Wetland Offset, Rehabilitation, and Management Plan

Erf 438 Stanford, Western Cape

For: Lornay Environmental Consulting

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Report Information

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Executive Summary

The owner of Erf 438, Standford, Overstrand Local Municipality, is proposing the establishment of a residential "Eco-Lifestyle" estate on the property that will be known as the Stanford Eco Estate.

The proposed development covers an area of approximately 5.23 hectares and will comprise the following:

- 28 Residential Properties:
    - 27 x Residential Zone 1: Single Residential (Erf 1 to 26, 28);
    - 1 x General Residential Zone 1: Town Housing – Erf 27 consent use for tourist accommodation (The lodge).
- Private Open Spaces; and
- Private and Public Roads.

Following an aquatic biodiversity assessment conducted on the 25th of July 2023, three wetlands were confirmed and delineated within the study site. Onsite wetlands include a hillslope seep wetland and two natural Unchanneled Valley-Bottom (UVB) wetlands coinciding with non-perennial drainage lines, were confirmed and delineated onsite (Gericke, 2023).

During the aquatic biodiversity assessment, the seep wetland was determined to be significantly degraded. The degraded state is due to historical vegetation clearing, soil compaction, ploughing, and the introduction of non-native soil. Much of the natural vegetation has been removed and replaced with grass cultivated for roll-on lawns, with only scattered, disturbance-tolerant wetland species remaining.

In contrast, the Mill Stream UVB wetland retains moderate ecological function despite being affected by surrounding land use. The vegetation is dominated by robust stands of *Phragmites australis* and *Typha capensis*. However, the wetland is impacted by the presence of mature Eucalyptus trees growing along the wetlands edge.

The small tributary UVB wetland, which crosses the southern corner of the site, is in the best condition of the three and exhibits the highest ecological sensitivity. Its vegetation is moderately diverse and dominated by indigenous wetland species.

The entirety of the seriously degraded seep wetland will be lost. To offset this loss, rehabilitation interventions will be undertaken on the two remaining UVB wetlands, which will be designated as wetland offset areas. An additional offsite portion of the Mill Stream UVB wetland has been identified and will be included in the overall wetland offset. This wetland area falls within the jurisdiction of the Overstrand Municipality. Following a series of engagements with relevant municipal officials, a formal lease agreement will be established between the developer and the Overstrand Municipality to secure the use and rehabilitation of the offsite wetland area.

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

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

- *The wetland rehabilitation efforts should increase the PES of the onsite and offsite offset wetland areas to upper category C with a minimum PES Score of 79 % as follows*:

Wetland rehabilitation within the wetland offset areas involves improving natural functionality and habitat. Soft engineering should be made use of rather than hard engineering by using natural landscape features and vegetation to direct water flow where possible.

- Removal, thinning, and control of dense stands of *Phragmites australis* (Common Reed). Although indigenous, *Phragmites australis* can become problematic in disturbed wetlands, such as those with excess nutrients, altered flow regimes, or increased sediment input, where it outcompetes other indigenous wetland plants and forms dense monocultures. These dense stands reduce open-water habitat, slow water flow, trap sediment, and subsequently alter the natural hydrology of the wetland. Since *Phragmites australis* is indigenous, the goal is not eradication but rather active management to maintain ecological balance and wetland function.
- Removal of all alien invasive vegetation from the offset wetland areas and adjacent buffer area. In particular, the area adjacent to the Mill Stream UVB wetland within the proposed development area is currently invaded by dense stands of *Eucalyptus camaldulensis* (Red River gum) trees. *Eucalyptus camaldulensis* in this area has decreased the species richness and diversity of indigenous wetland vegetation, as they release allelopathic substances that prevents other plant species from germinating (Ruwanza *et al*. 2015). Combined with the heavy shading and accumulation of leaf litter beneath their canopy, these factors have further suppressed the growth and regeneration of indigenous vegetation.
- Removal of all dumped rubble and fill material within the offset wetland areas.
- Reshape the northeastern bank of the onsite Mill Stream UVB wetland to create a more gradual slope, reflecting the natural topography of a UVB wetland, with gentle slopes and varied microtopography. This structure is essential for supporting key ecosystem services such as sediment and nutrient retention, groundwater recharge, flood attenuation, and the provision of diverse wetland habitats.
- Establishment of a healthy and diverse indigenous vegetation community within the offset wetland areas. Revegetate, where necessary, with indigenous wetland plant species based on the relevant species list in this report and within the Landscape Plan for the development. This would require planting of locally indigenous wetland vegetation throughout the wetland area at reasonable density (approximately 4 plants per m^2). The vegetation should ultimately form dense cover, with intermediate to tall height / robustness to assist with flood attenuation, sediment trapping, phosphate / nitrate / toxicant assimilation, amongst other provisioning and cultural wetland ecosystem services.
- To protect the onsite wetland offset area, the development must carefully manage stormwater to maintain both water quantity and quality. This will be achieved through the installation of a vegetated swale, landscaped with indigenous wetland species, which will convey stormwater flow toward the designated wetland offset area. The swale will help regulate flow, reduce runoff velocity, and filter out pollutants.
- The rehabilitation of the wetlands is expected to enhance cultural ecosystem services, particularly in terms of aesthetic value, recreation, and tourism potential. By creating

visually appealing and ecologically functional wetlands, the site will offer visitors an opportunity to engage with nature in an urban setting. The inclusion of a walkway and a floating deck will further contribute to this value, encouraging education, passive recreation, and appreciation of the site's biodiversity and natural beauty.

- Ensure the protection of the Western Leopard Toad (*Sclerophrys pantherina*) during rehabilitation and development activities. Rehabilitation and development activities within and around the wetland offset areas must prioritise the protection of the Critically Endangered Western Leopard Toad. All interventions should be mindful of the species' habitat requirements, breeding season and movement patterns. Toad-friendly design principles must be incorporated into stormwater infrastructure, road crossings, and other relevant features to prevent entrapment and facilitate safe passage. The protection of the toad must be considered throughout the planning, implementation, and long-term management phases of the wetland rehabilitation process.
- Ensure that the offset areas are managed in accordance with this plan, such that the rehabilitated state is maintained in perpetuity.

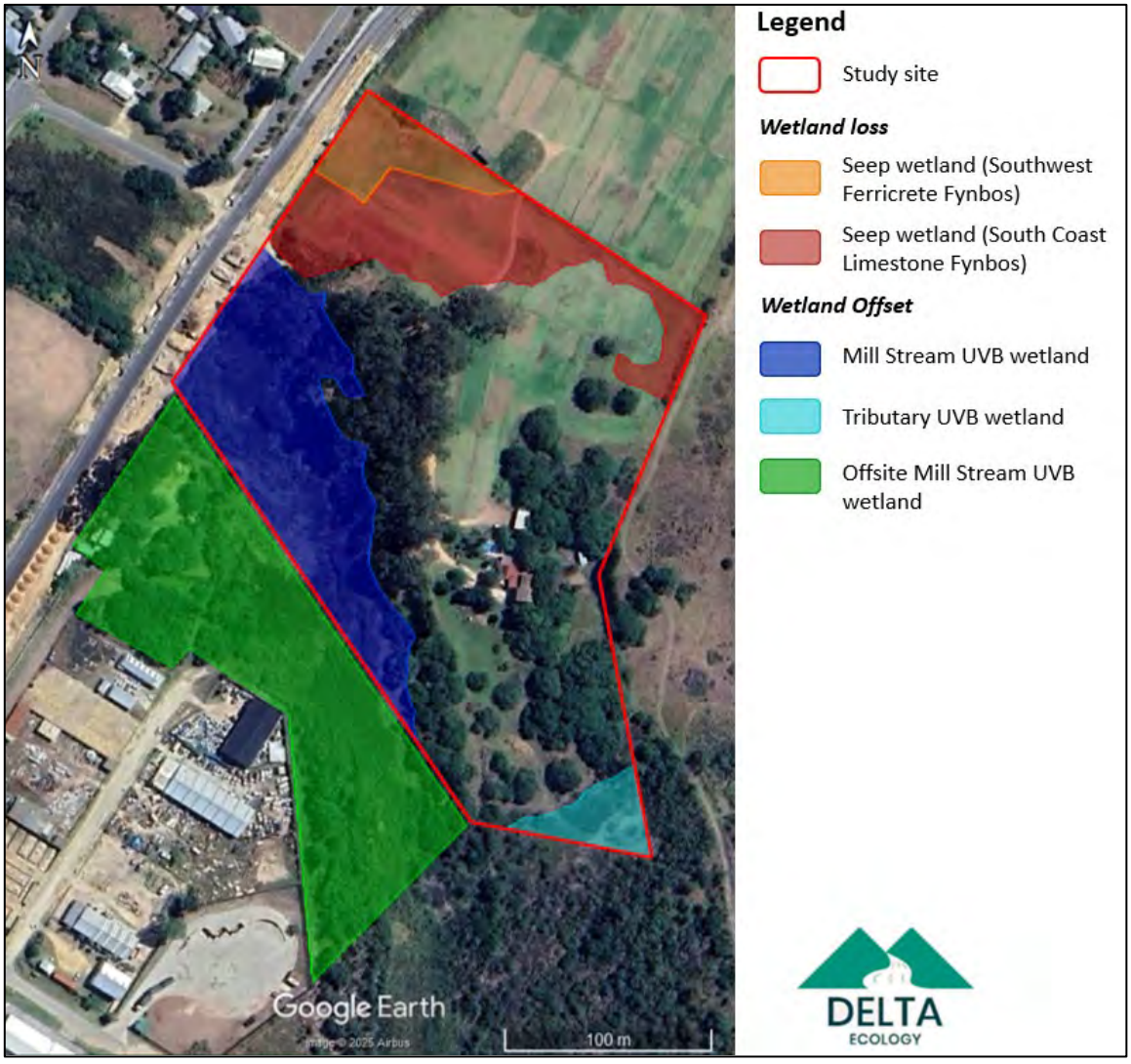

Figure i: Wetland loss and wetland offset areas.

The proposed development will result in the complete loss of the degraded seep wetland. The wetland loss 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 establishment, rehabilitation, and management effort. The results of the offset calculations are presented in **Table i** below.

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

Offset Balance Table						
Wetland Name	**Area (ha)**		**Function (HE)**		**Habitat (HE)**	
	Losses	**Gains**	**losses**	**Gains**	**Losses**	**Gains**
Seep wetland lost (LT)	-0,7000	0,0000	-0,2660	0,0000	-0,0140	0,0000
Seep wetland lost (CR)	-0,2000	0,0000	-0,0760	0,0000	-0,2400	0,0000
Mill Stream UVB wetland rehabilitated	0,0000	1,0400	0,0000	0,1304	0,0000	1,8532
Tributary UVB wetland rehabilitated	0,0000	0,2000	0,0000	0,0026	0,0000	0,3760
Subtotal (HE)	*-0,9000*	1,2400	*-0,3420*	*0,1331*	*-0,2540*	*2,2292*
Balance (HE)	**0,3400**		**-0,2089**		**1,9728**	
Offsite wetland offset area included						
Offsite Mill Stream UVB wetland rehabilitated	0,0000	1,7000	0,0000	0,2244	0,0000	2,7460
Subtotal (HE)	*-0,9000*	*2,9400*	*-0,3420*	*0,3575*	*-0,2540*	*4,9752*
Balance (HE)	**2,0400**		**0,0155**		**4,7212**	

The total wetland loss was valued at -0,3420 HE of function and -0,2540 HE of habitat. The onsite wetland offset activities resulted in a surplus of 1,9728 HE of wetland habitat while wetland function was not completely achieved. The onsite wetland offset does not fully offset the loss of the Seep wetland. *To address this shortfall, the additional offsite Mill Stream UVB wetland area located on municipal land adjacent to the study site will be secured through a formal lease agreement.* ***The inclusion of the offsite wetland area ensures that the overall wetland offset achieves a positive balance.***

A detailed rehabilitation plan was drafted for the wetland offset areas, including the removal of alien invasive vegetation and foreign fill material, reshaping, revegetation with indigenous wetland plant species, and onsite water quality management. Implementing the rehabilitation measures will achieve an *increase in the PES of the onsite wetland offset areas to upper category C with a minimum PES Score of 79 %.*

A management plan was drafted thereafter to ensure that the gains achieved through establishment and rehabilitation are maintained or slowly increased.

