Wetland Functionality Assessment & Rehabilitation Plan for the Constructed Montrose Farming Trust Dam on Persberg Farm Near Helpmekaar in KwaZulu-Natal.

for Afzelia Environmental Consultants (Pty)

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Report name	**Wetland Functionality Assessment & Rehabilitation Plan for the Constructed Montrose Farming Trust Dam on Persberg Farm Near Helpmekaar in KwaZulu-Natal.**	
Reference code	**AFZ-1607-09**	
Submitted to	**Andrew Batho at Afzelia**	
Report writer 1	**Wayne Jackson**	**25th September 2016**

DECLARATION

I, **Wayne Jackson** declare that:

- I act as the independent specialist in this matter;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act (Act 107 of 1998) (NEMA), regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the NEMA Act, regulations and all other applicable legislation;
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B-(1) of the National Environmental Management Act, 1998 (Act 107 of 1998);
- I have no, and will not engage in, conflicting interests in the undertaking of the activity; and
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; all the particulars furnished by me in this report are true and correct.

Wayne Jackson

10 October 2016

INDEMNITY

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Executive Summary

The wetland survey was conducted on the 19th of July 2016 during the drier winter months and a short site visit is recommended during the wet season. The survey included all the wetland indicators as well as assessing the PES, the ecoservices provided by the wetlands, and the EIS of the wetlands.

The FEPA wetlands were classified as a bench (flat) wetland and a Hillslope Seep wetland. The Wetland condition and rankings for both these FEPA wetlands were A/B (≥75% Natural vegetation) and rank four (4) (wetlands with A/B condition and associated with at least three other wetlands). These sites were classified as predominantly natural. The NFEPA wetland information is a coarse data set and must be ground truthed.

From the field assessment undertaken and Google Earth historical imagery it is concluded that the wetlands were not Bench Flats and Hillslope Seeps, but rather Unchannelled valley bottom wetland system (HGM 1). There was an existing dam in 2012 (as far as Google Earth history goes) as well as evidence of cattle paths which indicate grazing activities within the wetland. These activities will alter the Present Ecological Category (PES) or wetland condition to a lower level of what can only be assumed as a C (Moderately Modified) State. This can only be assumed as the wetland assessment was only conducted post-construction of the new Montrose Farming Trust (MFT) dam wall.

The PES rating after construction was classified as an E (Seriously Modified)

The wetland identified provides an intermediate level of services to the environment and people.

HGM 1 was assessed to have a high benefit for flood attenuation. The wetland also has a moderately high ability to improve water quality by assimilating phosphates, nitrates, and toxicants, as well as to control erosion.

The ecological importance and sensitivity of HGM 1 was assessed to be high (B) with regards to the Ecological Importance & Sensitivity, as well as the Hydrological Functional Importance. These were rated high due to the location of the wetland being within FEPA wetland layers as well as the sensitivity of Unchannelled Valley Bottom wetlands to alteration of low flows (which will occur if the EWR is not implemented). The Direct Human Benefit was rated to be moderately important (C).

Findings from the DWS aspect and impact register / risk assessment are provided in Table 5-2.

The MFT Dam has already been constructed and the risks/impacts cannot be assessed accurately, the Dam has not undergone its first filling and this will be included in the assessment. The operational phase was assessed and mitigation measures have been recommended to monitor and improve wetland functionality were possible.

Three aspects were addressed in the risk assessment:

- The initial infilling of the dam and its impacts on the alteration of flow volumes and patterns, as well as the loss of wetland from the extended inundation area;
- The infestation of alien vegetation post construction and how that would impact on the flow patterns and volumes of the wetlands; and
- The downstream releases and its impacts on the downstream wetland function and ecology.

The risk matrix shows that the initial flooding will have a high impact on the wetlands at the point of inundation, with the remaining aspects having a moderate impact.

Professional Opinion

The dam construction will and has had a significant impact on the wetland present at Persberg Farm, however it is crucial to conduct an Environmental Water Requirement (EWR) assessment to determine if the dam is fatally flawed. Therefor no decision can be made at this point to determine whether the dam is acceptable or not.

Once the EWR assessment has been completed the results will be assessed by the wetland specialist and this report will be updated accordingly.

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1 INTRODUCTION

Afzelia appointed Earth Water Environmental Science (Hereafter EWES) conduct the wetland functional assessment and Wetand Rehabilitation Plan for the Montrose Farming Trust Dam (Hereafter MFT Dam) project located on the Farm Persberg, between the towns of Greytown and Dundee in KwaZulu-Natal.

1.1 LOCALITY AND PROJECT DESCRIPTION

The study area is located in the Msinga District Municipality of the KwaZulu-Natal Province. More specifically, the site is situated on Farm Persberg (Plan 1). The nearest town, Pomeroy, is approximately 16 km south of the project site (Table 1-1).

Table 1-1: MFT Dam Coordinates.

South (DMS)	East (DMS)
28° 26' 01.44"	30° 24' 40.48"

1.2 TERMS OF REFERENCE

The purpose of this report is to provide the following;

- A wetland resource delineation;
- Present Ecological State (PES) and functioning using the WET-Health guidelines (Macfarlane, et al., 2009);
- The ecosystem services provided using the WET-EcoServices guideline (Kotze, et al., 2009);
- The Ecological Importance and Sensitivity (EIS);
- A risk assessment and associated mitigation measures; and
- A wetland rehabilitation plan.

1.3 LIMITATIONS

The following aspects were considered as limitations;

- The assessment was conducted during the dry season on the 19th of July 2016.

Plan 1: The local setting of the MFT Dam project.

2 APPLICABLE LEGISLATION

2.1 NATIONAL WATER ACT (NWA, 1998)

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) allows for the protection of water resources, which includes:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means:

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

The NWA recognises that the entire ecosystem, and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS.

For the purposes of this project, a wetland area is defined according to the NWA (Act No. 36 of 1998): *"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".*

Wetlands have one or more of the following attributes to meet the NWA wetland definition (DWAF, 2005):

- A high water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;

- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils; and
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

2.2 National Environmental Management Act (NEMA, 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998), states that prior to any development taking place within a wetland or riparian area, an environmental authorisation must be obtained.

