be reshaped so that they tie in with surrounding UVBW slope and must be rehabilitated immediately according to the revegetation **Section 8.5**.