

ENVIRONMENTAL WETLAND REHABILITATION PLAN FOR BLUE HILLS 105 & 106 AGRICULTURAL HOLDINGS IN, MIDRAND, GAUTENG PROVINCE



FOR OMEIDA 426CC

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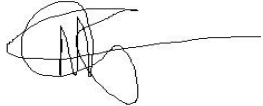
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Date Issued: 22 April 2024

ECM-WRHP -10_0424D	ENVIRONMENTAL COMPLIANCE / OCCUPATIONAL HEALTH AND SAFETY MONTHLY REPORT	REV 001
		Page 0 of 37
		YEAR: 2024

Document Control

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DECLARATION

I, Musa Magala declare that:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist work relevant to this application, including knowledge of the Act (NEMA), regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations, and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan, or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Musa Magala

Aquatic and Ecological Specialist

22 April 2024

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Contents	Page
1 INTRODUCTION	5
1.1 TERMS OF REFERENCE	5
2 METHODOLOGY AND APPROACH	6
3 ASSUMPTIONS AND LIMITATIONS	6
4 BASELINE ENVIRONMENTAL SETTING	6
4.1 PROJECT LOCATION, BIOPHYSICAL AND CONSERVATION CONTEXT OF PROJECT SITE	6
4.1.1 GAUTENG CONSERVATION PLAN V 3.3 (C-PLAN 3.3)	9
4.1.2 NATIONAL FRESHWATER ECOSYSTEM PRIORITY AREAS (NFEPAs)	9
4.2 GEOLOGY AND SOILS	10
4.3 SURFACE WATER	11
5 REHABILITATION AIM AND OBJECTIVES	13
5.1 SITUATION ANALYSIS – WHAT ARE THE PROBLEMS	13
5.2 REHABILITATION AIM	15
6 ROLES AND RESPONSIBILITIES	17
7 REHABILITATION ACTION PLAN	19
7.1 REHABILITATION ACTION PLAN AND ACTIVITIES FOR EACH COMPONENT (AREA) 20	
8 MONITORING AND MAINTENANCE	30
8.1 GUIDELINES FOR MONITORING AND MAINTENANCE	30
9 REFERENCES	34

List of Figures

Figure 1: Aerial View of the Project site.....	8
Figure 2: images of ditch dug in wetland -impact to be addressed	14
Figure 3: Vegetation clearing on portion of wetland inside property	14
Figure 4: Impact of excavator moving on wetland in private property	15

List of Table

Table 1: Details of Project Area.....	9
Table 2: Summary Biophysical characteristics summary of the site	12
Table 3: Site 1 - Area within the boundary of the property cleared of vegetation on the wetland. 20	

Table 4: Site 2: Ditch dug just outside the boundary of the property, for stormwater drains construction.	23
Table 5: Site 3: Rehabilitation actions	27
Table 6: Rehabilitation Monitoring Plan.....	32

List of Appendices

Appendix A: Rehabilitation Sites Map

1 INTRODUCTION

Omeida Trading 426CC was granted an Environmental Authorisation (EA) - Ref#: GAUT 002/18-19/E0036, by the Gauteng Department of Agriculture and Rural Development (GDARD) on 31 August 2018. The environmental authorisation granted the holder permission to undertake medium-density township development on holdings 105 and 106 of Bluehills Agricultural Holdings, City of Johannesburg Metropolitan Municipality.

During the construction activities of the development, the holder was found in non-compliance with the environmental authorization by excavating within a wetland without water use authorization from the Department of Water and Sanitation (DWS) and by undertaking activities such as clearing and stockpiling within a wetland and failing to demarcate the edge of the wetland clearly. The EA holder was issued with a directive by the GDARD. The directive contains a requirement for the holder to provide a rehabilitation plan to address the impacts that have occurred within the wetland at the construction site vicinity.

Selahle Consulting and Projects (Pty) Ltd was appointed by Acacia Villa trading under Omeida Trading 426CC as a Wetland Specialist to compile a Site Rehabilitation Plan to address outstanding rehabilitation work required onsite.

Rehabilitation is defined as promoting the recovery of ecosystem functions and values in a degraded system in order to regain some of the value the system previously had to society (Day, et al. 2016). It should be noted Rehabilitation is not the same as restoration, which is the manipulation of a site in order to revert the watercourse back to its full range of natural (historic) processes and functions (National Ocean Service and National Marine Fisheries Service, 2002). This document, therefore, sets out the Rehabilitation Plan that should be followed to address the rehabilitation at the Bluehills medium-density township development construction site.

1.1 TERMS OF REFERENCE

This report constitutes a rehabilitation plan for the wetland area impacted by the Bluehills medium density township development. As per the impact observed on site, the scope of work included the following:

- Develop a Rehabilitation Plan to manage impacts associated with the construction activities that occurred on wetland on site.
- Provide a description of the procedures that should be followed for successful rehabilitation.
- Provide a framework for monitoring and reporting on the success of the Rehabilitation Plan.
- Define roles and responsibilities for the implementation of this plan.