3 Methodology

The National Wetland Classification Systems (NWCS) developed by the South African National Biodiversity Institute (SANBI) will be considered for this study. This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, and also then includes structural features at the lower levels of classification (Ollis, et al., 2013). The classification system is described in Appendix A.

3.1 Desktop Assessment

The following information sources were considered for the desktop assessment;

- Information as presented by the South African National Biodiversity Institutes (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org);
- Aerial imagery (Google Earth Pro);
- Land Type Data (Land Type Survey Staff, 1972 - 2006)
- The National Freshwater Ecosystem Priority Areas (Nel, et al., 2011);
- Contour data (5m).

3.2 Wetland Delineation

The wetland areas are delineated in accordance with the DWAF (2005) guidelines, a cross section is presented in Figure 3-1. The outer edge of the wetland areas were identified by considering the following four specific indicators:

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;

- The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
  - The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991);
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

Vegetation is used as the primary wetland indicator. However, in practise the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

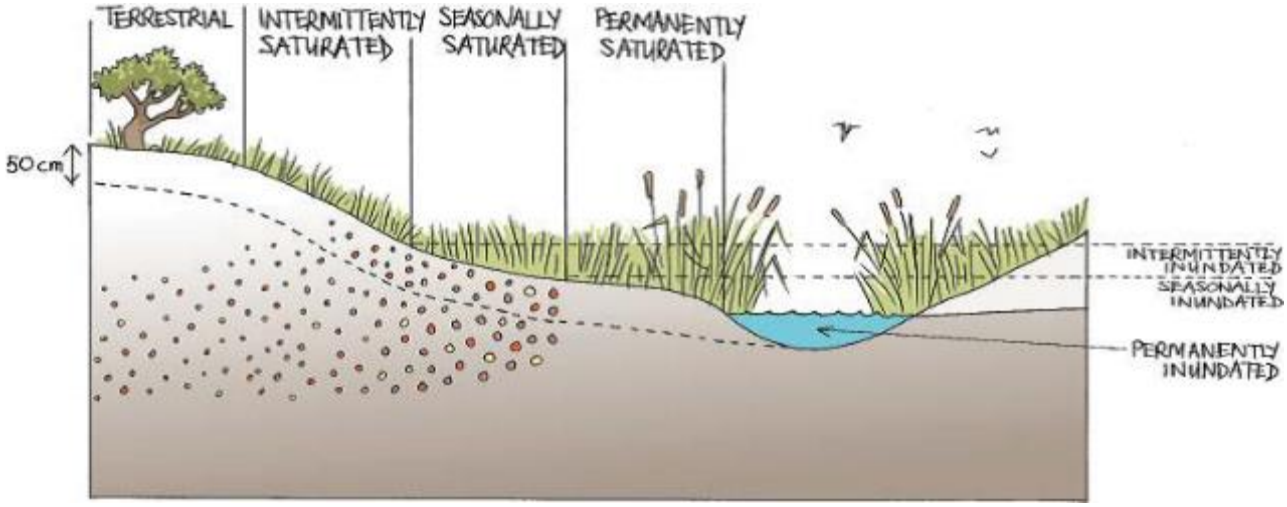

Figure 3-1: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis, et al., 2013).

3.3 Present Ecological Status (PES)

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society (ecosystem services). Management of these systems is therefore essential if these attributes are to be retained within an ever changing landscape. The primary purpose of this assessment is to evaluate the ecophysical health of wetlands, and in so doing promote their conservation and wise management.

3.3.1 Level of Evaluation

Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

3.3.2 Units of Assessment

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

3.3.3 Quantification of Present Ecological State (PES) of a Wetland

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a PES score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The impact scores and Present State categories are provided in Table 3-1 and Table 3-2.

Table 3-1: The magnitude of impacts on wetland functionality (Macfarlane, et al., 2009).

Impact Category	Description	Score
None	No Discernible modification or the modification is such that it has no impacts on the wetland integrity	**0 to 0.9**
Small	Although identifiable, the impact of this modification on the wetland integrity is small.	**1.0 to 1.9**
Moderate	The impact of this modification on the wetland integrity is clearly identifiable, but limited.	**2.0 to 3.9**
Large	The modification has a clearly detrimental impact on the wetland integrity. Approximately 50% of wetland integrity has been lost.	**4.0 to 5.9**
Serious	The modification has a highly detrimental effect on the wetland integrity. More than 50% of the wetland integrity has been lost.	**6.0 to 7.9**
Critical	The modification is so great that the ecosystem process of the wetland integrity are almost totally destroyed, and 80% or more of the integrity has been lost.	**8.0 to 10**

Table 3-2: The PES categories (Macfarlane, et al., 2009).

Impact Category	Description	Impact Score Range	Present State Category

None	**Unmodified, natural**	**0 to 0.9**	**A**
Small	**Largely Natural** with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	**1.0 to 1.9**	**B**
Moderate	**Moderately Modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	**2.0 to 3.9**	**C**
Large	**Largely Modified.** A large change in ecosystem processes and loss of natural habitat and biota has occurred.	**4.0 to 5.9**	**D**
Serious	**Seriously Modified.** The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	**6.0 to 7.9**	**E**
Critical	**Critical Modification.** The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	**8.0 to 10**	**F**

3.3.4 Overall Health of the Wetland

Once all HGM Units have been assessed, a summary of health for the wetland as a whole is calculated. Since hydrology, geomorphology and vegetation are interlinked their scores are aggregated to obtain an overall PES health score using the following formula (Macfarlane, et al., 2009):

Health = ((Hydrology score) x3 + (Geomorphology score) x2 + (Vegetation score) x2)) ÷ 7

3.4 WETLAND ECOSYSTEM SERVICES

The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described in WET-EcoServices (Kotze, et al., 2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the services are provided (Table 3-3):

- Flood attenuation
- Stream flow regulation
- Sediment trapping
- Phosphate trapping
- Nitrate removal
- Toxicant removal
- Erosion control
- Carbon storage
- Maintenance of biodiversity
- Water supply for human use
- Natural resources
- Cultivated foods
- Cultural significance
- Tourism and recreation
- Education and research

Table 3-3: Classes for determining the likely extent to which a benefit is being supplied (Kotze, et al., 2009).

