Section E of the proposed ESKOM Construction of a 40km 400Kv and 765Kv Powerline between Masa and Ngwedi substations (Limpopo and North West Provinces)

General wetland rehabilitation- and monitoring plan to mitigate the construction related impacts

January 2014

Drafted by Antoinette Eyssell-Knox
(Pr Sci Nat)
Limosella Consulting
P.O. Box 32733, Waverley
Pretoria, 0135
Email: Eyssell@limosella.co.za

Prepared for Mandara Consulting Solutions (pty) Ldt.
Gartner House, 31-33 Wessel Road Rivonia, 2128
P O Box 3203, Rivonia 2128
Tel: 081 3833 453 / 011 234 8485
Fax: 086 5488 052
Email: mandaraconsulting@gmail.com

Declaration of Independence

I, **Antoinette Bootsma**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement.

_____ _____

Antoinette Bootsma (PrSciNat) Date

Ecologist/Botanist

SACNASP Reg. No. 400222-09

Indemnity

This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information at the time of study. Therefore, the author reserves the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

Although the author exercises due care and diligence in rendering services and preparing documents, she accepts no liability, and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of this document.

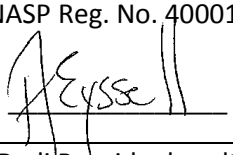
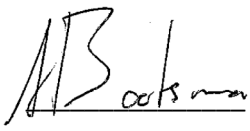
Section	Compiled by	Authorised by
Report writing	Antoinette Eyssell Terrestrial Ecologist SACNASP Reg. No. 400019/11 	Antoinette Bootsma (PrSciNat) Ecologist/Botanist/Wetland specialist SACNASP Reg. No. 400222-09  January 2014 Date
Field work and data analysis	Rudi Bezuidenhoudt Wetland specialist / Ecologist SACNASP Reg. No. Pending	

Table of Contents

Tables

FIGURES

1 INTRODUCTION

Eskom proposes to construct two powerlines (a 750kV and 400kV line) from Masa substation (Limpopo Province) to Ngwedi substation (North West Province). The servitude width for the two powerlines combined is 135m i.e. 80m for the 765kV powerline and 55m for the 400kV powerline. Limosella Consulting was appointed by Mandara Consulting Solutions to undertake wetland and riparian assessment of sections of the proposed powerline routes and to provide input into the Environmental Management Plan with regards to buffer zones of wetlands and riparian areas that should be avoided by construction and operation of the powerlines (Limosella Consulting, 2013). In order to limit the detrimental impacts on watercourses along the proposed routes, Limosella Consulting was also requested to compile a general rehabilitation and monitoring plan to mitigate any direct and indirect impacts that could arise due to construction and operation of the proposed powerline routes.

1.1 Assumptions and limitations

- This document is based on information as received by Mandara Consulting Solutions.
- The document takes into account the likely impacts that can arise during construction of the new structures, stringing and the likely impacts that could arise as a result of the operation of the powerlines. However, some unique impacts may arise that must be recorded during monitoring and appropriate corrective actions taken.
- Engineering drawings and the specification of rehabilitation structures falls outside of the scope of this general rehabilitation plan.
- This rehabilitation plan does not include reference to fauna and flora.
- This report understands that 'construction' includes the following phases:
  - clearing of vegetation for the tower footprint;
  - construction of the new tower structures; and
  - the stringing of the conductors.

  Furthermore, it is understood that the time lapse between the above three phases of construction depends on the contactor's work plan. Although it is advised that the construction activities be done simultaneously to reduce the likely impact on wetland areas (e.g. exposed soils could erode if not followed up by construction and rehabilitation), this report assumes that there will be a time lapse between the different construction phases.
- The specialist cannot be held accountable if a water use license is not granted.

1.2 Objective and aims

The wetland rehabilitation and monitoring plan is specific to the construction of:

- towers within the watercourses or within the protective buffer thereof;
- towers within close proximity to watercourses (within 500m); and
- towers that are situated on slopes and could impact on watercourses or drainage lines down slope.