2 METHODOLOGY AND APPROACH

There are several guideline documents which provide recommendations on how the river and wetland rehabilitation should be undertaken. For the purpose of this plan, the following guideline documents were be considered:

- Manual for River Rehabilitation in South Africa (Day, *et al.*, 2016).
- WET-RehabPlan: Guidelines for planning wetland rehabilitation in South Africa (Kotze, *et al.* 2009).
- WET-RehabMethods: National guidelines and methods for wetland rehabilitation (Russel, 2009.)

The successful rehabilitation of a wetland requires that the cause of damage or degradation is addressed and that the natural flow patterns of the wetland system are re-established towards the conservation of biodiversity.

3 ASSUMPTIONS AND LIMITATIONS

The following limitations and assumptions apply to the baseline freshwater aquatic ecosystem assessment:

- The rehabilitation plan is based on information gathered from site visits undertaken to date and specialist studies that were conducted.
- Additional information used to inform the report was limited to data and GIS coverage's available for the province at the time of the assessment.
- This report must be considered as a living document. The report will be updated as information becomes available, and monitoring and rehabilitation progresses.

4 BASELINE ENVIRONMENTAL SETTING

4.1 PROJECT LOCATION, BIOPHYSICAL AND CONSERVATION CONTEXT OF PROJECT SITE

Specialist studies that were carried out as part of the Basic Assessment Report submitted as part of the EA for this development were reviewed to understand the biophysical context of the site. In addition, the Land Use Decision Support (LUDS) tool developed by SANBI is a tool that provides the most relevant conservation plan or biodiversity dataset for each land parcel in South Africa. From the Desktop Assessment, the biophysical description of the broader study area was assessed using the tool. Consideration of the biophysical and conservation context of the project area and the surrounding landscape is important as it informs decision-making regarding the significance of the area. The project site located The property is located on the southwestern corner of Acacia and Mimosa Roads, Midrand, City of Johannesburg Metropolitan Municipality.

Figure 1 shows the aerial view of the study area and the surrounding land uses. Table 1 provides details of the project location.

A summary of key biophysical characteristics for the project area and the catchment area is presented in Table 2, below.



Figure 1: Aerial View of the Project site

Table 1: Details of Project Area

Summary of the Freshwater Ecosystem in Project Location	
Project Location	On Holdings 105 and 106 of Blue Hills Agricultural holdings, City of Johannesburg Metropolitan Municipality.
Coordinates	Latitude: 25°57'29.68"S Longitude: 28° 5'24.17"E
SG Digit Code (s)	T0JR00160000010400000

4.1.1 GAUTENG CONSERVATION PLAN V 3.3 (C-PLAN 3.3)

The Gauteng Conservation Plan Version 3.3 (GDARD, 2014) identifies those sites that are critical for maintaining biodiversity, enabling planners, environmental professionals, and land use managers to integrate biodiversity into land use planning and decision-making.

The C-Plan 3.3 delineates biodiversity priority areas for conservation and sustainable land use management. The map identifies biodiversity priority areas into three major categories: Protected Areas; Critical Biodiversity Areas or Ecological Support Areas. **A small section of the southern portion of the eastern boundary falls within a CBA, considered important for “Red” and “Orange” listed plant habitat and for primary vegetation.** The southernmost portion of the study area falls within an area considered to be an ESA. Furthermore, according to the Gauteng C-Plan the southernmost portion of the of the project site traverses the wetland and falls within a wetland buffer (Scientific Terrestrial Services - Freshwater Ecological Assessment Report, 2017).

Critical Biodiversity Areas (CBAs): CBAs include natural or near-natural terrestrial and aquatic features that were selected based on an area’s biodiversity characteristics, spatial configuration, and requirements for meeting both biodiversity pattern and ecological process targets. CBAs include irreplaceable sites where no other options exist for meeting targets for biodiversity features, as well as best-design sites that represent an efficient configuration of sites to meet targets in an ecologically sustainable way that is least conflicting with other land uses and activities. These areas need to be maintained in the appropriate condition for their category. Some CBAs are degraded or irreversibly modified but are still required for achieving specific targets, such as cultivated lands for threatened species.

4.1.2 NATIONAL FRESHWATER ECOSYSTEM PRIORITY AREAS (NFEPA)

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach for the sustainable and equitable development of South Africa’s scarce water resources. The database affords guidance on how many rivers, wetlands, and estuaries, and which of these, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (NWA). This directly applies to the NWA, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel et al. 2011).

The main intention of the Freshwater Ecosystem Priority Areas (FEPAs) is to be conservation support tools and are envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act (NEMBA) biodiversity goals informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel et al., 2011).