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

3.5 Ecological Importance and Sensitivity (EIS)

The method used for the EIS determination was adapted from the method as provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in Table 3-4.

Table 3-4: Description of EIS categories.

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

4 RESULTS & DISCUSSION

4.1 DESKTOP BACKGROUND FINDINGS

4.1.1 Climate

The MFT area is characterised by a summer rainfall pattern with peak rainfall from December to January. Frequent fog adds to the overall precipitation. Mean Annual Precipitation (MAP) is almost 920 mm and mean annual evaporation reaches 1 770 mm. Mean Annual Temperature (MAT) of 14.3°C and almost 30 days of frost indicate that the unit is found close to the lower limit of warm-temperate climate (Macina, et al., 2006).

4.1.2 Geology & Soils

The geology of the area is mainly Ecca and Beaufort Groups (Karoo Supergroup) mudstone or shale.

According to the land type database (Land Type Survey Staff, 1972 - 2006)the MFT Dam falls within the Bb72 land type and it is expected that, the dominant soils in the crest positions will be Shallow Mispah and Glenrosa soils. The midslope positions should have Hutton, Avalon, and Westleigh soil forms. The soils that dominated the footslopes and the valley bottoms are Katspruits.

4.1.3 Vegetation

The project area falls within the Sub-Escarpment Grassland vegetation group, but more specifically the GS 3 (Low Escarpment Moist Grassland vegetation type (Macina, et al., 2006).

Complex mountain topography. Steep, generally east- and south-facing slopes, with a large altitudinal range. Supporting tall, closed grassland with *Hyparrhenia hirta* and *Themeda triandra* dominant. *Protea caffra* communities and patches of *Leucosidea* scrub feature at higher altitudes.

4.1.4 National Freshwater Ecosystem Priority Area (NFEPA) Status

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the NWA (Nel, et al., 2011).

Two (2) FEPA wetlands (not WetFEPA) were identified within the 500m buffer of the MFT Dam. The FEPA wetlands in the vicinity of the MFT Dam are shown in (Plan 2). The FEPA sites within 500m are listed in Table 4-1.

The FEPA wetlands were classified as a bench (flat) wetland and a Hillslope Seep wetland. The Wetland condition and rankings for both these FEPA wetlands were A/B (≥75% Natural

vegetation) and rank four (4) (wetlands with A/B condition and associated with at least three other wetlands). These sites were classified as predominantly natural. The NFEPA wetland information is a coarse data set and must be ground truthed.

From the field assessment undertaken and Google Earth historical imagery it is concluded that the wetlands were not Bench Flats and Hillslope Seeps, but rather Unchannelled valley bottom wetland systems. There was an existing dam in 2012 (as far as Google Earth history goes) as well as evidence of cattle paths which indicate grazing activities within the wetland. These activities will alter the Present Ecological Category (PES) or wetland condition to a lower level of what can only be assumed a C (Moderately Modified) State. This can only be assumed as the wetland assessment was only conducted post-construction of the new MFT Dam wall.

Table 4-1: NFEPA description for the FEPA sites near the proposed development.

FEPA Wetland	Classification Levels				Wetland Vegetation Class	Natural / Artificial	Wetland Condition	Wetland Rank
	L1 (System)	L2 (Ecoregion)	L3 Landscape Position	L4 HGM Classification				
Flat (light Blue)	Inland System	North Eastern Uplands	Bench	Flat/ Depression	Gs 3 – Low Escarpment Moist Grassland	Natural	A/B : ≥ 75 % natural land cover	4 – wetlands in A/B classification and associated with at least three other wetlands
Hillslope Seep (Purple)			Slope	Seep				

Plan 2: The NFEPA wetlands located within 500m of the MFT Dam.

4.2 WETLAND FIELD DELINEATION

The wetland survey was conducted on the 19th of July 2016 during the drier winter months and a small investigation is recommended in the wetter months. The survey included all the wetland indicators as well as assessing the PES, the ecoservices provided by the wetlands, and the EIS of the wetlands.

Plan 3: MFT Dam wetland delineation with the 500m assessment buffer.

The wetland delineation is shown in Plan 3 and the HGM units in Plan 4 with the wetland classification as per SANBI guidelines (Ollis, et al., 2013) in Table 4-2.

One (1) HGM unit was identified namely;

- Unchannelled Valley Bottom (HGM 1) (17.4ha).

These are described in the subsequent sections.

Table 4-2: Wetland classification as per SANBI guideline (Ollis, et al., 2013).

Wetland Name	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 1	Inland	North Eastern Uplands	Sub-Escarpment Grassland – Gs3	Valley Floor	Unchannelled Valley Bottom	(N/A)	(N/A)

Plan 4: MFT Dam HGM unit.

4.2.1 (HGM 1) Unchannelled Valley Bottom

The unchannelled Valley Bottom wetland system (HGM1) shown in Figure 4-2 (17.4 ha within the 500m assessment buffer). The wetland is fed by a 340 ha catchment on the top of a mountain. It drains from the north west into the assessment buffer and then drains north east into the MFT

Dam location. The wetland then drains into a culvert under the R33 road and continues draining north east. The unchannelled valley bottom then links up with another unchannelled valley bottom system and drains south west down the mountain feeding the larger catchment.

The soils are shallow Mispah soils on the northern banks with slopes in excess of 10%. The southern bank is flatter in slope and the soils are deeper with Clovelly and Hutton soils dominating the midslope positions in the land scape. The valley bottom shows a transition from Clovelly soils (midslope), to Westleigh soils (footslope), to Katspruit soils (valley bottom) (Figure 4-1).

Figure 4-1: The soils present from left to right; Clovelly, Westleigh, and Katspruit.

Figure 4-2: The unchannelled valley bottom.

4.3 Present Ecological State (PES)

4.3.1 (HGM 1) Unchannelled Valley Bottom

The overall PES score for the Unchannelled Valley Bottom wetland was that of an E (Seriously Modified) as shown in Table 4-3. The individual drivers were assessed and described below.