This Wetland Offset, Rehabilitation and Management Plan is practically implementable and will achieve the maximum feasible onsite wetland offset, further supported by an additional offsite wetland area. It is therefore the specialist's opinion that it is 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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Specialist Details

Specialist Details | Louise Zdanow	
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SACNASP Reg. No.	114072
Area of Specialisation	Botany

Louise is the Managing Director of EnviroSwift KZN (Pty) Ltd; and is an associate of Delta Ecology. She has a BSc Honours degree in Botany from the University of Cape Town. She began working as an environmental specialist in 2012 and has since gained extensive experience in conducting freshwater as well as vegetation assessments in the residential, mining, renewable energy and infrastructure development sectors. She has also completed several short courses in wetland assessment methodologies and plant identification. Louise is a registered Professional Natural Scientist (Pr. Sci. Nat.) with the South African Council for Natural Scientific Professions (SACNASP, Reg. no. 114072) and is a member of the South African Wetland Society.

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SACNASP Reg. No.	Pending
Area of Specialisation	Ecology

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 438, Standford, Overstrand Local Municipality (**Figure 1-1**), is proposing the establishment of a residential "Eco-Lifestyle" estate on the property that will be known as the Stanford Eco Estate (**Table 1-1** & **Figure 1-2**).

The proposed development covers an area of approximately 5.23 hectares and will comprise the following:

- 28 Residential Properties:
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- Private Open Spaces; and
- Private and Public Roads.

Following an aquatic biodiversity assessment conducted on the 25th of July 2023, three wetlands were confirmed and delineated within the study site (**Figure 1-3**). Onsite wetlands include a hillslope seep wetland and two natural Unchanneled Valley-Bottom (UVB) wetlands coinciding with non-perennial drainage lines.

During the aquatic biodiversity assessment, the seep wetland was determined to be significantly degraded. The degraded state is due to historical vegetation clearing, soil compaction, ploughing, and the introduction of non-native soil. Much of the natural vegetation has been removed and replaced with grass cultivated for roll-on lawns, with only scattered, disturbance-tolerant wetland species remaining.

In contrast, the Mill Stream UVB wetland retains moderate ecological function despite being affected by surrounding land use. The vegetation is dominated by robust stands of *Phragmites australis* and *Typha capensis*. However, the wetland is impacted by the presence of mature Eucalyptus trees growing along the wetlands edge.

The small Tributary UVB wetland, which crosses the southern corner of the site, is in the best condition of the three and exhibits the highest ecological sensitivity. Its vegetation is moderately diverse and dominated by indigenous wetland species.

The entirety of the seriously degraded seep wetland will be lost because of the proposed development activities. To offset this loss, rehabilitation interventions will be undertaken on the two remaining UVB wetlands which will be designated as wetland offset areas. An additional offsite portion of the Mill Stream UVB wetland has been identified and will be included in the overall wetland offset. This wetland area falls within the jurisdiction of the Overstrand Municipality. Following a series of engagements with relevant municipal officials, a formal lease agreement will be established between the developer and the Overstrand Municipality to secure the use and rehabilitation of the offsite wetland area.

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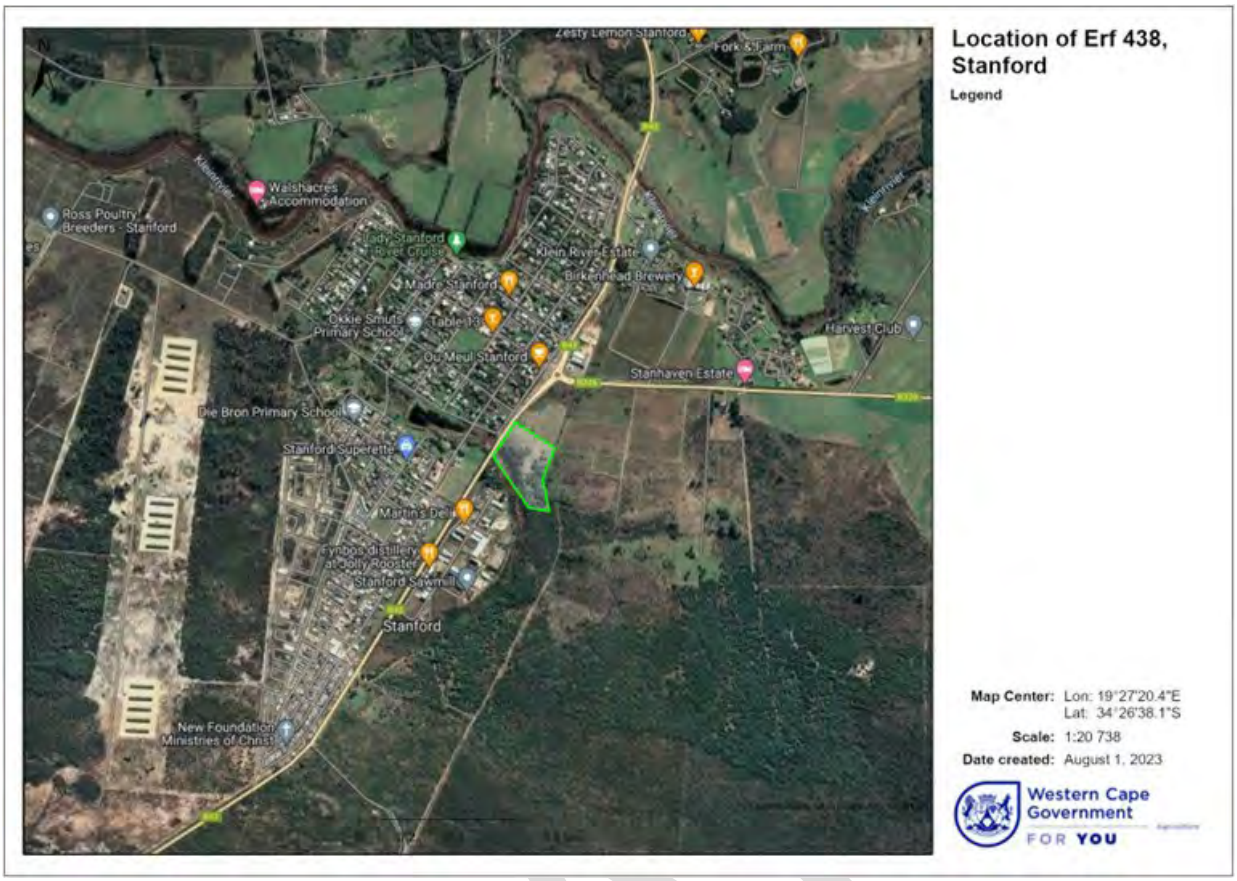

Figure 1-1: Location of proposed development area.

Table 1-1: Percentage of each component.

Legend Colour	Zoning	Size (m²)	Percentage
	Open Space Zone 3: Private Open Space	21588	41,56%
	General Residential Zone 1: Town Housing	4902	9,36%
	Residential Zone 1: Single Residential	19423	37,11%
	Transport Zone 2: Road and Parking (A) (Private)	5130	9,80%
	Transport Zone 2: Road and Parking (B) (Public)	1299	2,64%
	Total	52342	100,00%

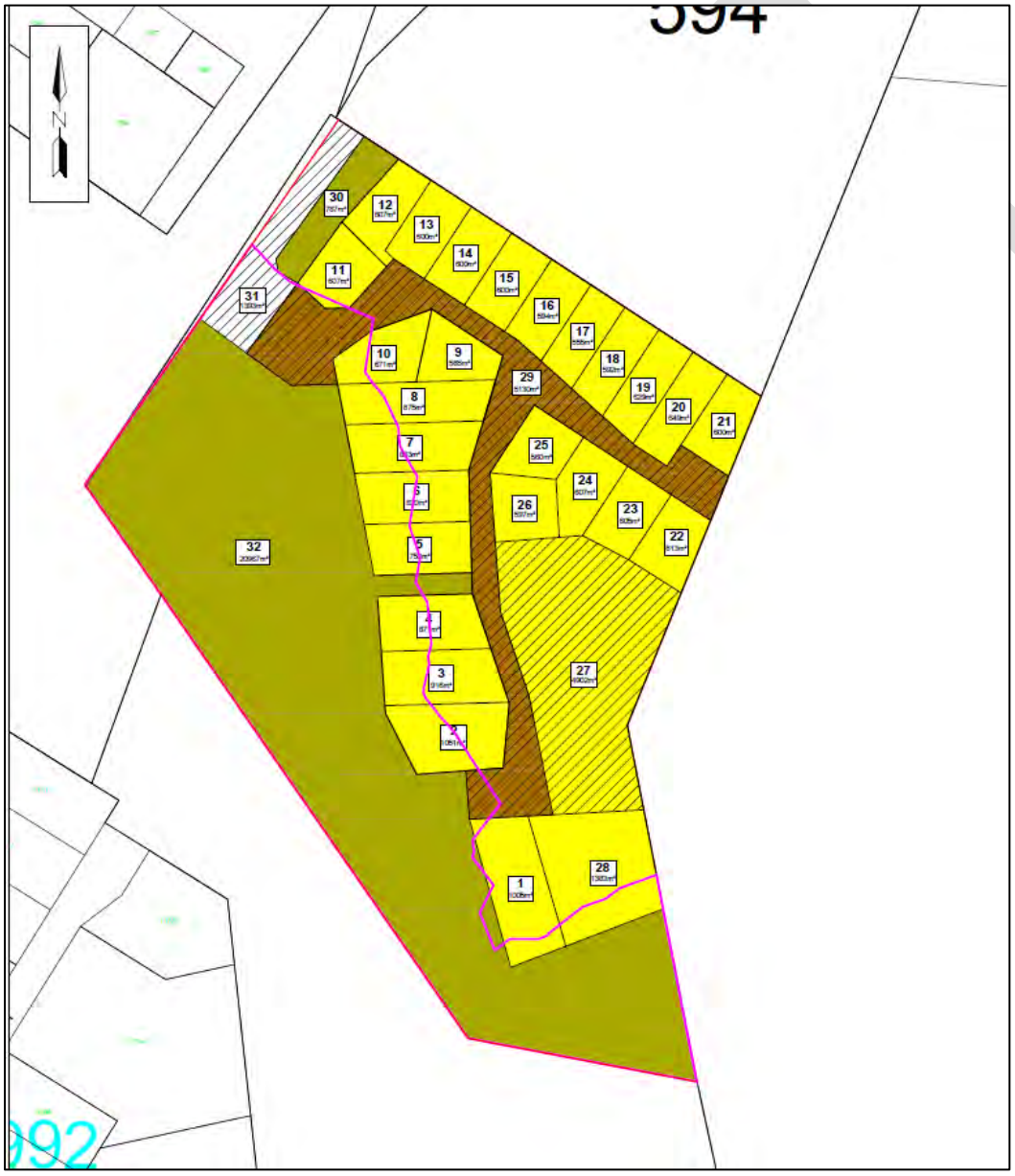

Figure 1-2: Spatial development plan for Farm 438.