According to the NFEPA database there are no wetland features situated within the study area, however two artificial seep wetlands, considered to be in a heavily to critically modified (WETCON Z3) ecological condition, with less than 25% natural vegetation cover remaining, are situated within the investigation area (Scientific Terrestrial Services - freshwater ecological assessment report, 2017).

The NFEPA database does not indicate any Rivers to be associated with the study area nor the investigation area, with the nearest feature, namely an unnamed tributary of the Jukskei River, situated approximately 1.1 km northwest of the study area (Scientific Terrestrial Services - freshwater ecological assessment report, 2017).

4.2 GEOLOGY AND SOILS

According to the 1:50 000 geological sheet 2528CC Lyttelton and 1:250 000 sheet 2528 Pretoria, the site is underlain by granite-gneiss and granite of the Lanseria Gneiss, Johannesburg Granite Dome and consists of poorly exposed biotite tonalite, trondjemite, granodiorite and migmatite varieties.

A specialist geotechnical study was undertaken at the project site to evaluate the regional geological character of the study area. Based on the results of the study, The surficial transported horizon is on average 0.47 m thick and comprises of slightly moist, greyish brown to brownish grey loose intact with open root channels of silty sand. The transported material in the floodplain is shattered with slickensided sandy clay and intercalated sand layers in some horizons. The typical pebble marker, regarded as the boundary between the upper transported and deeper residual materials, is only present in the higher elevated test pits on Holding 105. The pebble marker is slightly moist, greyish to yellowish brown, loose, pinholed with open root channels, clayey silty sand with sub-angular, quartz, and granite gravel, and Fe and Mn nodules on the northern site boundary.

According to the specialist, drainage precautions are required to minimise differential movements, collapse settlements, and erosion.

4.3 SURFACE WATER

In the specialist freshwater assessment study that was undertaken, a single freshwater resource i.e., Channelled valley bottom wetland: A valley-bottom wetland with a river channel running through it, was identified within the southern portion of the study area. The identified freshwater resource was classified according to the classification system (Ollis, et al., 2013) as an Inland System, falling within the Highveld Aquatic Ecoregion, and the Mesic Highveld Grassland Group 3 WetVeg (wetland vegetation) group.

The PES was assessed to be category D (Largely modified) which indicates the degree to which the hydrology, geomorphology and vegetation modules have been modified and have significantly decreased the ecological integrity of the resource. Various modifiers to the Present Ecological State (PES) of the system were observed, such as the construction of Acacia road (gravel road) and an artificial dam (east of Acacia Road) upstream of the feature as well as infilling, through the creation of a berm within the western portion of the freshwater resource. These anthropogenic derived impacts have resulted in an alteration in the hydrology and geomorphology of the system. Leakage from an on-site sewage system (French Drain) within the central portion of the study area, immediately south of the housing associated with the small holding, upgradient of the freshwater resource was also observed, which might have altered the water quality of the freshwater resource.

Table 2: Summary Biophysical characteristics summary of the site

Aquatic ecoregion and sub-regions in which the proposed pipelines are located		Detail of the proposed pipeline alternatives in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
Ecoregion	Highveld	FEPACODE	The study area is located within a sub-quaternary catchment considered to be an Upstream Management Area These are Upstream Management Catchments required to prevent the downstream degradation of FEPAS and Fish support Areas.
Catchment	Limpopo		
Quaternary Catchment	A21CF		
WMA	Crocodile (West) & Marico	NFEPA Wetlands	According to the NFEPA database there are no wetland features situated within the study area however two artificial seep wetlands, considered to be in a heavily to critically modified (WETCON Z3) ecological condition, with less than 25% natural vegetation cover remaining, are situated within the investigation area (Figure 3).
subWMA	Upper Crocodile		
Dominant characteristics of the Bushveld Basin Ecoregion Level 2 (8.05) (Kleynhans <i>et al.</i> , 2007)			
Dominant primary terrain morphology	Plains; Low Relief	Wetland Vegetation Type	The study area falls within the Mesic Highveld Grassland Group 3 wetland vegetation type, which is considered to be critically endangered.
Dominant primary vegetation types	Rocky Highveld Grassland, Mixed Bushveld		
Altitude (m a.m.s.l)	1300-1900	NFEPA Rivers	The NFEPA database does not indicate any Rivers to be associated with the study area nor the investigation area, with the nearest feature, namely an unnamed tributary of the Jukskei River, situated approximately 1.1 km northwest of the study area (Figure 3).
MAP (mm)	500 to 700		
Coefficient of Variation (% of MAP)	20 to 34		
Rainfall concentration index	55 to 64	Detail of the proposed pipeline alternatives in terms of the Gauteng Conservation Plan (C-Plan V3.3, 2011)	
Rainfall Seasonality	Early to mid-summer	Critical Biodiversity Area (CBA) (Figure 4)	A small section of the southern portion of the eastern boundary falls within a CBA, considered important for "Red" and "Orange" listed plant habitat and for primary vegetation. A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges (GDARD, 2014a)
Mean annual temp. (°C)	14 to 18		
Winter temperature (July)	0 – 20 °C		
Summer temperature (Feb)	12 – 30 °C		
Median annual simulated runoff (mm)	20 to 60		
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014)		Ecological Support Area (ESA) (Figure 4)	The southernmost portion of the study area falls within an area considered to be an ESA. An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation.
Sub-quaternary reach	A21C-01195 (Jukskei River Tributary	Wetland (Figure 5)	According the Gauteng C-Plan the southern most portion of the of the study area falls within a wetland buffer.
Proximity to proposed pipeline	Approximately 1.1 km northwest of the study area	River (Figure 8)	The Gauteng C-Plan indicated a non-perennial River buffer immediately south of the study area.
Assessed by expert?	Yes		
PES Category Median	E	Urban Area	The study area falls within the Urban Area according to the Gauteng C-Plan Although the Urban Edge was rescinded as a policy document in the Gauteng Spatial Development Framework (2011), it nevertheless remains a useful indicator of where the concentration [of development] should occur.
Mean Ecological Importance (EI) Class	Low		
Mean Ecological Sensitivity (ES) Class	Moderate		
Stream Order	1		
Default Ecological Class (based on median PES and highest EI or ES mean)	Moderate (Class C)		

DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; m.a.m.s.l = Meters Above Mean Sea Level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State WMA = Water Management Area

5 REHABILITATION AIM AND OBJECTIVES

According to the South African Guideline for River Rehabilitation (Day, *et al.* 2016), This is the most important consideration for any proposed rehabilitation action plan. Objectives for interventions need to be clear, explicit, and acceptable to all stakeholders involved. To achieve this, a situation analysis was undertaken. The specialist studies that have been conducted have aided in the compilation of the rehabilitation plan

5.1 SITUATION ANALYSIS – WHAT ARE THE PROBLEMS

Urban rivers generally have number of problems that affect ecosystem quality due to human activities. For the purposes of this rehabilitation plan, the focus was on problems that were caused by the construction works during the township development. The following were the key problems identified at the project site:

- A ditch has been dug in the permanent zone of the wetland – As part of the stormwater drains installation construction activities, a ditch was dug within the permanent zone of the wetland. The impact of this is that this open ditch draws water along its gradient, thus robbing the wetland downstream of water and altering the even spread of floodwater over the width of the wetland. See Figure 2.
- Vegetation clearing – There is a portion of the wetland that traverses the property, this was supposed to be demarcated as per environmental authorisation however, this was not done and there was vegetation clearing and stockpiling of construction material. There was also vegetation clearing and stripping of topsoil along the access road. See Figure 3.
- Change in ground cover/impact on land- While attempting to load an excavator on a flatbed, the excavator entered private property adjacent to the construction site. There was a disturbance in the ground cover which exposed the wetland soil and cleared vegetation. See Figure 4.



Figure 2: images of ditch dug in wetland -impact to be addressed



Figure 3: Vegetation clearing on portion of wetland inside property



Figure 4: Impact of excavator moving on wetland in private property

5.2 REHABILITATION AIM

The aim of the Rehabilitation Plan is to re-establish, manage, and maintain drainage, indigenous vegetation units and plant communities of the wetland that have been impacted by the development unplanned construction works, by rehabilitating degraded areas to that which existed prior to construction works and to improve and prevent further deterioration of ecosystem health of the wetland due to the impacts of the development.

The **rehabilitation objectives** for the identified impacted areas have been defined as the following:

- To adequately rehabilitate the cleared vegetation wetland areas within- and outside the development property.
- Clean-up/ rehabilitate the wetland channel impacted by excavation and installation of stormwater drains works.
- Stabilisation and rehabilitation of the identified watercourses and sensitive areas
- Reducing the impact and likelihood of erosion and subsequent sedimentation
- Establishment of the suitable slope, vegetation, and biodiversity in the impacted area
- Comply with the relevant local and national regulatory requirements.
- Leave a safe and stable environment for both humans and animals.
- Maintain and monitor the rehabilitated areas.

The overall objective of the rehabilitation plan is to ensure the return of the impacted environment in and around the construction site to a state as close to the state prior to construction in rehabilitated areas by increasing the quality, uniformity, and efficiency of standards and to allow effective monitoring and auditing of the rehabilitated areas. Adherence to this Rehabilitation Plan

will ensure that the site is effectively rehabilitated to minimise lasting negative impacts on the environment.