HYDROLOGY

The hydrological component of the HGM unit was categorised as a F (Critically Modified), as a result of the increased dam size with regards to the relatively small catchment of 340ha, and the high level of abstraction that has been proposed in the hydrological assessment (Krugel, 2016). The hydrological assessment has not discussed any Environmental Water Releases, which will impact the downstream portions of these wetlands significantly. The wetland portions are also located at the top of mountain and is the source of wetlands down the catchment.

GEOMORPHOLOGY

The geomorphology of the wetland was categorised as a C (Moderately Modified) as a result of the dams' construction which has affected the actual size of the wetland by

VEGETATION

The vegetation component was categorised as a D (Largely Modified), as a result of the new dam volume increasing the surface area that will be inundated by water. This drowns previously established wetland plant communities. The dam wall has also reduced the wetland vegetation area purely through its construction footprint. The area is being used for cattle grazing reducing the natural vegetation community.

RECOMMENDATIONS

The PES rating before dam construction was assumed to be a C (Moderately Modified), this however cannot be verified as a wetland assessment was not conducted prior to construction. The PES rating after construction is an E (Seriously Modified).

A EWR assessment is crucial to determine the feasibility of the dam wall and whether it will have a significant impact on the wetlands downstream.

Table 4-3: The PES results for the MFT Dam

Wetland	Area (ha)	Hydrology		Geomorphology		Vegetation	
		Rating	Score	Rating	Score	Rating	Score
HGM 1	17.4	F: Critically Modified	10.0	C: Moderately Modified	3.0	D: Largely Modified	5.9

Overall PES Score	6.8	Overall PES Class	E: Seriously Modified

4.4 Ecosystem Services Assessment

The Ecosystem services provided for the HGM unit present at the site were assessed and rated as per Table 4-4 using the WET-EcoServices method (Kotze, et al., 2009). The summarised results for HGM 1 is shown in Table 4-5 with the spider diagram illustrated in Figure 4-3.

The wetland identified provides an intermediate level of services to the environment and people.

HGM 1 was assessed to have a high benefit for flood attenuation. The wetland also has a moderately high ability to improve water quality by assimilating phosphates, nitrates, and toxicants, as well as to control erosion.

Table 4-4: Ecoservices rating of likely extent to which a benefit is being supplied.

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

Table 4-5: The EcoServices being provided by HGM 1.

Wetland Unit					HGM 1
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation		1.6
			Streamflow regulation		2.7
			Water Quality enhancement benefits	Sediment trapping	1.9
				Phosphate assimilation	2.2
				Nitrate assimilation	2.8
				Toxicant assimilation	2.1
				Erosion control	2.1
			Carbon storage		2.0
	Direct Benefits	Biodiversity maintenance			1.8
		Provisioning benefits	Provisioning of water for human use		2.1
			Provisioning of harvestable resources		1.6
			Provisioning of cultivated foods		1.2
		Cultural benefits	Cultural heritage		0.0
			Tourism and recreation		1.1
			Education and research		1.3
Overall					26.4
Average					1.8

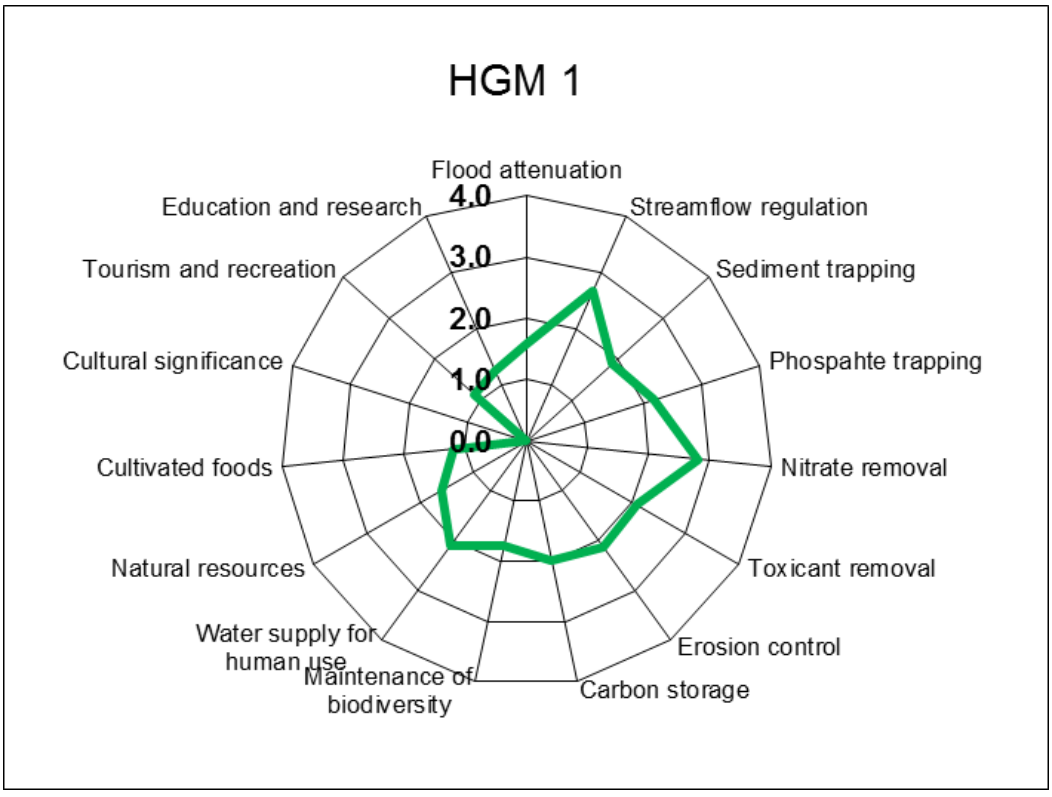

Figure 4-3: The spider diagram of Ecosystem services provided by HGM 1.

4.5 Ecological Importance & Sensitivity (EIS)

The EIS assessment was applied to the HGM units described in previous section in order to assess the levels of sensitivity and ecological importance of the wetland. The results of the assessment are shown in Table 4-6.