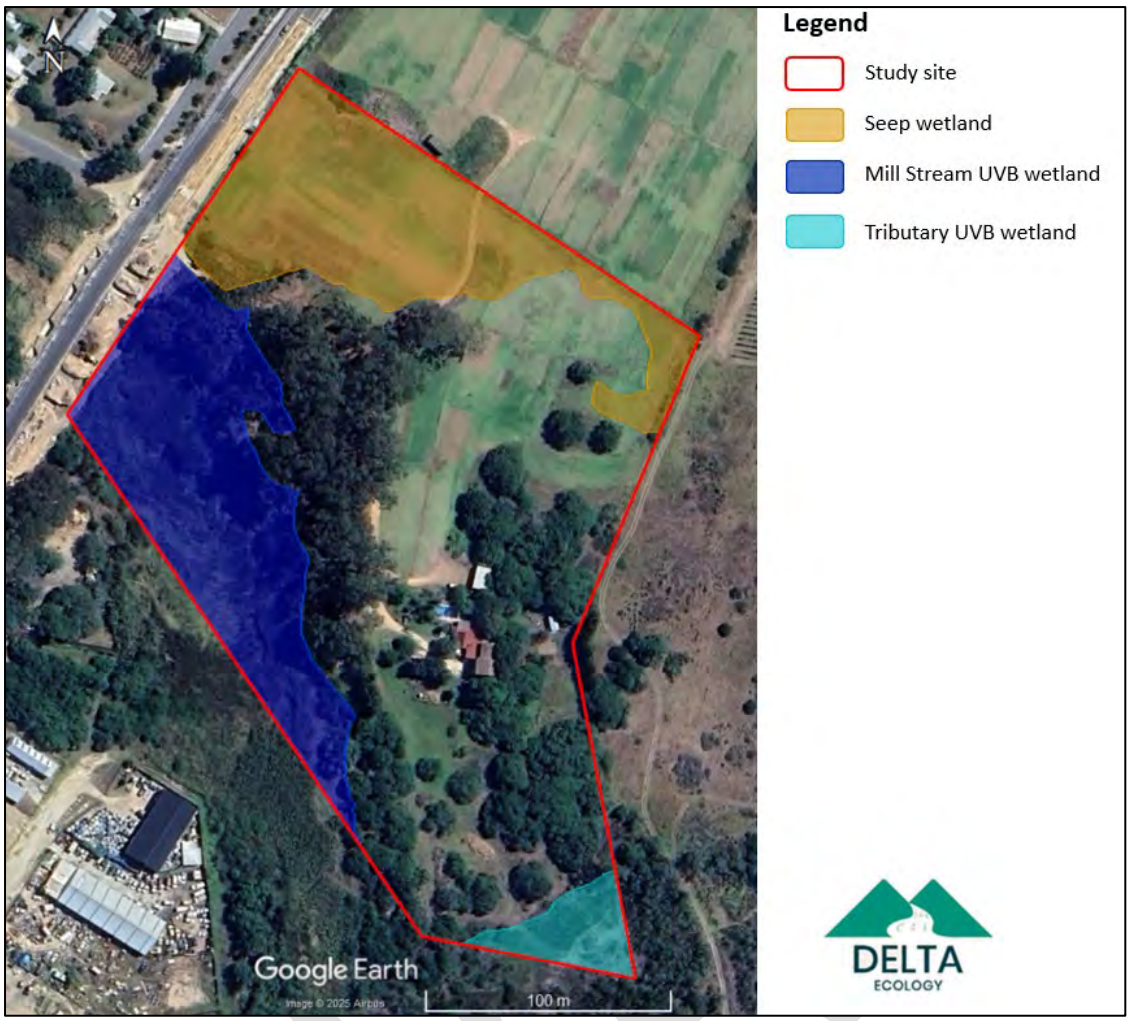

Figure 1-3: Wetlands delineated within Erf 438 (van Zyl & Morton, 2024).

1.1. Terms of Reference

The Terms of Reference (ToR) 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 and establishment strategy for the identified offset areas that will satisfy the offset requirements of the National Wetland Offset Guidelines (Macfarlane *et al*. 2016).
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 Assessments (Van Zyl & Morton, 2024) conducted for the development, and extend to the current report:

- Site assessments were undertaken on the 25th of July 2023, during winter. The assessment does 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 site assessment does not cover complete seasonal variation in conditions at the site and thus would not depict any seasonal variation in alien species community composition. It is therefore recommended that the professional appointed to implement AIS control measures, recommend control methods for any additional AIS species identified.
- The watercourses were delineated using a Garmin handheld GPSMAP 66i 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.
- The seep wetland present within the proposed site were disturbed due to historical agricultural activities, resulting in areas with absent natural vegetation, and highly variable and disturbed soils. This complicated wetland delineation during the site assessment. The specialists are however of the opinion that the onsite seep wetland, as indicated in this report, has been adequately identified, delineated, and assessed for the purposes of the report. The seep wetland's Present Ecological State (PES) was determined to be E (seriously degraded) with a Combined PES Score of 38 %, the Mill stream UVB wetland's PES was C (Moderately Modified) with a Combined PES Score of 60 %, the Tributary UVB wetland also obtained a PES score within category C with a Combined PES Score of 77 %, according to the WET Health methodology (Macfarlane *et al*. 2020).
- The information provided by the client forms the basis of the planning and layouts discussed.
- Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions, species' seasonality, and migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage.
- Description of the depth of the regional water table and geohydrological and hydro pedological processes falls outside the scope of the current assessment. Flood line calculations fall outside the scope of the current assessment.
- The delineation of all onsite watercourses, and calculation of buffer zones presented in this report, do not consider climate change or future changes to watercourses resulting from increasing catchment transformation.
- Watercourse delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, while converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. It is therefore suggested that the wetland offset identified in the current report be pegged in the field in collaboration with the surveyor for precise boundaries. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by, for example, photocopying and printing.

Notwithstanding the above limitations, the specialist is of the opinion that the site assessment, 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 portions 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 either a Memorandum of Understanding (MoU), or a conservation servitude over the wetland area. As far as possible, the mechanism used should ensure that no future development can occur within the wetland, and that the wetland is suitably managed in perpetuity.

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 Aquatic Biodiversity Assessment, as detailed in (van Zyl & Morton, 2024), 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 PES within the identified offset wetland.

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 and feasible wetland offset locality. Wetland offsetting involves rehabilitating or reinstating an area of wetland equal to or greater than the wetland value (in terms of wetland habitat / functionality HE) lost. The offset strategy developed in this report involves rehabilitating the two onsite UVB wetlands to achieve maximum feasible onsite wetland offset, further supported by an additional offsite portion of the Mill Stream UVB wetland. 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 G40L, and is underlain by the Overberg Regional Aquifer. The applicable sub-quaternary catchment has not been designated as significant in terms of the National Freshwater Ecological Priority Areas (NFEPA) (CSIR, 2011). The regional setting, in terms of the Level 1 Department of Water Affairs (DWA) (now Department of Water and Sanitation) Ecoregions, is within the Southern Coastal Belt.

According to the Western Cape Biodiversity Spatial Plan (WCBSP), the Mill Stream and Tributary UVB wetlands are designated partly as an Aquatic Ecological Support Area 1 (ESA) and partly as an ESA 2 (Degraded) (WCBSP, 2017; van Zyl & Morton, 2024). However, in the updated 2023 WCBSP, the Mill Stream and Tributary UVB wetlands are designated as Critical Biodiversity Areas 1 (CBA) (WCBSP, 2023).

In terms of mapped watercourses, the National Geospatial Information (NGI) river line dataset indicates two non-perennial drainage lines that intersect the proposed site across the southern and western corners and confluence just south of the site (NGI, 2019). The National Wetlands Map Version 5 (NWM5) (SANBI, 2018) wetland layer indicates a floodplain wetland coinciding with the non-perennial drainage lines. The NFEPA maps this wetland as a Channelled Valley-Bottom wetland (CVBW) (CSIR, 2011). The Mill Stream and Tributary wetlands are classed by desktop resources as a floodplain wetland (NWM5) and a CVBW (NFEPA). However, no defined stream channel was noted during the assessment, so overtopping is unlikely to be a significant water source. Lateral flow from the adjacent shallow slopes (particularly subsurface flow) is likely to make up a large portion of the hydrological supply, which is more consistent with the unchanneled valley bottom (UVB) wetland classification.

Following the aquatic biodiversity assessments conducted on the 25th of July 2023, three wetlands were confirmed and delineated within the study site (**Figure 4-1**). Onsite wetlands include a hillslope seep wetland and two natural UVB wetlands coinciding with the non-perennial drainage lines.

The hillslope seep wetland has been significantly altered by agricultural activities, historical clearing of natural vegetation, infilling, and soil compaction. The wetland is currently used for the

cultivation of roll-on lawn, and the natural wetland habitat has been almost entirely replaced. Indigenous wetland vegetation is limited to sparse, disturbance-tolerant species, with much of the area dominated by cultivated grasses. Soil conditions within the seep wetland reflect prolonged disturbance, with introduced non-native soils, reduced infiltration capacity, and compacted profiles. The hydrology of the system is dominated by surface runoff associated with irrigation practices, the presence of compacted access roads, and gravel tracks which have altered natural drainage patterns. Although some waterlogged soils were identified, the system no longer exhibits the structure, vegetation, or hydrological regime typical of a functional seep wetland and offers limited ecological value in its current state.

The Mill Stream UVB wetland has been affected by historical excavation activities near the R43 road and local water abstraction, which have altered its natural hydrological regime. The wetland is vegetated by dense stands of *Phragmites australis* (Common Reed) and *Typha capensis* (Bulrush), with adjacent thickets of *Sideroxylon inerme* (Milkwood) and *Olea europaea* subsp. *africana* (Wild Olive). The area immediately surrounding the wetland is invaded by mature *Eucalyptus* trees, which impacts the wetland because *Eucalyptus* trees suppress the growth of native plant species beneath them through shading and allelopathic effects (Ruwanza *et al*. 2015). Runoff from upstream industrial areas, along with nutrient-rich water from the surrounding lawn farm, is likely to impact the water quality of the wetland. Despite these disturbances, the Mill Stream wetland retains moderate ecological function and offers valuable opportunities for rehabilitation.

The small Tributary UVB wetland, crossing the southern corner of the site, supports a moderately diverse community of indigenous wetland vegetation including *Carex clavata* (Swamp Grass), *Ficinia elatior (Side Clubrush), Orphium frutescens* (Sea Rose), and *Stenotaphrum secundatum* (St. Augustine Grass). Recent clearing of invasive *Acacia saligna* (Port Jackson) has improved the ecological integrity of the system. Minor disturbances such as dirt tracks and vegetation clearing may have affected surface hydrology and geomorphology, but the wetland remains structurally intact. Agricultural runoff in the wider catchment may contribute to slight water quality degradation. Overall, the Tributary UVB wetland is in relatively good condition and is considered the most sensitive of the three wetland systems present, and the signs of recovery following alien plant removal indicate strong potential for ecological improvement under appropriate management.

The health and value of the wetlands within the study site was assessed as part of the 2024 Aquatic Biodiversity Assessment (van Zyl & Morton, 2024) using the current best practice methods (Macfarlane *et al*. 2020 WET-Health Version 2.0, Duthie *et al*., 1999 and Rountree *et al*., 2013 Ecological Importance and Sensitivity (EIS) method, Kotze *et al*. 2020 WET-EcoServices (WES)Version 2, and Rountree *et al*. 2013 Recommended Ecological Category (REC). The condition of the UVB wetlands was moderately disturbed, and the EIS and WES scores calculated were high to moderately high indicating that these wetlands are sensitive and important in terms of conservation planning or provision of ecosystem services (**Table 4-1**). The hillslope seep wetland is seriously disturbed, and of moderate to low importance in terms of conservation planning or provision of ecosystem services.

Table 4-1: Results of the wetland status quo assessment (van Zyl & Morton, 2024).

	PES	EIS	WES (Highest)	REC
Mill Stream UVB Wetland	C	High	High	B
Tributary UVB Wetland	C	High	Moderate	B
Hillslope Seep Wetland	E	Moderate	Moderately Low	D