6 ROLES AND RESPONSIBILITIES

Position/Title	Role	Responsibilities/Description of tasks
Authorities	Oversee the correct implementation of the Rehabilitation Plan	▪ The relevant authorities overseeing the correct implementation of the rehabilitation of the project site along the Bule Hills township development project comprise: ▪ Gauteng Department of Agriculture and Rural Development (GDARD) ▪ Department of Water and Sanitation
Contractor	Implementation of the Rehabilitation Plan and remedial construction activities	▪ Responsible for implementing the rehabilitation plan for all the areas impacted. ▪ Responsible for ensuring that the construction team complies with the requirements of the Rehabilitation Plan and EMPr. ▪ Reporting back on the environmental issues (including rehabilitation) at regular site meetings and other meetings that may be called regarding environmental matters. ▪ Keeping records (fixed photos) of all activities/incidents on site concerning the environment (including rehabilitation) and reporting these to the ECO.
The Environmental Control Officer (ECO)	Monitoring of the implementation of the EMPr and Rehabilitation Plan for the duration of the activities and for reporting on the degree of compliance	▪ Inspecting the site and surrounding areas regularly with regard to compliance with the EMPr as well as this Rehabilitation Plan and reporting these findings at least quarterly throughout the construction phase to the relevant environmental authorities. ▪ Ensure that all contractors/ subcontractors/ employees are fully aware of their environmental responsibilities. This should take the form of an initial environmental awareness-training program in which requirements of the rehabilitation plan will be explained.

Position/Title	Role	Responsibilities/Description of tasks
		▪ Review or advice as necessary on procedures required. ▪ Conduct a final environmental audit and a review of management and rehabilitation measures. ▪ Keeping records of all environmental incidents on site in the Site Diary and reporting these to the applicant. ▪ Keeping a photographic record of progress on rehabilitation progress and other actions affecting the environment of the site. ▪ Reviewing and approving construction method statements related to rehabilitation of the site.
Client: Omeida Trading 426 CC	Implementation, Monitoring and Review	▪ Ensure that all necessary environmental authorisations and permits (including plant permits for the destruction or removal of species of conservation concern) have been obtained. ▪ Ensure that activities on site comply with other relevant environmental legislation.

7 REHABILITATION ACTION PLAN

The activities involved in the Rehabilitation Action Plan are discussed according to the different needs of the impacted areas identified for rehabilitation and these components (areas) are detailed in below and a map of these components is provided in Annexure 1.

- **Site 1:** Area within the boundary of the property cleared of vegetation on the wetland. See Figure 3
- **Site 2:** Ditch dug just outside the boundary of the property, for stormwater drains construction. See Figure 2
- **Site 3:** Area impacted by excavator in private property and along main road. See Figure 4

7.1 REHABILITATION ACTION PLAN AND ACTIVITIES FOR EACH COMPONENT (AREA)

Table 3: Site 1 - Area within the boundary of the property cleared of vegetation on the wetland.

Observed Impacts	Target	Rehabilitation Actions	Timeframe
- Wetland vegetation clearing (loss on natural vegetation) - Stockpiling and rubble dumping - Soil compaction	- Complete site clean-up. - Reinstate and rehabilitate areas disturbed by construction activities. - Achieve 75% coverage for areas that have been grassed or hydroseeded. - No bare patches exceeding 0.25m² in an area of 1m x 1m.	- The wetland area inside the boundary of the property must be properly demarcated to prevent further degradation and impacts as per the condition of the EA. - To begin rehabilitation of the area, all remnants of foreign debris should be removed from the site. These include plants, and construction rubble & debris. - All rubble and debris on site is to be collected and removed from site and disposed of at a licensed waste disposal site. The ECO must be provided proof of disposal in the form of an invoice from the contractor, or a weighbridge notice from the relevant disposal site. - Alien invasive species that are identified within the servitudes should be removed prior to construction related soil disturbances. This will prevent seed spreading into disturbed soils. - Manual / mechanical removal is preferred to chemical control. If herbicide must be used it should be registered for aquatic use.	Immediately

Observed Impacts	Target	Rehabilitation Actions	Timeframe
		▪ Compacted soil should be ripped to a depth of more than 150 mm. ▪ The final prepared surface should not be smooth but furrowed to follow the natural contours of the land. ▪ Do not permit vehicular or pedestrian access into natural areas or into seasonally wet areas during and immediately after rainy periods, until such a time that the soil has dried out. ▪ Reshape and reprofile the wetlands in order to achieve a natural topography. ▪ Redistribute stockpiled topsoil across the wetlands. ▪ Implement erosion control measures within newly worked, bare areas in order to prevent the loss of topsoil due to wind and water erosion. These areas may be covered with geotextiles. ▪ Do not remove temporary erosion protection materials until the vegetation cover has re-established. ▪ Revegetate the wetlands with the indigenous wetland species as listed below as soon as possible after the application of topsoil and stabilizing of soils: ○ <i>Bulbostylis hispidula</i> ○ <i>Cyperus dives</i> ○ <i>Cyperus laevigatus</i> ○ <i>Cyperus sexangularis</i> ○ <i>Juncus dregeanus</i>	