The ecological importance and sensitivity of HGM 1 was assessed to be high (B) with regards to the Ecological Importance & Sensitivity, as well as the Hydrological Functional Importance. These were rated high due to the location of the wetland being within FEPA wetland layers as well as the sensitivity of Unchannelled Valley Bottom wetlands to alteration of low flows (which will occur if the EWR is not implemented). The Direct Human Benefit was rated to be moderately important (C).

Table 4-6: The EIS results for the MFT Dam.

WETLAND IMPORTANCE AND SENSITIVITY	
HGM 1	
	Importance
ECOLOGICAL IMPORTANCE & SENSITIVITY	**2.3**
HYDROLOGICAL/FUNCTIONAL IMPORTANCE	**2.2**
DIRECT HUMAN BENEFITS	**1.2**

5 RISK ASSESSMENT

5.1 METHODOLOGY

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines.

The matrix assesses impacts in terms of consequence and likelihood. Consequence is calculated based on the following formula:

Consequence = Severity + Spatial Scale + Duration

Whereas likelihood is calculated as:

Likelihood=Frequency of Activity + Frequency of Incident +Legal Issues + Detection.

Significance is calculated as:

Significance \Risk= Consequence X Likelihood.

The significance of the impact is calculated according to Table 5-1.

Table 5-1: Significance ratings matrix

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

5.2 FINDINGS

The environmental consequences of large dams are numerous and varied, and includes direct impacts to the biological, chemical and physical properties wetlands.

The dam traps sediments and restrict natural flows, which are critical for maintaining physical processes and habitats downstream of the dam.

Another significant impact is the transformation upstream of the dam. Reservoirs often host non-native and invasive species (e.g. snails, algae, predatory fish) that further undermine the natural communities of plants and animals.

The alteration of a wetlands flow and sediment transport downstream of a dam often causes the greatest sustained environmental impacts. Life in and around a wetland evolves and is

conditioned on the timing and quantities of water flow. Disrupted and altered water flows can be as severe as completely de-watering wetlands and the life they contain. Even subtle changes in the quantity and timing of water flows impact the system. A dam holds back sediments that would naturally replenish downstream ecosystems. When a channel is deprived of its sediment load, it seeks to recapture it by eroding the downstream river bed and banks altering wetland sizes and function. (International Rivers).

Findings from the DWS aspect and impact register / risk assessment are provided in Table 5-2.

The MFT Dam has already been constructed and the risks/impacts cannot be assessed accurately, the dam has not undergone its first filling and this will be included in the assessment by estimating the impacts of deep flooding of the unchannelled valley bottom wetland. The operational phase was estimated and mitigation measures have been recommended to monitor and improve wetland functionality were possible.

Three aspects were addressed in the risk assessment:

- The initial infilling of the dam and its impacts on the alteration of flow volumes and patterns, as well as the loss of wetland from the extended inundation area;
- The infestation of alien vegetation post construction and how that would impact on the flow patterns and volumes of the wetlands; and
- The downstream releases and its impacts on the downstream wetland function and ecology.

The risk matrix shows that the initial flooding will have a high impact on the wetlands with the remaining aspects having a moderate impact. The mitigation measures are described in the subsequent sections and address how some of these risks can be reduced, as well as measures to improve the PES rating of the wetlands affected.

Table 5-2: Risk Assessment as per DWS guidelines.

Phase	Activity	Aspect	Impact	Flow Regime	Physical & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota		Severity	Spatial scale	Duration		Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection		Likelihood	Significance	Risk Rating
Construction	Construction of the Dam	Initial Flooding of Dam	Alteration of patterns of flows (increased /decreased flood peaks)	5	4	5	5		4.75	4	5		13.75	1	5	5	2		13	178.75	H
			Alteration of existing wetland area	5	5	5	5		5	4	5		14	1	5	5	2		13	182	H
Operational	Operation of completed dam	Infestation of alien vegetation post construction	Alteration to flow volumes	4	4	4	4		4	4	5		13	1	4	5	2		12	156	M
		Downstream Releases	Increase erosion potential and changes in downstream ecology	4	4	4	4		4	4	5		13	1	4	5	2		12	156	M

5.3 Mitigation Measures

The below mitigation measures are to be completed to reduce any impacts that the dam currently has on the wetland and must not be seen as final. The EWR assessment will determine whether the dam is fatally flawed and a final decision can only be based on the EWR results.

5.3.1 Specific Mitigation Measures

Operational Phase

- It is critical that an alien vegetation control programme is implemented, as encroachment of alien vegetation will increase as a result of the construction process disturbances. Rehabilitation of disturbed areas, utilising indigenous wetland vegetation species, will assist in reducing the impact of construction.
- The Environmental Water Requirement (must be completed) for releases from the dam must be adhered to and records must be kept to verify these releases.
- During the operational phase vehicles must remain on designated roads and must not drive in the wetland areas or the edge of the dam as new wetland systems would have established there.
- Complete an Environmental Flow Requirement (EWR) assessment to determine the required environmental releases from the dam to sustain wetland functions downstream. This must be done or the dam will have a fatal flaw and must then be decommissioned;
- Reducing the proposed irrigation usage to allow the wetland to sustain some function upstream and downstream;
- Fencing off of the wetland to prevent cattle from grazing within the wetland; and
- Ensure no erosion occurs at the dam inlet and outlet points.

6 Conclusion & Recommendations

The wetland survey was conducted on the 19th of July 2016 during the drier winter months and it is recommended that a small site investigation be conducted during the wetter months. The survey included all the wetland indicators as well as assessing the PES, the ecoservices provided by the wetlands, and the EIS of the wetlands.

The FEPA wetlands were classified as a bench (flat) wetland and a Hillslope Seep wetland. The Wetland condition and rankings for both these FEPA wetlands were A/B (≥75% Natural

vegetation) and rank four (4) (wetlands with A/B condition and associated with at least three other wetlands). These sites were classified as predominantly natural. The NFEPA wetland information is a coarse data set and must be ground truthed.