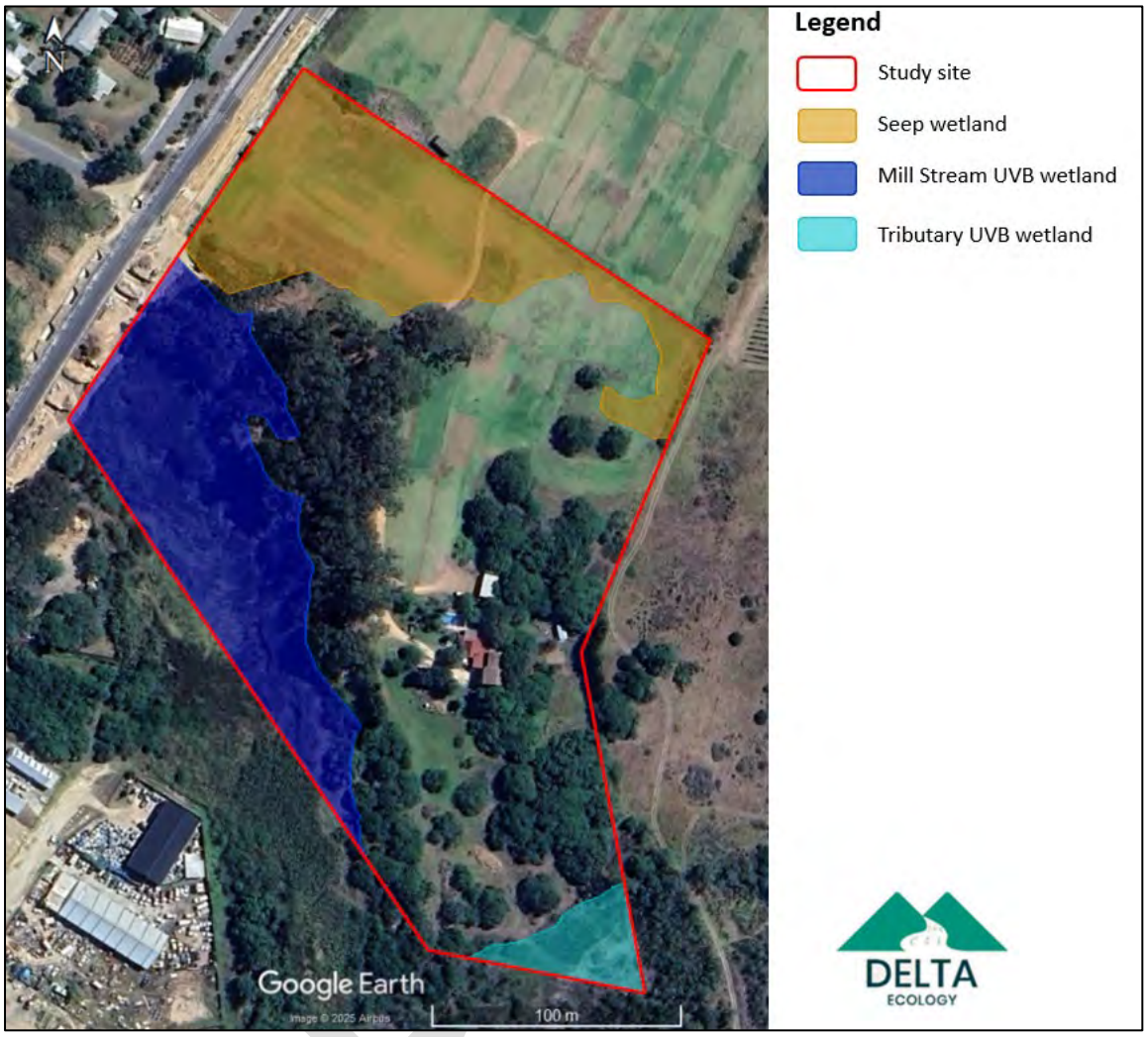

Figure 4-1: Watercourse delineation map.

5. Wetland Loss and Mitigation Opportunities

The study site is 5.3 ha, the seep wetland covers approximately 0.9 ha (17 %), the Mill Stream UVB wetland covers approximately 1 ha (19 %) and the Tributary UVB wetland covers approximately 0.22 ha (4 %), leaving 3.2 ha (60 %) of terrestrial ground. A total of 3.1 ha (58 %) of the entire site will be required to establish the proposed development.

The entirety of the seriously modified seep wetland will be lost. To offset this loss, rehabilitation interventions will be undertaken on the Mill Stream and the Tributary UVB wetlands. These onsite wetlands will be restored and managed to improve their ecological functioning. Additionally, the offsite area of the Mill Stream UVB wetland will be included in the wetland offset area, adding 1.7 ha to overall wetland offset. Maximum wetland offsetting opportunities were thus identified for the proposed development (**Figure 5-1**).

The identified offset areas will require rehabilitation to increase the function of wetland habitat. The aim for onsite wetland offset areas will be to increase the wetlands to a PES within the upper category C (Moderately modified system).

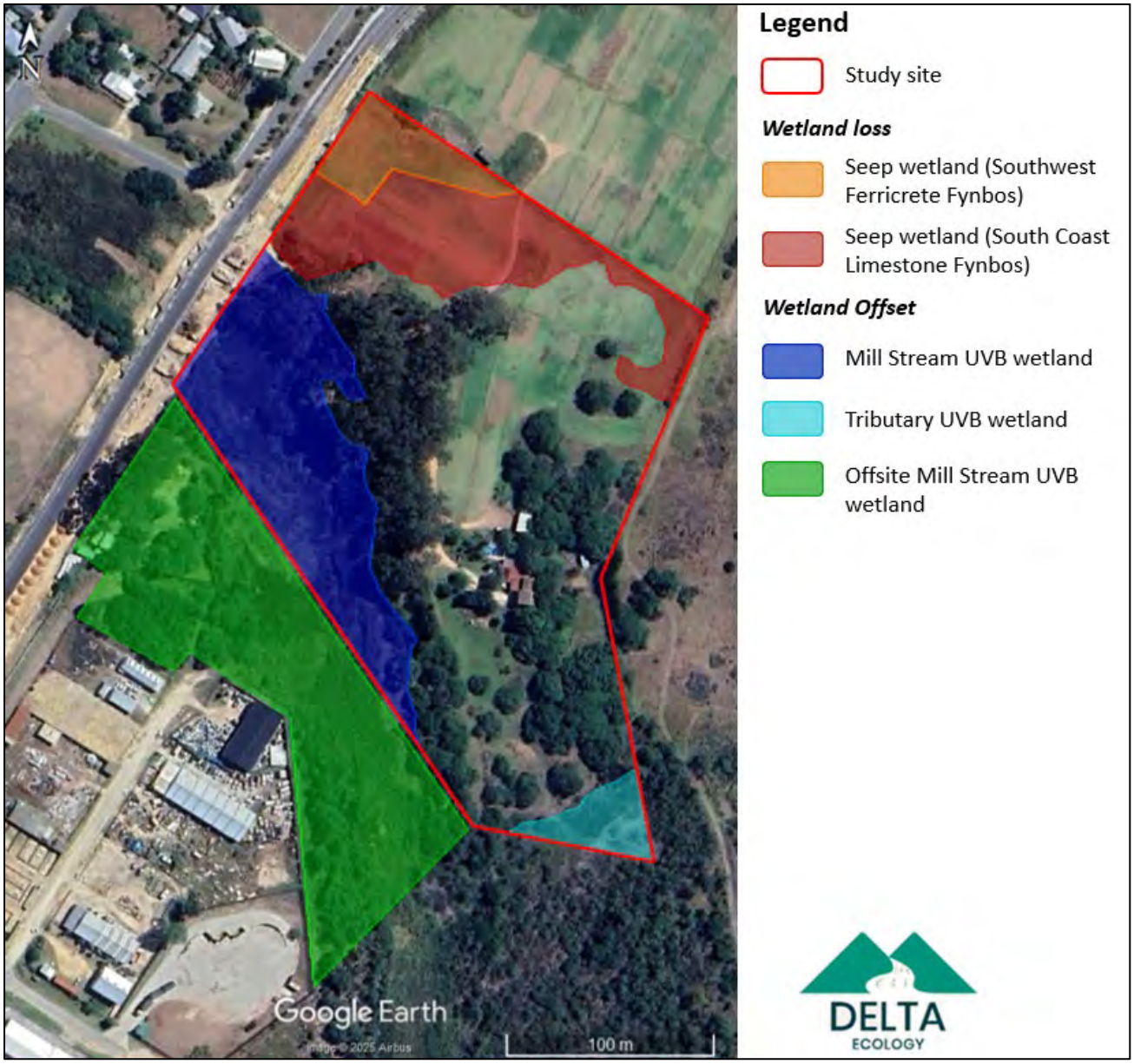

Figure 5-1: Wetland loss and wetland offset areas.

6. Evaluating Residual Wetland Loss

The Macfarlane *et al.* (2016) wetland offset calculator was applied to the wetland area that will be lost during development. The proposed development will result in the entirety of the Seep wetland (0.9 ha) being lost. During the calculation of residual wetland loss, the Seep wetland was split into two different portions, since the wetland occurs over two different wetland vegetation types.

The calculation yielded a total of -0,3420 HE of function and -0,2540 HE of habitat that will be lost and require offsetting. The results of the evaluation are presented in **Table 6-1** to **Table 6-4** below.

Table 6-1: Results of the evaluation of wetland function loss for the portion of Seep wetland (LT).

Wetland Functionality Targets			
Impact Assessment	Prior to development	Wetland size (ha)	0,7
		Functional value (%)	38
	Post development	Functional value (%)	0
		Change in functional value (%)	38
	Key Regulating and Supporting Services Identified		Negligible provision of services
	Development Impact (Functional hectare equivalents)		0.3
Offset calculation	Offset Ratios	Triggers for potential adjustment in exceptional circumstances	None
		Functional Importance Ratio	1,0
	Functional Offset Target (Functional hectare equivalents)		0,2660
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 the portion of Seep wetland (LT).

Ecosystem Conservation Targets				
Impact Assessment	Prior to development	Wetland size (ha)		0,7
		Habitat intactness (%)		40
	Post development	Habitat intactness (%)		0
		Change in habitat intactness (%)		40
	Development Impact (Habitat hectare equivalents)			0,28
Determining offset ratios	Ecosystem Status	Wetland Vegetation Group (or type based on local classification)		South Coast Limestone Fynbos
		Threat status of wetland	Threat status	LT
			Threat status Score	1
		Protection level of wetland	Protection level	Well Protected
			Protection level Score	0,25
		Ecosystem Status Multiplier		0,25
	Regional and National Conservation context	Priority of wetland as defined in Regional and National Conservation Plans	Not specifically identified as important	0,5
		Regional & National Context Multiplier		0,8
	Local site attributes	Uniqueness and importance of biota present in the wetland	Low biodiversity value	0,5
		Buffer zone integrity (within 500m of wetland)	Buffer compatibility score	0
		Local connectivity	Low connectivity	0,5
		Local Context Multiplier		0,4
	Ecosystem Conservation Ratio			0,05
Offset Calculation	**Development Impact (Habitat hectare equivalents)**			0,3
	Ecosystem Conservation Ratio			0,1
	Ecosystem Conservation Target (Habitat hectare equivalents)			0,0140

Table 6-3: Results of the evaluation of wetland function loss for the Seep wetland (CR).

Wetland Functionality Targets			
Impact Assessment	Prior to development	Wetland size (ha)	0,2
		Functional value (%)	38
	Post development	Functional value (%)	0
		Change in functional value (%)	38
	Key Regulating and Supporting Services Identified		Negligible provision of services
	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)		0,0760
Further considerations	Have other key Provisioning or Cultural Services Identified that require compensation?		No
	Additional compensatory mechanisms proposed	N/A	

Table 6-4: Results of the evaluation of wetland habitat loss for the Seep wetland (CR).

Ecosystem Conservation Targets				
Impact Assessment	Prior to development	Wetland size (ha)		0,2
		Habitat intactness (%)		40
	Post development	Habitat intactness (%)		0
		Change in habitat intactness (%)		40
	Development Impact (Habitat hectare equivalents)			0,08
Determining offset ratios	Ecosystem Status	Wetland Vegetation Group (or type based on local classification)		Southwest Ferricrete 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	Not specifically identified as important	0,5
		Regional & National Context Multiplier		0,8
	Local site attributes	Uniqueness and importance of biota present in the wetland	Low biodiversity value	0,5
		Buffer zone integrity (within 500m of wetland)	Buffer compatibility score	0
		Local connectivity	Moderate connectivity	0,5
		Local Context Multiplier		0,4
	Ecosystem Conservation Ratio			3,00
Offset Calculation	**Development Impact (Habitat hectare equivalents)**			0,1
	Ecosystem Conservation Ratio			3,0
	Ecosystem Conservation Target (Habitat hectare equivalents)			0,2400

7. Evaluating Potential Wetland Offset

The proposed development will result in the complete loss of a degraded Seep wetland. To offset this loss, the two remaining wetland systems located within the development site, the Mill Stream UVB wetland and the Tributary UVB wetland, will be rehabilitated and incorporated into the wetland offset.

An additional offsite portion of the Mill Stream UVB wetland has been secured for inclusion in the offset. This wetland area falls within the jurisdiction of the Overstrand Municipality. The PES of this additional wetland was assessed to confirm its suitability for inclusion in the offset calculations. Following a series of engagements with relevant municipal officials, a formal lease agreement will be established between the developer and the Overstrand Municipality to secure the use and rehabilitation of the offsite wetland area. In total, the offset strategy will include approximately 1.2 ha of rehabilitated onsite wetlands and an additional 1.7 ha of offsite wetland.

The gain from rehabilitation and protection of the identified offset areas was assessed with the assumption that all objectives within **Section 8.1** below will be fully achieved.

The evaluation indicated that, given effective offset interventions as outlined in **Section 8,** 0,1331 HE of wetland function and 2,2292 HE of wetland habitat could be provided by the rehabilitation of the onsite wetland offset.

The additional offsite wetland offset will further provide 0,2244 HE of wetland function and 2,7460 HE of wetland habitat.

The results of the assessment for the onsite wetland offset areas is provided in **Table 7-1** through to **Table 7-6**.

Table 7-1: Functional offset contribution results for the onsite Mill Stream UVB wetland offset.