Observed Impacts	Target	Rehabilitation Actions	Timeframe
		○ <i>Aristida junciformis</i> ○ <i>Setaria sphacelate</i> ○ <i>Aristida junciformis</i> ○ <i>Imperata cylindrica</i> ▪ Additional wetland plants required for rehabilitation purposes must be sourced from a local nursery which breeds plants from the region. ▪ It is recommended that the temporary areas of wetlands are broadcast seeded or hydroseeded with the grass species as listed above. ▪ Water plants immediately after they are planted and regularly for the first week to aid in establishment. ▪ Areas where minimal disturbances took place, can be ripped and allowed to naturally re-vegetate (take note that this excludes sloped areas). ▪ Re-vegetation must be monitored to ensure that alien invasive plant species do not colonise the disturbed areas. ▪ Revegetation must take place in winter (between June and August). This will allow the plants to establish before flood events. Regular watering of revegetated areas is required prior to spring rainfall. ▪ Revegetation, including floral species selection and positioning as well as planting method, must be overseen by a suitably qualified landscaper or rehabilitation specialist.	

Observed Impacts	Target	Rehabilitation Actions	Timeframe
		Ideally, the rehabilitated area, especially along the wetland areas, must be fenced-off to prevent vehicle and pedestrian traffic and trampling.	

Table 4: Site 2: Ditch dug just outside the boundary of the property, for stormwater drains construction.

Observed Impacts	Target	1. Rehabilitation Actions	Timeframe
- Excavation of ditch in wetland - Vegetation clearing - Exposure of peat soils	- Re-instate topography and drainage of the wetland. - Revegetation of impacted area. - Backfill ditches	- Following construction of the stormwater drains, remove all alien invasive species within the construction works footprint. - Implement temporary stormwater management measures, to diffuse flow during construction of the permanent stormwater measures, where necessary. - Construction of the stormwater drains should be immediately followed by rehabilitation. - Soils excavated in the wetland should be stored in sequence and not in the wetland perimeter. - Only excavate to the required width and depth, with shoring to prevent slumping of the saturated material. - Stockpiled in heaps must be a maximum of 2 metres and protected from erosion and loss of any form of contamination.	Immediately after construction activities.

Observed Impacts	Target	1. Rehabilitation Actions	Timeframe
		▪ If necessary to stabilise culverts installations, place a pioneer layer of permeable material (e.g. rockfill) over the bed of the excavation, or place a layer of suitable geo grid. ▪ Refill the dug excavation with the stockpiled wetland soils in the order it was excavated with topsoil at the top. ▪ If necessary, backfill can be supplemented by organic brought purchased or from distant locations. ▪ Reshape and reprofile the wetlands in order to achieve a natural topography. ▪ It is imperative that the reinstatement of a more natural hydrological regime is achieved prior to revegetation, as the wetland species assemblages which will be used to revegetate the wetland areas are dependent on the hydrological regime of the wetlands. ▪ Following excavation (ditch) backfill compaction, the compacted areas should be ripped or scarified and topsoil must be replaced from the areas where it was removed so that impacted areas can be re-vegetated. Note that ripping or scarifying soils which are saturated with water is ineffective and should be avoided. ▪ Redistribute stockpiled topsoil across the disturbed area of the wetland.	

Observed Impacts	Target	1. Rehabilitation Actions	Timeframe
		▪ Implement erosion control measures within newly worked, bare areas in order to prevent the loss of topsoil due to wind and water erosion. These areas may be covered with geotextiles such as Biojute (this is of particular importance in areas with a steeper slope) or may be stabilized with the use of sediment fences. ▪ Do not remove temporary erosion protection materials until the vegetation cover has re-established. ▪ Revegetate the wetlands with the indigenous wetland species as listed below as soon as possible after the application of topsoil and stabilizing of soils. ▪ Plugs may be obtained from adjacent habitats of similar plant composition. However, if plugs are sourced from adjacent habitat, care must be taken so as not to result in the excessive disturbance of the surrounding areas. An ECO must oversee the removal of plugs from adjacent areas. ▪ Additional wetland plants required for rehabilitation purposes must be sourced from a local nursery which breeds plants from the region; ▪ Wetlands are subdivided into permanent, seasonal and temporary zones of wetness, and different wetland species are adapted to these varying degrees of wetness. The disturbed area at this site	

Observed Impacts	Target	1. Rehabilitation Actions	Timeframe
		falls within the permanent and seasonal zones. Examples of indigenous graminoid and sedge species which may be utilised during revegetation as well as the wetness zone in which they should be planted is provided below: Permanent Zone: ○ <i>Cyperus latifolius</i> ○ <i>Cyperus dives</i> ○ <i>Cyperus solidus</i> ○ <i>Juncus lomatophyllus</i> ○ <i>Phragmites australis</i> Seasonal Zone: ○ <i>Bulbostylis hispidula</i> ○ <i>Cyperus dives</i> ○ <i>Cyperus laevigatus</i> ○ <i>Cyperus sexangularis</i> ○ <i>Cyperus solidus</i>; ○ <i>Cyperus sphaerospermus</i> ○ <i>Juncus dregeanus</i> ○ <i>Pycnus nitidus</i>. ▪ Re-vegetation must be monitored to ensure that alien invasive plant species do not colonise the disturbed areas.	