From the field assessment undertaken and Google Earth historical imagery it is concluded that the wetlands were not Bench Flats and Hillslope Seeps, but rather an Unchannelled valley bottom wetland system (HGM 1). There was an existing dam in 2012 (as far as Google Earth history goes) as well as evidence of cattle paths which indicate grazing activities within the wetland. These activities will alter the Present Ecological Category (PES) or wetland condition to a lower level of what can only be assumed as a C (Moderately Modified) State. This can only be assumed as the wetland assessment was only conducted post-construction of the new MFT Dam wall.

The PES rating after construction was classified as an E (Seriously Modified).

The wetland identified provides an intermediate level of services to the environment and people.

HGM 1 was assessed to have a high benefit for flood attenuation. The wetland also has a moderately high ability to improve water quality by assimilating phosphates, nitrates, and toxicants, as well as to control erosion.

The ecological importance and sensitivity of HGM 1 was assessed to be high (B) with regards to the Ecological Importance & Sensitivity, as well as the Hydrological Functional Importance. These were rated high due to the location of the wetland being within FEPA wetland layers as well as the sensitivity of Unchannelled Valley Bottom wetlands to alteration of low flows (which will occur if the EWR is not implemented). The Direct Human Benefit was rated to be moderately important (C).

Findings from the DWS aspect and impact register / risk assessment are provided in Table 5-2.

The MFT Dam has already been constructed and the risks/impacts cannot be assessed accurately, the Dam has not undergone its first filling. The operational phase was estimated and mitigation measures have been recommended to monitor and improve wetland functionality were possible.

Three aspects were addressed in the risk assessment:

- The initial infilling of the dam and its impacts on the alteration of flow volumes and patterns, as well as the loss of wetland from the extended inundation area;
- The infestation of alien vegetation post construction and how that would impact on the flow patterns and volumes of the wetlands; and
- The downstream releases and its impacts on the downstream wetland function and ecology.

The risk matrix shows that the initial flooding will have a high impact on the wetlands with the remaining aspects having a moderate impact.

6.1 Professional Opinion

The dam construction will and has had a significant impact on the wetland present at Persberg Farm, however it is crucial to conduct an Environmental Water Requirement (EWR) assessment to determine if the dam is fatally flawed. Therefor no decision can be made at this point to determine whether the dam is acceptable or not.

Once the EWR assessment has been completed the results will be assessed by the wetland specialist and this report will be updated accordingly.

7 REHABILITATION CRITERIA

During the design of the Wetland Rehabilitation Plan and in defining the rehabilitation requirements for the wetland areas associated with proposed MFT Dam, several criteria were considered. The following sections briefly define the principles and aspects considered during the development of the Wetland Rehabilitation Plan.

7.1 RESTORATION OF WETLAND SYSTEMS

Wetland systems (and the associated catchments) are often influenced and impacted on by various activities. These systems are altered through the loss of seepage areas, changes to the hydrological regime and the loss of ecological services. In response to these losses, efforts are made to either remediate, restore or rehabilitate a system, the difference of which is presented in Figure 7-1. According to (Rutherfurd, et al., 1999), the differences between remediation, restoration and rehabilitation are as follows:

- Restoration of a degraded system would involve reinstating numerous variables to natural conditions.
- Rehabilitation involves improving the most important aspects of the ecosystem to resemble its original condition. A rehabilitated system still retains ecosystem functionality.
- Remediation of a degraded system recognises that the ecosystem has been altered to an extent that the original condition is no longer achievable due to irreversible changes that have taken place within the catchment and system itself. Therefore, remediation aims to improve the current ecological condition of the system.

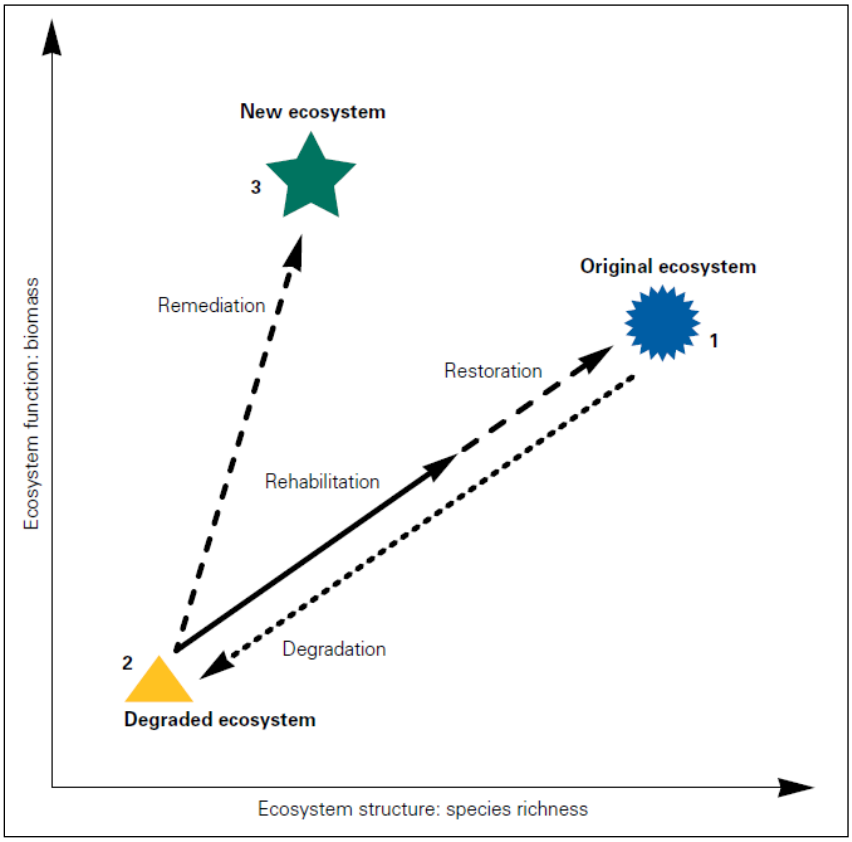

Figure 7-1: The differences between restoration, rehabilitation and remediation (Rutherfurd, et al., 1999)

7.2 The Mitigation Hierarchy

The mitigation hierarchy is a tool that is used to help manage potential impacts to biodiversity and the associated ecosystem services. The first (and preferred) step of the hierarchy is to avoid any impacts to biodiversity and the local ecosystems. In the event that impacts cannot be avoided, these impacts need to be mitigated to reduce the significance of these impacts. Where possible, it is required that aspects of the local environmental that will be impacted on be rescued, this by possible relocations where possible. The next step is to provide a form of rehabilitation to repair, reinstate and/or restore the status and functioning of the impacted environments. Figure 7-2 presents the mitigation hierarchy.