Contribution Towards Wetland Functionality Targets				
Wetland attributes	Wetland Reference		**Mill Stream UVB wetland (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 a different type to the impacted wetland.	May be acceptable
	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	Aligns moderately well with the priorities in the guidelines.		
Preliminary Offset Calculation	**Prior to offset activities**	Wetland size (ha)	1,04	
		Functional value (%)	60	
	Following successful offset implementation	Functional value (%)	79	
		Change in functional value (%)	19	
	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 riskier than rehabilitation or averted loss activities.	Rehabilitation & Protection	0,66
	Final Offset Contribution (Functional hectare equivalents)		**0,1304**	

Table 7-2: Habitat offset contribution results for the onsite Mill Stream UVB wetland offset.

Contribution Towards Ecosystem Conservation Targets				
Wetland attributes	Wetland Reference		Mill Stream UVB wetland (rehabilitated)	
	Wetland Vegetation Group (or type based on local classification)		South Coast Limestone Fynbos	
	Threat status of wetland		Threat status	**LT**
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 an alternative wetland type of a lower threat status within the same wetland vegetation group.	Acceptable
	Landscape planning	To what degree is wetland selection aligned with Regional and National Conservation Plans	Wetlands have been identified as being of high importance in landscape planning	Ideal
	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 characterised by habitat and / species of high biodiversity value.	Ideal
	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	Moderately well aligned		
Preliminary Offset Calculation	Wetland areas to be secured	Wetland size (ha)	**1,0**	
		Habitat intactness (%)	**79**	
		Wetland habitat contribution (hectare equivalents)	**0,8**	
	Buffer zones to be secured	Area of wetland buffer zone included in the wetland offset site	**0,7**	
		Integrity of buffer zone	**0,6**	
		Buffer zone hectare equivalents	**0,1**	
		Buffer zone contribution (hectare equivalents)	**0,1**	
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)	1,6	
		Buffer zone contribution (hectare equivalents)	0,2	
		Functional Offset Contribution (hectare equivalents)	**1,8532**	

Table 7-3: Functional offset contribution results for the onsite Tributary UVB wetland offset.

Contribution Towards Wetland Functionality Targets				
Wetland attributes	Wetland Reference		**Tributary UVB wetland (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 a different type to the impacted wetland.	May be acceptable
	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	Aligns moderately well with the priorities in the guidelines.		
Preliminary Offset Calculation	**Prior to offset activities**	Wetland size (ha)	0,2	
		Functional value (%)	77	
	Following successful offset implementation	Functional value (%)	79	
		Change in functional value (%)	2	
	Preliminary Offset Contribution (Functional hectare equivalents)		**0,1**	
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 riskier than rehabilitation or averted loss activities.	Rehabilitation & Protection	0,66
	Final Offset Contribution (Functional hectare equivalents)		**0,0026**	

Table 7-4: Habitat offset contribution results for the onsite Tributary UVB wetland offset.

Contribution Towards Ecosystem Conservation Targets				
Wetland attributes	Wetland Reference		Tributary UVB wetland (rehabilitated)	
	Wetland Vegetation Group (or type based on local classification)		South Coast Limestone Fynbos	
	Threat status of wetland		Threat status	**LT**
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 an alternative wetland type of a lower threat status within the same wetland vegetation group.	Acceptable
	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	Ideal
	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 characterised by habitat and / species of high biodiversity value.	Ideal
	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	Moderately well aligned.		
Preliminary Offset Calculation	Wetland areas to be secured	Wetland size (ha)	**0,2**	
		Habitat intactness (%)	**79**	
		Wetland habitat contribution (hectare equivalents)	**0,16**	

	Buffer zones to be secured	Area of wetland buffer zone included in the wetland offset site	**0,2**	
		Integrity of buffer zone	**0,6**	
		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)	0,3	
		Buffer zone contribution (hectare equivalents)	0,1	
		Functional Offset Contribution (hectare equivalents)	**0,3760**	

Table 7-5: Functional offset contribution results for the offsite Mill Stream UVB wetland offset.

Contribution Towards Wetland Functionality Targets

Wetland attributes	Wetland Reference		**Offsite Mill Stream UVB wetland (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 a different type to the impacted wetland.	May be acceptable
	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	Aligns moderately well with the priorities in the guidelines.		
Preliminary Offset Calculation	**Prior to offset activities**	Wetland size (ha)	1,7	
		Functional value (%)	59	
	Following successful offset implementation	Functional value (%)	79	
		Change in functional value (%)	20	

	Preliminary Offset Contribution (Functional hectare equivalents)		**0,3**	
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 riskier than rehabilitation or averted loss activities.	Rehabilitation & Protection	0,66
	Final Offset Contribution (Functional hectare equivalents)		**0,2244**	

Table 7-6: Habitat offset contribution results for the offsite Mill Stream UVB wetland offset.

Contribution Towards Ecosystem Conservation Targets				
Wetland attributes	Wetland Reference		Offsite Mill Stream UVB wetland (rehabilitated)	
	Wetland Vegetation Group (or type based on local classification)		South Coast Limestone Fynbos	
	Threat status of wetland		Threat status	**LT**
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 an alternative wetland type of a lower threat status within the same wetland vegetation group.	Acceptable
	Landscape planning	To what degree is wetland selection aligned with Regional and National Conservation Plans	Wetlands have been identified as being of high importance in landscape planning	Ideal
	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 characterised by habitat and / species of high biodiversity value.	Ideal
	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	Moderately well aligned		
Preliminary Offset Calculation	Wetland areas to be secured	Wetland size (ha)	**1,7**	
		Habitat intactness (%)	**79**	
		Wetland habitat contribution (hectare equivalents)	**1,3**	

	Buffer zones to be secured	Area of wetland buffer zone included in the wetland offset site	**0,0**	
		Integrity of buffer zone	**0,0**	
		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)	2,7	
		Buffer zone contribution (hectare equivalents)	0,06	
		Functional Offset Contribution (hectare equivalents)	**2,7460**	

8. Wetland Rehabilitation

8.1. Objectives

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

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

- *All rehabilitation efforts should increase the PES of the offset wetland areas to upper category C with a minimum PES Score of 79 % as follows*:

- *Wetland rehabilitation within the wetland offset areas involves improving natural functionality and habitat. Soft engineering should be made use of rather than hard engineering by using natural landscape features and vegetation to direct water flow where possible.*

- Removal, thinning, and control of dense stands of *Phragmites australis* (Common Reed). Although indigenous, *Phragmites australis* can become problematic in disturbed wetlands, such as those with excess nutrients, altered flow regimes, or increased sediment input, where it outcompetes other indigenous wetland plants and forms dense monocultures. These dense stands reduce open-water habitat, slow water flow, trap sediment, and subsequently alter the natural hydrology of the wetland. Since *Phragmites australis* is indigenous, the goal is not eradication but rather active management to maintain ecological balance and wetland function.

- Removal of all alien invasive vegetation from the offset wetland areas and adjacent buffer area. In particular, the area adjacent to the Mill Stream UVB wetland within the proposed development area, is currently invaded by dense stands of *Eucalyptus camaldulensis* (Red River gum) trees. *Eucalyptus camaldulensis* in this area has decreased the species richness and diversity of indigenous wetland vegetation, as they release allelopathic substances

that prevents other plant species from germinating (Ruwanza *et al*. 2015). Combined with the heavy shading and accumulation of leaf litter beneath their canopy, these factors have further suppressed the growth and regeneration of indigenous vegetation.

- Removal of all dumped rubble and fill material within the offset wetland areas.
- Reshape the northeastern bank of the onsite Mill Stream UVB wetland to create a more gradual slope, reflecting the natural topography of a UVB wetland, with gentle slopes and varied microtopography. This structure is essential for supporting key ecosystem services such as sediment and nutrient retention, groundwater recharge, flood attenuation, and the provision of diverse wetland habitats.
- Establishment of a healthy and diverse indigenous vegetation community within the offset wetland area. Revegetate with indigenous wetland plant species based on the relevant species list in this report (**Table 8-1**) and within the Landscape Plan for the development. This would require planting of locally indigenous wetland vegetation throughout the wetland area at reasonable density (approximately 4 plants per m^2). The vegetation should ultimately form dense cover, with intermediate to tall height / robustness to assist with flood attenuation, sediment trapping, phosphate / nitrate / toxicant assimilation, amongst other provisioning and cultural wetland ecosystem services.
- To protect the wetland offset areas, the development must carefully manage stormwater to maintain both water quantity and quality. This will be achieved through the installation of vegetated swales, landscaped with indigenous wetland species, which will convey stormwater flow toward the designated wetland offset area. The swales will help regulate flow, reduce runoff velocity, and filter out pollutants.
- The rehabilitation of the wetlands is expected to enhance cultural ecosystem services, particularly in terms of aesthetic value, recreation, and tourism potential. By creating visually appealing and ecologically functional wetlands, the site will offer visitors an opportunity to engage with nature in an urban setting. The inclusion of a walkway and a floating deck will further contribute to this value, encouraging education, passive recreation, and appreciation of the site's biodiversity and natural beauty.
- Ensure the protection of the Western Leopard Toad (*Sclerophrys pantherina*) during rehabilitation and development activities. Rehabilitation and development activities within and around the wetland offset areas must prioritise the protection of the Critically Endangered Western Leopard Toad. All interventions should be mindful of the species' habitat requirements, breeding season and movement patterns. Toad-friendly design principles must be incorporated into stormwater infrastructure, road crossings, and other relevant features to prevent entrapment and facilitate safe passage. The protection of the toad must be considered throughout the planning, implementation, and long-term management phases of the wetland rehabilitation process.
- Ensure that the offset areas are managed in accordance with this plan, such that the rehabilitated state is maintained in perpetuity.

Sections 8.2 to **8.4** below provide a detailed rehabilitation methodology for the offset areas that includes the techniques involved to achieve each of these objectives.

8.2. Rehabilitation of the wetland offset areas

Wetland rehabilitation within the wetland offset areas involves improving natural functionality and habitat. Soft engineering should be made use of rather than hard engineering by using natural landscape features and vegetation to direct water flow where possible.

8.2.1. Re-shaping

When rehabilitating a wetland offset area, it is essential to mimic the structure, function, and ecological processes of natural wetlands.

A typical UVB wetland has a very gentle to nearly flat slope, as it typically has a flat, broad valley floor with a lack of a defined river channel or banks.

Typical Slope Characteristics for UVB Wetlands:

1. Central basin (floor) 0 - 1%
    - Nearly flat; this allows water to pond seasonally or permanently.
2. Transitional edge (to fringe zone) 1 - 3%
    - Slight gradient allows zonation of wetland plants (from emergent to facultative).
3. Outer buffer/upland zone >3% (usually 4 - 5%)
    - Transition to upland or adjacent land, depending on site topography.

It is important to replicate the characteristic gentle slopes of a natural UVB wetland to ensure proper hydrological function and ecological integrity. A flatter basin promotes water retention by allowing ponding during wet periods. Gentle gradients also facilitate natural vegetation zonation, where even minor elevation differences of 10 to 20 centimetres can significantly influence the distribution and diversity of plant species. In contrast, steep banks should be avoided as they reduce habitat complexity, increase erosion risk, and may lead to rapid drainage, all of which undermine the stability and long-term functionality of the wetland system.