Observed Impacts	Target	1. Rehabilitation Actions	Timeframe
		- Revegetation must take place in winter (between June and August). This will allow the plants to establish before flood events. Regular watering of revegetated areas is required prior to spring rainfall. - Revegetation, including floral species selection and positioning as well as planting method, must be overseen by a suitably qualified landscaper or rehabilitation specialist. - Ideally, the rehabilitated area, especially along the wetland areas, must be fenced-off to prevent vehicle and pedestrian traffic and trampling. - Revegetation, including floral species selection and positioning as well as planting method, must be overseen by a suitably qualified landscaper or rehabilitation specialist.	

Rehabilitation actions to be undertaken in site 3 including private property are summarised below.

Table 5: Site 3: Rehabilitation actions

Observed Impacts	Target	Rehabilitation Actions	Timeframe
Landcover disturbance	- Revegetation of impacted area. - Re-instate soil stabilization prevent erosion.	To begin rehabilitation of the area, all remnants of foreign debris should be removed from the site.	Immediately

Observed Impacts	Target	Rehabilitation Actions	Timeframe
- Vegetation disturbance & clearing - Exposed wetland soils		These include plants, and construction rubble & debris. - All rubble and debris on site is to be collected and removed from site and disposed of at a licensed waste disposal site. The ECO must be provided proof of disposal in the form of an invoice from the contractor, or a weighbridge notice from the relevant disposal site. - The area where the excavator travelled has minimal disturbances, and therefore should be manually ripped/scarified to level the disturbed area and erosion channels that have formed. The area should then be allowed to naturally re-vegetate (take note because the area is a slope it cannot be ripped to depths over 100mm). - Additional organic topsoil may be sourced to level and support plant growth. After the application of topsoil and stabilizing of soil, erosion control measures should be installed. - Along the slope of the disturbed area (including in private property where excavator travelled), implement erosion control measures (e.g. covering disturbed, bare areas with geotextiles, straw bales, brush packing, mulch etc.) in order to prevent the erosion and sedimentation of wetland areas.	

Observed Impacts	Target	Rehabilitation Actions	Timeframe
		▪ Erosion control measures must be implemented with guidance from the ECO. ▪ Downstream of the slope next to the road where there have been disturbance on the wetland, reshape and reprofile in order to achieve a natural topography and hydrology of the wetland. ▪ After re-instating the topography, revegetate the wetlands with the indigenous wetland species as listed below as soon as possible: ○ <i>Typha capensis</i> ○ <i>Eleocharis limosa</i> ○ <i>Bulbostylis hispidula</i> ○ <i>Phragmites australis</i> ▪ Plugs may be obtained from adjacent habitats of similar plant composition. However, if plugs are sourced from adjacent habitat, care must be taken so as not to result in the excessive disturbance of the surrounding areas. An ECO must oversee the removal of plugs from adjacent areas. ▪ Additional wetland plants required for rehabilitation purposes must be sourced from a local nursery which breeds plants from the region. ▪ The construction site and surroundings must be checked by the ECO for alien and invasive species and alien species noted must be removed.	

8 MONITORING AND MAINTENANCE

Monitoring refers to the repetitive and continued observation, measurement, and evaluation of environmental criteria to follow changes over a period of time and to assess the efficiency of control measures. To ensure success of the rehabilitation, ongoing monitoring and maintenance of the site is fundamental. Monitoring will also be the tool which will indicate whether the pre-determined objectives have been met. Comprehensive monitoring should be undertaken to identify corrective action and to assess the success of the implemented rehabilitation measures. Table 5 below provides the monitoring plan for the rehabilitation works undertaken.

8.1 GUIDELINES FOR MONITORING AND MAINTENANCE

The physical aspects of rehabilitation should be carefully monitored during the operational phase as well as during the progress of establishment of desired final ecosystems. The following items should be monitored continuously:

- Alignment of actual final topography to expected & planned landform.
- Depth of topsoil stripped and placed.
- Erosion status
- Surface drainage systems and surface water quality
- Vegetation basal cover
- Vegetation species diversity
- Faunal re-colonisation

Problems such as failed re-vegetation and erosion should be remediated as soon as it is recorded in the monitoring process. Corrective action should be taken and can include the re-initiation of rehabilitation in severe cases or by correction of the problem.