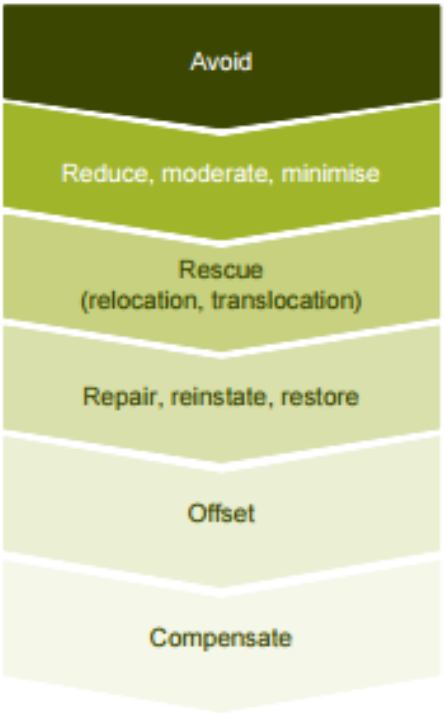

Figure 7-2: The mitigation hierarchy

The application of the mitigation hierarchy was implemented for the study to achieve the following:

- To identify mitigation measures to reduce any potential impacts to wetlands that will be affected by the dam; and
- To develop rehabilitation measures that take into account best practices and relevant guidelines.

7.3 WETLAND PES, ECOSERVICES, EIS AND RECOMMENDED ECOLOGICAL CATEGORY (REC)

The overall wetland PES falls within a Class E (Seriously modified, a significant loss of natural habitat, biota and basic ecosystem functions has occurred).

The wetland functioning and ecoservices provision within the vicinity of the MFT Dam achieving an average score of 1.8, which indicates that the wetlands provide an intermediate benefit in terms of its ecological, economic and social benefits.

The EIS assessment indicated a B and C level of integrity and importance.

No Recommended Ecological Category can be set at this stage as the EWR assessment must be completed first.

7.4 Extent and Applicability of the Rehabilitation Plan

This rehabilitation plan is applicable to the activities directly associated with the construction and operation of the dam.

7.5 Sensitive Habitats and Landscapes

The most pertinent threats which are currently posed to the system, over which the proponent for this development has control include erosion, incision and siltation of the watercourse, inundation of upstream areas, prevention and control of alien plant species invasion, loss of topsoil, management of compaction within the wetland areas and loss of vegetation cover.

Should these factors be mitigated and effective rehabilitation measures be implemented, the wetland area will regain some ecological service provision capability. The rehabilitation plan can also aid in mitigating future impacts on the ecology of the area through protection from erosion, incision and sedimentation.

7.6 Alien and Invasive Species

The study area at present is not significantly affected by alien invasive species. However, the proliferation of alien vegetation species is expected within the watercourse, riparian and wetland areas during the implementation/construction and post-rehabilitation/operational phases of the constructed dam.

Alien plant species contribute to habitat degradation and decrease the service provision capability of the system. Removal of alien plant species must take place according to the methods as set out in the Rehabilitation Plan and focus on problem areas. The alien control programme should take place during and after construction of the dam and continue for a minimum period of ten years.

7.7 Soil Disturbance

The dam may contribute to further erosion and sedimentation within wetland upstream and downstream. These disturbances may lead to permanent loss of habitat for wetland floral species and lowered vegetation cover. The loss of vegetation cover will lead to reduced availability of cover and habitat for smaller faunal species that are likely to have colonised the area in the past.

Should the measures as set out in this report be adhered to and implemented efficiently, the ecological service provision levels associated with flood attenuation, erosion control, filtration and habitat provision will improve significantly and will allow the watercourse and wetland area to continue functioning into the future.

7.8 ECOLOGICAL PROCESSES

The measures, as set out in the rehabilitation plan, are deemed sufficient for the conservation of ecological processes and provide a tool for managing and/or improving the PES of the area. If these measures are adhered to and well implemented, ecological processes will not only continue, but also in some instances improve in functionality.

8 REHABILITATION MANAGEMENT PLAN

This Wetland Rehabilitation Plan is designed to manage, maintain and/or improve the PES and EIS of the wetland areas and surrounding terrestrial areas within the MFT dam area, with particular emphasis on the impacts that the development of the dam will have.

The rehabilitation plan will focus on the already constructed dam wall and the area that will be inundated by the FSL of the dam as well as any aspects that need to be addressed upstream and downstream of the dam.

The HGM unit that will/has been affected is HGM 1 (Unchannelled Valley Bottom). The wetland is classified as seriously modified (PES E) as a result of the inundation of the dam.

The rehabilitation plan will need to be updated once the results of the EWR have been submitted as this assessment will determine the viability of the dam and the effectiveness of any proposed mitigation measures.

8.1 REHABILITATION OBJECTIVES

The objectives of this plan are to:

- Ensure as far as is practicable that the measures contained in the report are implemented;
- Manage activities within identified unchannelled valley bottom in order to improve ecological integrity of the study area;
- Minimise adverse impacts on the receiving environment;
- Maximise the service provision and ecological functioning of the wetland area;
- Maximise the ecological functioning of the watercourse and wetland system; and
- Monitor the impact of the dam on the receiving environment.

8.2 MONITORING OF THE REHABILITATION WORKS

During implementation of the rehabilitation the monitoring of the rehabilitation works must form part of the wetland implementation rehabilitation specialist. Monitoring must include, but not be limited to, the following parameters:

- Determining if the final landforms of backfilled and re-profiled areas are in line with the natural surroundings;
- Assessment of surface and slope stability;

- Measuring the depth of topsoil replaced within rehabilitated areas;
- Determining erosion levels;
- Calculating ground cover percentages within revegetated areas including vegetation basal cover; and
- Determining plant community composition and structure of rehabilitated areas.