Once completed all cleared areas should be revegetated with appropriate indigenous species as per **Section 8.3.4.**

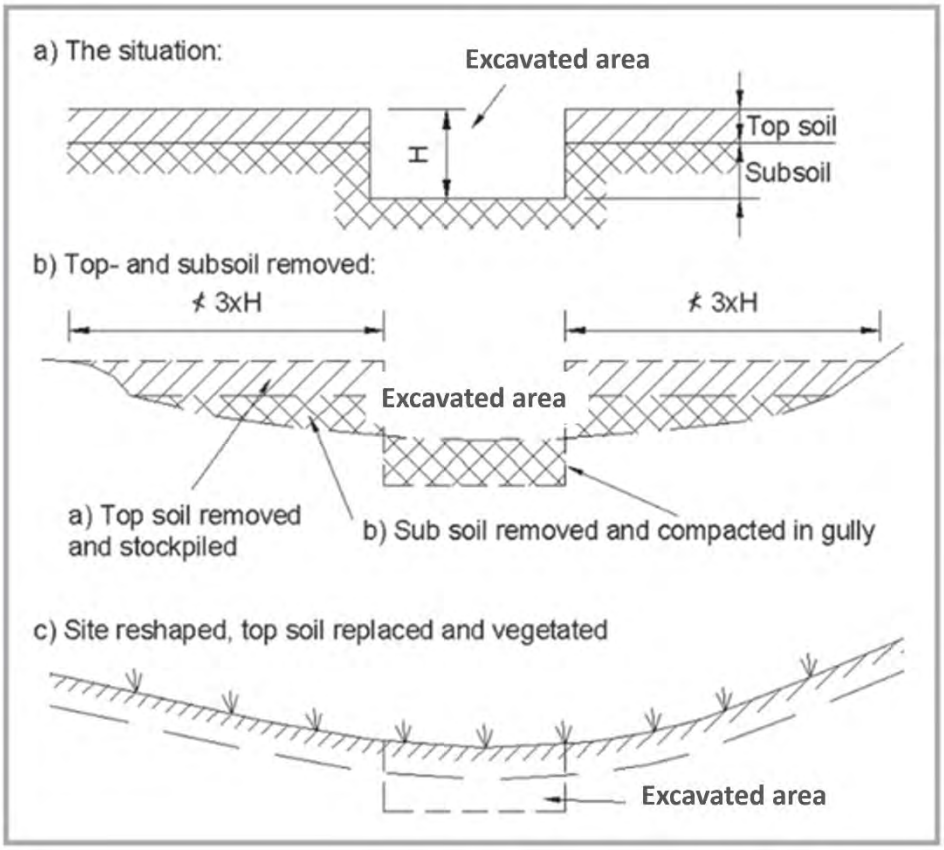

Figure 8-1: Sloping wetland banks.

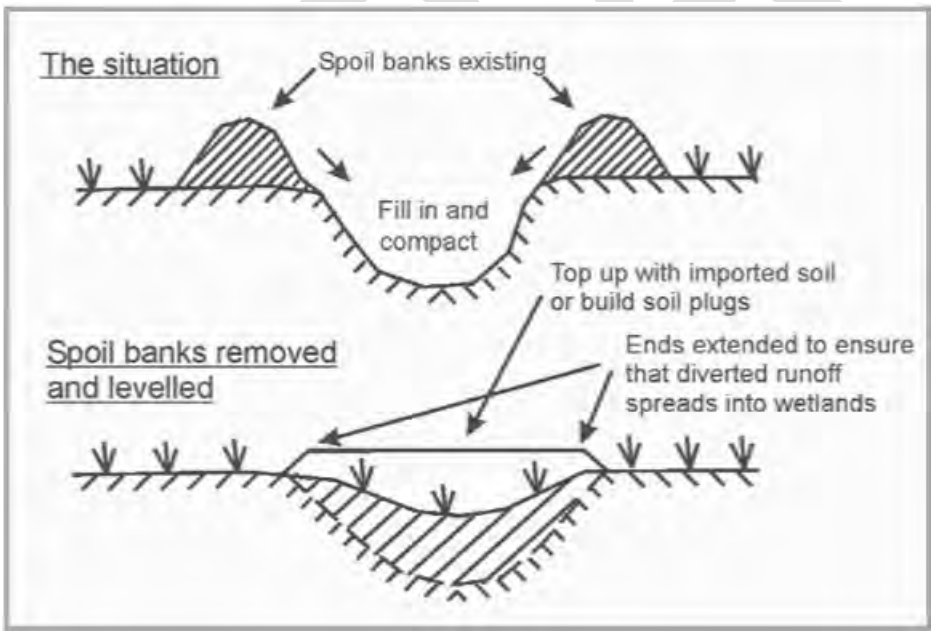

Figure 8-2: Sloping wetland banks.

The following points should be incorporated into the rehabilitation and reshaping of the offset wetland areas:

- Wetland reshaping, where appropriate, should take place during the dry season.
- The wetland offset area should be reshaped to resemble a natural UVB wetland, with a structure and profile similar to that of the reference system (**Figure 8-1**). This configuration will create the necessary conditions to support key ecosystem services typically provided by UVB wetlands, including sediment trapping, nutrient cycling, pollutant filtration, groundwater recharge, and flood attenuation.
- The banks of the wetland should have a gentle slope (**Figure 8-1**). Slope gradients should not be steeper than 1:3. This ensures that the wetland will have the natural wetland zones which include temporary, seasonal, and permanent zones.
- Earthworks must be completed in time to allow for the establishment of new plants prior to the onset of the winter rainfall season.
- Earthworks must not take place during the Western Leopard Toads breeding season (late July to September).
- Earthworks must not disturb the permanent zone, dominated by indigenous wetland species, as far as possible.
- Topsoil should be applied to stabilise wetland banks where required at a later stage.
- Planting of wetland vegetation should take place shortly after the earthworks for the wetland offset has been completed (please refer to **Section 8.3.4** for revegetation methodology).

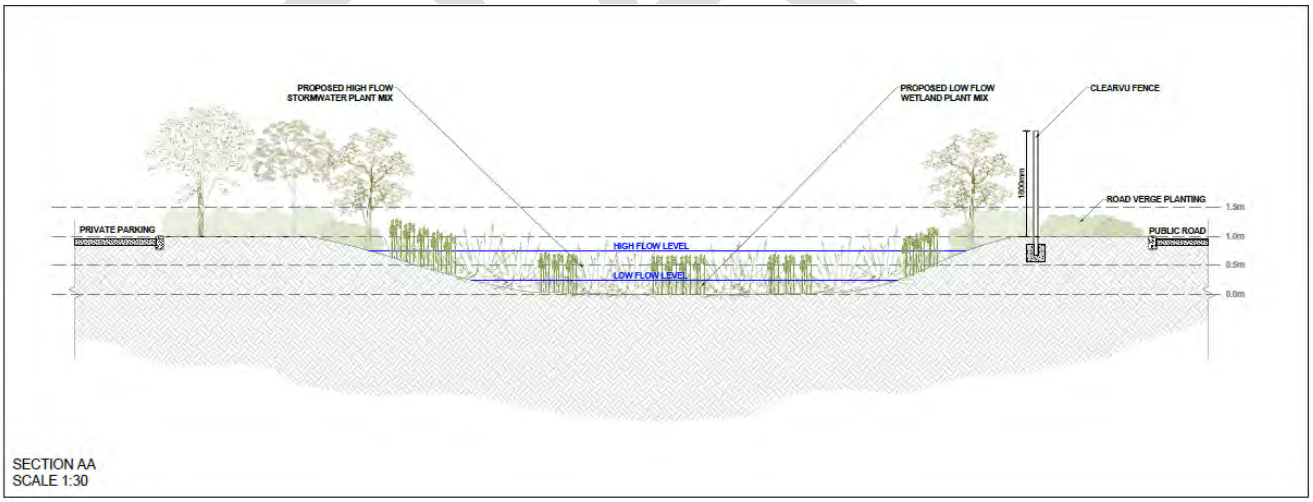

Figure 8-3: Conceptual design of wetland offset (Rula Landscapers).

8.2.2. Removal of fill material

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. Within and along the edge of the Mill Stream UVB wetland, there were instances of areas that have been historically impacted by infilling and currently contain foreign fill material.

To adequately restore/re-create wetland habitat and function, and to achieve PES targets, all foreign fill material (building rubble, fill material from dirt road etc.) must be removed from the wetland offset areas prior to the rehabilitation and restoration of existing wetland habitat.

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 offset wetland areas 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, along with the appointed ECO or landscaper. After the removal, it is recommended that the appointed ECO, landscaper, or 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 any natural area or within 32 m of any onsite watercourse.

Once the fill material is removed from the wetland, reshaping and reprofiling should be done and topsoil must be replaced in the disturbed areas to ensure the wetland profile is stable and well-integrated (**Figure 8-1** - **Figure 8-3**).

8.2.3. Removal / control of dense stands of Phragmites australis

Several areas of the wetland have dense stands of *Phragmites australis* (Common Reed). Although indigenous, *Phragmites australis* can become problematic in disturbed wetlands, such as those with excess nutrients, altered flow regimes, or increased sediment input, where it outcompetes other indigenous wetland plants and forms dense monocultures. These dense stands reduce open-water habitat, slow water flow, trap sediment, and subsequently alter the natural hydrology of the wetland. Since *Phragmites australis* is indigenous, the goal is not eradication but rather active management to maintain ecological balance and wetland function.

Thinning of *Phragmites australis* is particularly important to improve habitat for the western leopard toad, especially along dense stands at wetland banks. These toads require gently sloping banks with open areas to move freely in and out of the wetland for breeding, foraging, and shelter. Dense reed monocultures restrict movement, reduce access to suitable breeding sites, and can isolate portions of the wetland, making them unsuitable for the species. Selective thinning of reed stands can create a mosaic of open water and vegetated zones, enhancing ecological connectivity, improving access to the water's edge, and increasing habitat heterogeneity. This approach supports the life cycle requirements of the Western Leopard Toad while also maintaining overall wetland biodiversity.

Selective thinning should be implemented by removing alternating clumps of reeds in strips or patches, while deliberately retaining some dense areas to maintain habitat structure. Prior to thinning, reed stands must be mapped and sensitive areas such as amphibian breeding zones and open water edges identified in consultation with an amphibian specialist. Thinning zones should then be defined in a patch-mosaic pattern, with approximately 30–50% of reed stems removed in strips or clusters, leaving uncut areas intact to preserve stabilisation and provide refuge habitat.

Manual removal of *Phragmites australis* is preferred (hand tools) in the wetland to avoid excessive soil disturbance. Mechanical methods (excavators, tractors) should be avoided as far as possible. Use herbicides only if necessary, and strictly in compliance with Department of Forestry, Fisheries and the Environment (DFFE) regulations, with appropriate aquatic-registered products.

The most effective method for the control of *Phragmites australis* in this wetland system is through manual cutting followed by natural inundation, potentially with a follow up usage of herbicides if required. This method is most effective in the permanently inundated zone of the wetland, although it can effectively thin reeds in the temporary zone.

The removal and management of *Phragmites australis* should be undertaken in late autumn, prior to the onset of the rainfall season. Cutting at this time removes above-ground biomass before nutrients can be translocated to the rhizomes, thereby maximising stress on the plants. All reed stems should be cut as close to ground level as possible, ideally below the water surface where conditions allow, and the cut material must be removed from the site to prevent re-rooting, blockages, or nutrient loading within the system. Cutting can be done with a rotary brush cutter, chainsaws, mechanical reed cutter, or an aquatic mower.

Once cut, reeds should be managed so that regrowth coincides with the wet season, when natural inundation can keep new shoots submerged and prevent them from reaching the surface. To be effective, cut material must remain completely underwater for a minimum of four weeks. If shoots emerge above the water level during this period, they must be re-cut below the waterline to ensure that they remain submerged and drowned. A follow-up inspection should therefore be conducted during the inundation period to confirm that no regrowth escapes the water surface.

It is important to remove biomass from site (not leave it in the wetland), otherwise decomposing plant matter enriches the system further. Where stands are very dense, physical removal of rhizomes and accumulated sediments may be required. As far as possible, manual/mechanical excavation should be used to remove sediments, for example, hand tools or small excavators working from the edges or from floating platforms to avoid deep rutting. Sediment removal should be targeted, and minimal, only to restore wetland functioning where sediment build-up has reduced capacity or flow. Over-excavation can permanently damage the wetland's ecological character.

Initial intensive removal may be required, followed by periodic maintenance (every 6-12 months). Although maintenance frequency should decrease over time as indigenous vegetation stabilises. All reed removal activities must be undertaken with an Environmental Control Officer or a suitably qualified ecologist present to ensure that management actions comply with environmental guidelines and that sensitive species, such as the western leopard toad, are not disturbed during the process.

Because disturbance through cutting or excavation without follow-up often stimulates regrowth and results in denser stands, it is essential to pair mechanical removal with either targeted herbicide application (see section below) or preferably as recommended in this report, ecological restoration measures such as revegetation with indigenous wetland species (see **Section 8.2.5** below).

Follow up herbicide treatment

Effective control of *Phragmites australis* can be achieved through the careful use of two herbicides that are commercially available: Glyphosate and Triclopyr. Glyphosate products, such as *Roundup* and *Mamba 360 SL*, act as systemic herbicides that are absorbed through the foliage and stems and then translocated to the rhizomes, resulting in the death of the entire plant. Because Glyphosate is non-selective, it should only be applied once surrounding indigenous plants have entered senescence, typically during the Western Cape dry season, in order to reduce the risk of collateral damage.