To ensure the accurate gathering of data, the following techniques and guidelines should be followed: Site walk through surveys should be applied as the preferred method of monitoring (at specified frequencies) with specific focus on: Erosion monitoring (for the duration of the raining season); Alien and invasive vegetation proliferation (at the start and end of the growing season); surface water monitoring; and waste and litter problems. General habitat unit overviews should also be undertaken that include stability and appropriateness of stormwater controls.

All data gathered should be measurable (qualitative and quantitative) and monitoring actions should be repeatable. Data should be auditable, and reports should present and interpret the data obtained. Monitoring must be as per the above, or in compliance with the conditions stipulated in the Water Use License issued by the Department of Human Settlements, Water and Sanitation with respect to this project.

Different types of monitoring phases should be implemented. These are described below:

1. **Monitoring post-construction phase:** Monitoring post-remedial construction activities is important to detect any erosion, sedimentation, or faulty structures. As each phase is completed the area is monitored for impacts and corrective action taken where needed.
2. **Seasonal monitoring:** after remedial construction activities are complete, rehabilitation success, as well as signs of erosion, sedimentation, and the presence of alien vegetation should be monitored twice during the summer months. once at the start and once at the end of the rainy season. This should be continued for at least three years after construction was completed.
3. **Rapid monitoring:** For the first two years, monitoring should take place immediately after heavy rainfall to ensure that rehabilitated areas are intact and that no erosion and subsequent sedimentation take place.
4. **Routine monitoring:** after three years, provided that all rehabilitation was found to be successful and no additional problems arose, monitoring can take place as part of the routine patrol of the pipeline during which problems may be highlighted

Table 6: Rehabilitation Monitoring Plan

Aspect	Method and tools	Monitoring Frequency	Key performance indicator	Corrective action
Erosion	- On-site inspection - Fixed point photography - Compare to adjacent land	- During and immediately after construction - Seasonal for the first three years and rapidly after heavy rainfall - Thereafter during routine inspections	- Areas where vegetation cover is limited or nil and where soil has started to erode - Bare soil patches or ditches - Stabilised head cut and gully erosion	Should erosion occur, soft options such as hay bales, ecologs and replanting should be considered, if erosion is too great for soft options, then a rehabilitation method should be discussed with an engineer and hydrologist
Vegetation Cover & Plant species diversity	- On-site inspection - Assess landscape functionality - Monitor species cover abundance and ensure that natural species cover increase (compare to vegetation study results prior to construction) - Fixed point photography	- After re-vegetation - Seasonal for the first three years and rapidly after heavy rainfall - Thereafter during routine	- Spreading and distribution of dominant plant species in specified wet zones - During rehabilitation, a vegetation basal cover on stream banks of at least 15% shall be maintained at all times - wetland re-vegetation shall be considered successful if the cover of wetland species is at least 80 percent of the type, density, and distribution of the	- If natural re-vegetation does not occur replanting of indigenous plants should be done at sites of concern - If re-vegetation is not successful at the end of 3 years, develop and implement (in consultation with an ecologist) a remedial re-vegetation plan to actively re-vegetate the disturbed area. Continue revegetation efforts until riparian revegetation is successful - If rehabilitation is successful at the end of 3 years, report on the

Aspect	Method and tools	Monitoring Frequency	Key performance indicator	Corrective action
			vegetation in adjacent riparian areas that were not disturbed by construction ▪ Presence/absence of species in specified wet areas.	status of the vegetation (e.g., using photographic record) and if maintenance activities might have disturbed the area again ▪ If exotic plants have colonised the area the exotic plants should be removed.
Hydrology of watercourse	▪ On-site inspection	▪ After construction and rehabilitation ▪ Seasonal for the first three years and rapidly after heavy rainfall ▪ Thereafter during routine inspections ▪ OR as per the monitoring requirements stipulated in the Water Use License	▪ Water flow does not result in scouring or downstream erosion ▪ Water flows through the rehabilitated area, not causing erosion	▪ Obtain input from hydrologists and engineers to identify structures that cause secondary degradation that need to be altered ▪ Energy dissipaters if required
Alien Invasive Plant species	▪ Monitor the emergence of alien invasive plant species in or around rehabilitated areas ▪ On-site inspection ▪ Fixed point photography	▪ After construction ▪ After re-vegetation ▪ Seasonal for the first three years and rapidly after heavy rainfall ▪ Thereafter during routine inspection	▪ Establishment of alien invasive plant species in rehabilitated areas or in watercourses	▪ Remove emergent invasive vegetation from the rehabilitated footprint and servitude as soon as it becomes apparent ▪ Manual labour is preferred above chemical or manual removal.

9 REFERENCES

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APPENDIX A

MAP REHABILITATION SITES