8.3 Roles and Responsibilities

The client will be responsible for the appointment of a relevant specialists to perform rehabilitation and monitoring activities as well as alien vegetation removal and control.

8.4 Mitigation and Management

The section below will define and describe the various environmental impacts affecting the integrity of the wetland areas associated with the dam activities and proposed management and mitigation measures related to each impact will be presented.

The table below (Table 8-1) serves to describe and explain the rehabilitation and management measures deemed necessary to effectively manage, maintain, rehabilitate and improve the ecological characteristics and functioning of the unchannelled valley bottom.

8.4.1 Alien Plant Management

Invasive and other noxious plants must be managed as per the requirements of the appointed vegetation specialist and the following legislations must be adhered to;

- The Department of Environmental Affairs (DEA) under the National Environmental Management: Biodiversity (NEM:BA) Act 10 of 2004.
- Conservation of Agricultural Resources Act (Act 43 of 1983, as amended in March 2001) Regulations.

8.4.2 Re-establishment of Vegetation Assemblage

It is important to prepare the soil for vegetation rehabilitation. Once the soil has been prepared, appropriate seeds must be used for the rehabilitation process.

There are several methods / techniques available for employment in re-establishing the site. Through understanding the site and the problems posed, options have been identified as the correct methods to achieve re-establishment. The planting methods are expanded upon below. Please note that re-vegetation planting must be undertaken in spring if possible to ensure that establishment is successful.

In order to properly implement the re-vegetation component, the following general planting guidelines have been adopted to drive the rehabilitation process.

- Non-woody portions must be returned to either hygrophilous vegetation (sedges, bulrushes) or to graminoid assemblages which favour relevant specific habitats.

All plantings in riparian and wetland areas must occur in consultation with the relevant wetland and vegetation environmentalists, to ensure best placement, within the wetland or riparian areas. In addition to the wetland/riparian specific mitigation measures:

- Removal of existing alien species must be consistently undertaken.
- Rehabilitation of disturbed areas must be done immediately;
- If it is necessary to import soil onto the site, the material; must be checked to ensure that it is not contaminated by weeds or invasive plants. However, this is a last resort and existing soil must be fortified first if possible.

8.4.3 Use of Plugs

Plugs will be planted where immediate cover is required for stabilisation. Particular areas would be drainage channels and very steep banks. Plugs will be –

- Planted at 10 cm centres
- Over a pegged artificial mesh (e.g. a light polypropylene, UV stabilised mesh with about 20mm openings) in areas of very high water velocity;
- Watered immediately to enhance establishment;
- Watered regularly for the first seven days or as required to ensure establishment.

In areas where steep slopes require stabilisation it is likely to be necessary to make use of Geotextiles. Ideally, vegetation is the best form of erosion control, with Geotextiles only used for temporary stabilisation purposes until this can establish. In coastal areas, Geotextiles are only superior to hydro-mulching in the following situations:

- When the growing season is short or unfavourable and plants cannot stabilise a slope quickly enough;
- When surfaces are so unstable or contours so channelled that a heavy rain would result in significant and costly erosion damage.

8.4.4 Hand Seeding

Compared to hydro-mulching, manual mulching and seeding is better suited to flatter land. Like other forms of seeding it must be carried out in suitable weather conditions.

8.4.5 Geotextiles

Geotextiles (also referred to as erosion control blankets or mats) are any permeable textile material that is used to hold topsoil in place, or holding disturbed soil on steep slopes and graded sites, in order to prevent erosion.

Good surface preparation is critical. The blanket or mat will extend beyond the edge of the area to be covered. The mat or blanket will need to be further secured with stakes. There must be maximum soil contact to prevent erosion underneath.

Although Geotextiles have historically been made of natural plant materials, they can increasingly be made from a synthetic polymer or a composite of natural and synthetic material. We do not support the usage of synthetic Geotextiles. Plant fibre-based Geotextiles are subject to decomposition and have a limited durability. However, they may be left in place to form an organic mulch to help in establishment of vegetation. Different fibres will degrade at different rates.

Coir Geotextiles degrade in 2-3 years while jute degrades in 1-2 years. Coir is therefore useful in situations where vegetation will take longer to establish, and jute is useful in low rainfall areas because it absorbs more moisture. Recommended products are BioJute™, which is produced by a company called Maccaferri and Geojute® which is produced by a company called Geotextiles Africa.

Table 8-1: Impacts with their associated mitigation and rehabilitation guidelines.

Phase	Impact	Aspect	Mitigation Measure
Operational	Infestation of alien vegetation post construction	Alteration to flow volumes	■ It is critical that an alien vegetation control programme is implemented Consult Vegetation Specialist to get a detailed list of aliens to be removed, as encroachment of alien vegetation is a certainty as a result of the disturbances resulting during the construction process. Rehabilitation of disturbed areas, utilising indigenous wetland vegetation species, will assist in reducing the impact of construction. ■ During the operational phase vehicles must remain on designated roads and must not drive in the wetland areas or the edge of the dam as new wetland eco-tones would have established there.
Operational	Downstream Releases	Increase erosion potential, from dam releases	■ During the operational phase vehicles must remain on designated roads and must not drive in the wetland areas or the edge of the dam as new wetland eco-tones would have established there. ■ **Complete an Environmental Flow Requirement (EWR) assessment to determine the required environmental releases from the dam to sustain wetland functions downstream; if this is not done then we have a fatal flaw and the dam must be decommissioned.** ■ Reducing the proposed irrigation usage to allow the wetland to sustain some function upstream; ■ Fencing off of the wetland to prevent cattle from grazing within the wetland; and ■ Ensure no erosion occurs at the dam inlet and outlet points.
Post Rehabilitation	All	All	■ Upon completion of rehabilitation works on site a suitably qualified specialist should continue to monitor the rehabilitation works for three months on a monthly basis. Thereafter, one monitoring site visit is recommended after 6 months from completion of rehabilitation works and final sign-off of rehabilitation works should take place.

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