Herbicides formulated with Triclopyr—including *Confront 360* and *Garlon 3A*—are also effective against *P. australis*. Importantly, both Glyphosate and Triclopyr are produced in versions for terrestrial as well as aquatic environments. When treatment is required in wetlands, only the aquatic-registered formulations may be used, as applying terrestrial formulations in such habitats poses a serious risk to aquatic organisms (including fish and macroinvertebrates) and to non-target native vegetation. For this reason, herbicide labels must be followed exactly, and all legal obligations must be met to safeguard wetland biodiversity.

To ensure environmental safety, the herbicide selected must be explicitly registered for aquatic application. Spraying should not be undertaken during amphibian breeding periods or when eggs and tadpoles are present. If there is any uncertainty about timing, an amphibian specialist should be consulted to provide confirmation.

Mixing of herbicide must be confined to the designated contractor laydown area, where controls can be enforced to prevent spillages, spray drift, and run-off into sensitive areas. Finally, all applications must align with LandCare recommendations, and any best-practice guidance provided by the relevant municipality or regulatory authority.

No reed management techniques should take place during July and August, as this period coincides with the breeding season of the western leopard toad. All management activities must avoid disturbance to breeding toads, their eggs, and tadpoles to ensure that the species is protected and that wetland ecological processes are not disrupted during this sensitive period.

8.2.4. Removal of woody alien invasives

Eucalyptus camaldulensis

The area adjacent to the Mill Stream UVB wetland is currently invaded by dense stands of *Eucalyptus camaldulensis* (Red River gum) trees. *Eucalyptus camaldulensis* is known to invade rivers in South Africa where it makes use of substantial volumes of freshwater.

Eucalyptus camaldulensis poses a significant threat to riparian / wetland ecosystems due to its classification as a NEMBA Category 1b invasive species when present in riparian / wetland and

Fynbos areas. This classification mandates that *Eucalyptus camaldulensis* must be controlled and wherever possible, removed and destroyed.

When present *Eucalyptus camaldulensis* decreases the species richness and diversity of indigenous riparian / wetland vegetation, as it releases allelopathic substances that prevents other plant species from germinating (Ruwanza *et al.* 2015). Combined with the heavy shading and accumulation of leaf litter beneath its canopy, these factors further suppress the growth and regeneration of indigenous vegetation. Furthermore, *Eucalyptus camaldulensis* uses vast quantities of water compared to indigenous vegetation, which can reduce stream flow. Its water-intensive nature is highly problematic for water-stressed environments such as the Western Cape.

Eucalyptus camaldulensis removal within and adjacent to the offset wetland area should be implemented by trained professionals, as due to their large size, removal can be hazardous. The trees can either be felled and then stacked burned or felled and removed. Stacking should not take place within delineated onsite watercourses. Biomass should not be left onsite for an extended period as it will be a high fire risk.

Other noted alien invasive woody plant species, such as *Acacia saligna* trees, are present within the onsite wetland areas, and should be removed using the methods indicated in **Appendix A**.

8.2.5. 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 alien invasive species.

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.

8.3.3.1. Procurement

Successful rehabilitation depends on the use of healthy, genetically appropriate, and locally sourced plant material. All seed and plant stock must be procured from nurseries that can confirm the origin of their genetic material, with nursery specialists providing guidance where necessary.

Bagged plants of the required species and appropriate provenance can be sourced from local nurseries such as Grootbos Nursery, Fernkloof (Hermanus), and Harold Porter (Kleinmond). Grootbos, in particular, has a strong supply of wetland plants and could assist with the propagation of additional material if required. Wherever possible, local indigenous nurseries should be prioritised to ensure that the vegetation used is well-adapted to local conditions and to support community-based conservation initiatives.

To ensure sufficient plant availability, nurseries must be given adequate notice, with orders ideally placed at least 12 months in advance (6 months as a minimum) prior to scheduled planting. For the rehabilitation of the wetland offset area (approximately 2 ha), an estimated 120,000 plants will be required, in addition to approximately 80,000 wetland and endemic indigenous plants for landscaping and public areas, and around 9,500 m² of Buffalo grass for residential and public spaces.

In addition, the applicant is exploring the establishment of a nursery on the adjacent property to secure a consistent supply of suitable species. This will allow for the propagation of local indigenous vegetation and ensure that sufficient material is available to meet the requirements for wetland rehabilitation.

8.3.3.2. Species for revegetation within the wetland offset

The wetland portions located within the study site had the following indigenous wetland plant species present *Typha capensis* (Bulrush), *Phragmites australis* (Common Reed), *Carex clavata* (Swamp Grass), *Ficinia elatior (Side Clubrush), Orphium frutescens* (Sea Rose), and *Stenotaphrum secundatum* (St. Augustine Grass).

A list of indigenous wetland plant species which should be considered for revegetation of the offset wetlands has subsequently been compiled (**Table 8-1**). This species list was developed based on the wetland plant species identified within the onsite wetlands, along with specialist knowledge of the wetland vegetation types (**Table 8-1**) in the general area.

A minimum of six species from this species list must be introduced to the wetland. Species selection can be guided by availability if 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 (terrestrial, temporary, seasonal, permanent).

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
Araceae	*Zantedeschia aethiopica*	LC	Indigenous	Facultative wetland	Permanent/seasonal
Cyperaceae	*Carpha glomerata*	LC	Indigenous	Obligate wetland	Permanent/seasonal
Cyperaceae	*Carex clavata*	LC	Endemic	Obligate wetland	Permanent/seasonal
Cyperaceae	*Cyperus congestus*	LC	Indigenous	Facultative wetland	Seasonal/temporary
Cyperaceae	*Cyperus thunbergii*	LC	Endemic	Obligate wetland	Seasonal/temporary

Cyperaceae	*Cyperus polystachyos*	LC	Indigenous	Obligate wetland	Seasonal/temporary
Cyperaceae	*Cyperus textilis*	LC	Endemic	Obligate wetland	Permanent/seasonal
Cyperaceae	*Ficinia elatior*	VU	Endemic	Obligate wetland	Permanent/seasonal
Dennstaedtiaceae	*Pteridium aquilinum*	LC	Indigenous	Facultative wetland	Permanent/seasonal
Fabaceae	*Psoralea aphylla*	LC	Endemic	Obligate wetland	Permanent/seasonal
Fabaceae	*Psoralea pinnata*	LC	Endemic	Obligate wetland	Permanent/seasonal
Gentianaceae	*Orphium frutescens*	LC	Endemic	Obligate wetland	Permanent/seasonal
Juncaceae	*Juncus punctorius*	LC	Indigenous	Obligate wetland	Permanent/seasonal
Restionaceae	*Restio paniculatus*	LC	Endemic	Obligate wetland	Permanent/seasonal
Rosaceae	*Cliffortia strobilifera*	LC	Indigenous	Obligate wetland	Permanent/seasonal

8.3.3.3. 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 most revegetation activities are focused on the introduction of whole plants, particularly into areas that are vulnerable to erosion. Revegetation must take place immediately after the reshaping and reprofiling of the newly created offset wetland area/rehabilitated wetland areas and those areas which have been disturbed during the removal of infill and alien vegetation removal is complete.

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 wetland areas have 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.
- Irrigate as required until the seedlings can survive independently (i.e. depending on the rainfall). 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 must be inspected and photographed to serve as a record for the pre-planting condition of the area (refer to **Section 10.2.3** for methodology). 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.

8.3.3.4. Landscaping

Indigenous plant species must be used for landscaping within the development; this promotes local biodiversity and protects the wetlands ecosystem. Landscapers 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.

8.3. Endangered Western Leopard Toad

The Endangered Western Leopard Toad (*Sclerophrys pantherinus*) is present within the site. There is potential for the proposed development to negatively impact the Western Leopard Toad and its habitat. Negative impacts primarily stem from habitat fragmentation, obstacles to toads' movements, and road mortalities.

Figure 8-4: Image of the EN Western Leopard Toad © Serban Proches.

8.3.1. Threats to toads from the proposed development

- Steep curb stones: The presence of steep curb stones acts as an impermeable barrier, trapping the toads and heightening the risk of mortality from cars. Moreover, the curb stones can act as a channel to stormwater drains which act as a one-way trap for toads generally resulting in death for the toads.
- Boundary walls and fences: The erection of boundary walls and fences further contributes to habitat fragmentation, acting as an impermeable barrier for toads restricting their access to habitat.
- Seep pool sides: The design of steep sides within pools presents a threat to toads. Pools can prevent toads from escaping; this leads to exhaustion and drowning. Additionally, prolonged exposure to chlorine is fatal for toads.
- High sided stormwater drains: The high sides of stormwater drains can trap toads, resulting in high levels of mortality rates as they cannot escape from the drains.

8.3.2. Proposed Mitigation measures

The following mitigation measures have been adopted from the Rebelo *et al.* 2004 Biodiversity management plan for the Western Leopard Toad. It is essential that these measures are implemented with the aim to minimize the impact of urban development (specifically habitat fragmentation, obstacles to toads' movements, and road mortalities) on the species:

- It is recommended that a suitably qualified Environmental Control Officer (ECO) is appointed during the construction phase to ensure that recommendations as per this report, and other specialist reports, are implemented.
- Search and rescue for toads should be conducted within the construction footprint prior to commencement of construction.
- During construction, holes and trenches should only be excavated when required. Trenches / open holes / excavations should be closed again as soon as is practically possible given their construction purpose. The appointed ECO / Ecologist should routinely monitor each open trench / hole / excavation. The appointed ECO / Ecologist should thoroughly examine each open trench / hole / excavation by checking beneath any leaf litter for trapped toads. Should any trapped biota be found, the appointed ECO / Ecologist should carefully remove trapped biota from the excavation (taking care not to damage the animal), place them into a plastic bucket with adequate aeration (holes in the lid), and immediately move them into surrounding natural areas.
- Toad-friendly curbs stones should be installed i.e. small curbs stones that are less than 50 mm tall, or half road gutters which provide passageways for toads. These can be implemented throughout the estate or at intervals of 50 m.
- An appropriate road reserve should be implemented for internal access roads within the estate to facilitate the movement of toads.
- Boundary walls and fences should be permeable to toads. Integrate toad holes of at least 100 mm diameter, spaced every 20 meters, and not exceeding 300 mm in length at ground level. Alternatively open gutters can be a suitable option.

- Stormwater systems should be designed with suitably spaced escape areas, allowing toads to escape. These escape areas should be positioned at intervals of at least 50 m.
- The estate should install non-chlorinated eco pools, ideally with a "beach pool" design with gently sloping sides emulating the natural bank of a wetland allowing toads to enter and exit the pool freely. Alternatively, if a pool design with high sides is installed, incorporate escape pathways such as toad ladders, toad friendly steps, or floating vegetated platforms anchored to the side of the pool.
- To prevent road mortalities, Western Leopard Toad signage should be erected and a speed limit within the eco estate should be implemented and strictly adhered to.
- Toad friendly gardens should be created, when it is not the toads breeding season (late July to September with the main breeding month being August), they inhabit suburban gardens. Natural vegetation should be planted to create ideal toad habitat.

By implementing these mitigation measures, the adverse impacts of urban development on the Western Leopard Toad population can be effectively mitigated, contributing to the essential conservation of these toads.

8.4. Stormwater management

Stormwater from the development will drain directly into the wetland (**Figure 8-5**), therefore appropriate stormwater management must be incorporated into development planning to ensure that the hydrology and water quality of the offset wetland area is not negatively impacted by the proposed development.

The proposed development will increase 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.

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 following mitigation measures should be incorporated:

- A suitable sediment forebay should be installed in the stormwater inlet zone to trap litter, debris, coarse sediment, and other gross pollutants before they enter the wetland offset area.
- Vegetated swales must be utilised rather than concrete drains or underground stormwater pipes to encourage infiltration, particularly next to roadways. Only indigenous vegetation is to be utilised within these swales.
- Even flow should be established throughout the constructed SW swale to prevent heavily concentrated flows or stagnation in certain areas.
- Energy dissipaters / erosion protection measures (such as lining with stones, grass, reno-mattresses, or gabions) should be considered where stormwater is released into downstream wetland to reduce the runoff velocity and therefore erosion.
- 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.

- 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, if adjacent to the wetland offset area should store any potential pollutants in such a way that pollution will not occur to the wetland offset areas (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 offset area 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 wetland offset and the SW system 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.
- Given the presence of the Endangered Western Leopard Toad within the site, all stormwater infrastructure must be designed to prevent entrapment and facilitate safe movement of amphibians. Stormwater systems should incorporate suitably spaced escape areas, such as gently sloped ramps or vegetated ledges, at intervals of no more than 50 metres. These features must allow toads to exit easily should they become trapped. Deep stormwater channels, pits, or attenuation ponds with vertical or sheer walls are particularly hazardous and should be avoided where possible. If such structures cannot be avoided, escape features must be incorporated into the design to allow toads and other small fauna to exit safely. Additionally, all stormwater outlets and culverts should be designed to prevent trapping and support safe passage during both wet and dry conditions.
- The stormwater system must be designed by a suitably qualified engineer.

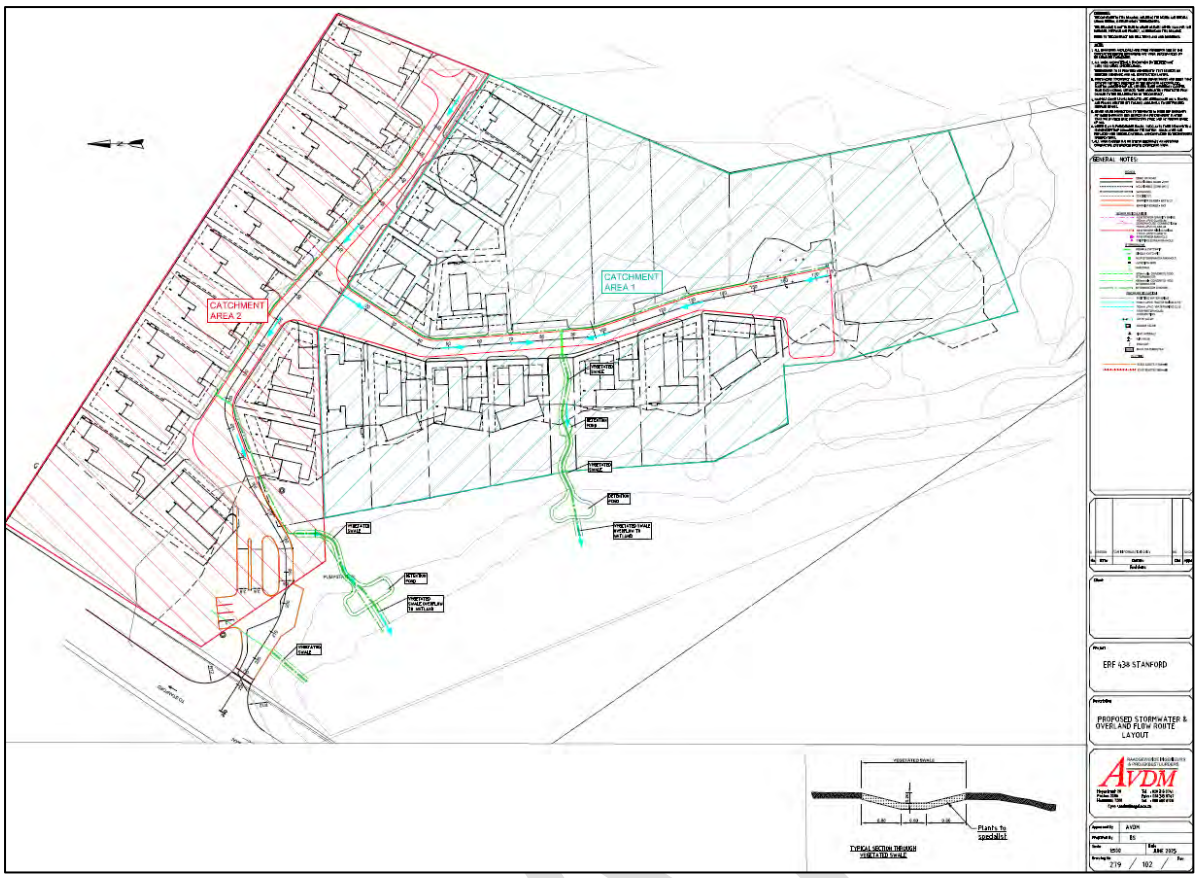

Figure 8-5: Stormwater management plan.

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 the development area. 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 in consultation with a wetland ecologist.	- Remove foreign fill material from the proposed offset wetland (where applicable). - Remove AIS. - Reshaping and reprofiling the wetland offset areas in consultation with the Wetland Ecologist. - Stormwater Management.
Rehabilitation Implementing Agent (Suitably qualified landscaper ideally with experience in wetland rehabilitation)	- Plant, seed, and propagule procurement. - Implement propagation, seeding and planting at appropriate plant densities. - Alien vegetation control.

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 wetland is maintained at the target ecological status:

The rehabilitation efforts should increase the PES of the onsite wetland offset to upper category C with a minimum PES Score of 79 %.

The implementation of these management interventions will further be monitored to determine effectiveness and can be adapted as needed.

10.1. Desired State

Implementing the rehabilitation measures will achieve:

- The rehabilitation efforts should increase the PES of the onsite wetland offset area to 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 five site visits from a freshwater or landscaper specialist will be required to ensure rehabilitation success:

- A site visit to ensure search and rescue of viable plants and top soil is conducted prior to construction commencement.
- A site visit after the removal of fill material, rubble, from the onsite remnant watercourses. The specialist must recommend if / how to re-shape the wetland at this visit;
- A site visit upon completion of the landscaping; *the freshwater specialist should conduct a PES / WES assessment.*
- If the PES target for the offset wetland areas 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. 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 development area 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 areas 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 aliens 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 / watercourse 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.

Fixed-point photographs should be taken before rehabilitation begins, and annually thereafter in the same month as the initial photographs, throughout the rehabilitation of the watercourses. Once rehabilitation is complete, fixed-point photography should continue annually, but the frequency may be reduced to once every five years.

A minimum of six to eight fixed photograph points must be implemented at both the Millstream UVB and the Tributary UVB wetland, to ensure most of the watercourses are recorded. Points must also be confirmed by the ECO. GPS coordinates should be taken for each point to ensure precise location accuracy. Photos must be taken from the same point. Install a permanent marker at each point to guarantee consistent photo capture from the exact spot and 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 relatively wide-angle lens of 25 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 wetlands. 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 areas due to stormwater peak flows. Signs of erosion within the offset wetlands and adjacent SW infrastructure should be checked monthly by the ECO or appointed Estate Manager, and after every heavy rainfall event, particularly within areas in which *stormwater is discharged*. 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, 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 8.3**. Gradually remove the fabric as plants become established.
- Erosion rills and gullies must be filled with rocks of between 5 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. Sediment control

The wetland offset areas should be monitored routinely, specifically after every heavy rainfall event, for accumulation of sediment. Wherever possible, sediment should be removed by hand. As far as possible, **manual/mechanical excavation** should be used to remove sediments, for example, hand tools or small excavators working from the edges or from floating platforms to avoid deep rutting. Sediment removal should be targeted, and minimal, only to restore wetland functioning where sediment build-up has reduced capacity or flow. Over-excavation can permanently damage the wetland's ecological character. The wetland banks must be adequately re-sloped as per **Section 8.4**.

Silt fences used in the SW system must be adequately maintained. Furthermore, the estate manager must monitor sediment fences / traps after every heavy rainfall event and any sediment that has accumulated must be removed by hand.

10.3.3. Phragmites australis & Alien Invasive Species (AIS)

To ensure that the *Phragmites australis* does not reestablish in the wetland, periodic maintenance (every 6–12 months) is recommended. Maintenance frequency should decrease over time as indigenous vegetation stabilises.

Maintenance of the required PES targets will require effective ongoing alien vegetation control to ensure no alien vegetation re-establishes over time. During the rehabilitation phase continued monthly alien invasive monitoring and clearing must take place by the ECO. 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 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 areas, they must be removed timeously using the methods indicated in this Appendix.

10.3.4. Management of the Sewer Network

The sewage system must be monitored and maintained into perpetuity. The developer must confirm who will be responsible for this monitoring and maintenance as well as their roles.

11. Conclusion and Recommendations

The proposed development will result in the complete loss of the degraded seep wetland. The wetland loss 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 establishment, rehabilitation, and management effort. The results of the offset calculations are presented in **Table 11-1**.

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

Offset Balance Table						
Wetland Name	**Area (ha)**		**Function (HE)**		**Habitat (HE)**	
	Losses	**Gains**	**losses**	**Gains**	**Losses**	**Gains**
Seep wetland lost (LT)	-0,7000	0,0000	-0,2660	0,0000	-0,0140	0,0000
Seep wetland lost (CR)	-0,2000	0,0000	-0,0760	0,0000	-0,2400	0,0000
Mill Stream UVB wetland rehabilitated	0,0000	1,0400	0,0000	0,1304	0,0000	1,8532
Tributary UVB wetland rehabilitated	0,0000	0,2000	0,0000	0,0026	0,0000	0,3760
Subtotal (HE)	*-0,9000*	1,2400	*-0,3420*	*0,1331*	*-0,2540*	*2,2292*
Balance (HE)	**0,3400**		**-0,2089**		**1,9728**	
Offsite wetland offset area included						
Offsite Mill Stream UVB wetland rehabilitated	0,0000	1,7000	0,0000	0,2244	0,0000	2,7460
Subtotal (HE)	*-0,9000*	*2,9400*	*-0,3420*	*0,3575*	*-0,2540*	*4,9752*
Balance (HE)	**2,0400**		**0,0155**		**4,7212**	

The total wetland loss was valued at -0,3420 HE of function and -0,2540 HE of habitat. The onsite wetland offset activities resulted in a surplus of 1,9728 HE of wetland habitat while wetland function was not completely achieved. The onsite wetland offset does not fully offset the loss of the Seep wetland. *To address this shortfall, the additional offsite Mill Stream UVB wetland area located on municipal land adjacent to the study site will be secured through a formal lease agreement.* ***The inclusion of the offsite wetland area ensures that the overall wetland offset achieves a positive balance.***

A detailed rehabilitation plan was drafted for the wetland offset areas, including the removal of alien invasive vegetation and foreign fill material, reshaping, revegetation with indigenous wetland plant species, and onsite water quality management. Implementing the rehabilitation measures will achieve an *increase in the PES of the onsite wetland offset area to upper category C with a minimum PES Score of 79 %.*

A management plan was drafted thereafter to ensure that the gains achieved through establishment and rehabilitation are maintained or slowly increased. It is specialist's opinion that it is 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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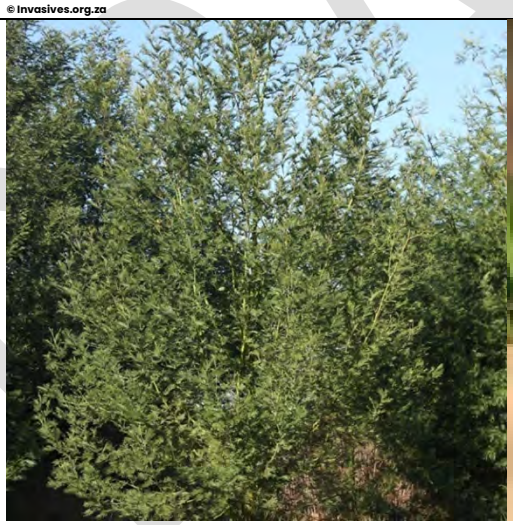
Appendix A: Invasive Species

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 control and 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
Pennisetum clandestinum (Kikuyu grass)	 
Eucalyptus camaldulensis (Red River gum)	  © Invasives.org.za

Eucalyptus cladocalyx (Sugar gum)	  © wikimedia.org
Acacia saligna (Port Jacksons willow)	  © Invasives.org.za
Acacia mearnsii (Black wattle)	  © Invasives.org.za

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 in the identified offset wetland and surroundings. 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:

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. Vegetation should be removed before seed is set and released.

Herbicide Stump Treatment

Use: Resprouting species that have undergone felling treatment

Some alien tree species are known to resprout from the stump after felling. To prevent this 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) the appropriate 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 section below 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.
- Application of herbicides must not take place in heavy winds or when there is any possibility of drift.
- Appropriate personal protection equipment (PPE) must be used when working with herbicides.
- Only herbicides which have been certified safe for use in aquatic environments by an independent testing authority may be considered.
- Personnel should be adequately trained on the safe application of these chemicals.
- The ECO must be consulted before any herbicide is utilised within the wetland areas.

Disturbed areas from which alien plant species have been removed must be reshaped so that they tie in with surrounding hillslopes and must be rehabilitated immediately according to the revegetation **Section 8.2.5**.