In addition, the rehabilitation plan also applies to disturbances in watercourses where absolutely necessary in order to string the electrical cables / conductors across watercourses. As the current state of the delineated watercourses (Limosella Consulting, 2013) is a symptom of the management of the hydrology in the

catchment as a whole, the rehabilitation efforts that form part of the proposed powerline are unlikely to improve the Present Ecological State (PES) of the watercourses along the proposed route (e.g. improve the PES from C to a B). However, this document aims to limit localised impacts relating to the construction and to prevent further degradation of the watercourses in the catchment. It also aims to encourage local improvements along the route and immediate surrounds.

The overall objective is to return the environment in and around the tower positions and construction areas to a state as close to the state prior to construction and to limit or negate any construction associated impacts by:

- Ensuring the footprint of the impact on the watercourses is as small as possible;
- Providing guidance on rehabilitation of areas that are temporarily disturbed during construction;
- Reducing the likelihood of erosion and subsequent sedimentation during construction and operation; and
- Recommending monitoring and corrective actions in order to mitigate impacts as soon as they become apparent.

2 METHODOLOGY

In order to realise the objective of the rehabilitation plan, it is necessary to limit the construction related impacts as much as possible so the need for costly rehabilitation and corrective action is reduced. Therefore, mitigation should already start in the planning phase in order to direct construction and operation activities to have the least impact possible, reducing follow-up rehabilitation and corrective actions. Therefore, this rehabilitation document comprises of three plans (Table 1):

1. Mitigation Plan: to focus pre-construction planning and activities on limiting the possible impacts that can arise during construction and operation.
2. Rehabilitation Plan: aimed at rehabilitating the areas temporarily disturbed by the construction. This document recognises that construction will entail three phases: clearing of the tower footprint and servitudes, construction of the towers and the stringing of the conductors.
3. Monitoring Plan: aimed at monitoring the success of rehabilitation, as well as recording any impacts that may arise during the operational phase of the powerline (including maintenance), for which corrective action is needed.

Table 1: Plans in relation to the relevant project phases

Plan	Project Phases
1. Mitigation plan	• Pre-construction planning and activities • Construction phases
2. Rehabilitation plan	• Construction: Clearing of tower footprints and servitudes • Construction: Tower • Construction: Stringing • Operation, including maintenance
3. Monitoring and corrective action	• Construction: Clearing of tower footprints and servitudes • Construction: Tower • Construction: Stringing • Operation, including maintenance

3 DESCRIPTION OF ENVIRONMENT AND WATERCOURSES AFFECTED

3.1 Background

The two proposed powerlines (a 750kV and 400kV line) cross numerous watercourses en route from Masa substation to Ngwedi substation. This report covers the final 40km of the proposed route for the towers 341-436 (765kV) and 327-417 (400kV) and are referred to as Section E of the line.

Wetlands and riparian areas perform many functions that are valuable to society including the supply of water and the improvement of water quality. The habitats created by wetlands and rivers are also important for many plant and animal species, especially in an urban environment.

3.2 Delineated Watercourses

As per Limosella Consulting (2013), the assessment recorded one riparian area and three wetland areas along this section of the proposed line. The wetland areas are further classified as an unchannelled valley bottom wetland and two seepage wetlands (Figure 1).

The riparian area consisted of numerous drainage lines and tributaries which forms part of the same river system. In the north the proposed lines mainly crossed small tributaries and drainage lines. In the south the proposed lines crossed larger rivers such as the perennial Elands River and its tributary, the Seshabele River. The final section of the proposed lines of Section E, ran parallel with the Elands River for about 17 km and often comes within 500m from the river. Due to the extensive nature of a riparian system, the proposed lines comes within 500m same system numerous times. In addition, the proposed lines crossed numerous drainage lines and tributaries of the riparian system. The majority of the riparian vegetation is intact and creates a sufficient buffer against natural erosional and sedimentation. However should this vegetation be removed it is likely that erosion and sedimentation will increase in those areas.

Drainage lines were also mapped although they do not fall into the definition of either wetland or riparian habitat. They do however form part of the hydrological environment and as such should be considered as sensitive features.

The unchannelled valley bottom wetland was located on shallow bedrock in proximity to Mogwase, while one seepage area was observed about 1.2 km south-west thereof. The last seepage wetland was situated around the sewerage plant another 6.5km south-west.

3.3 Current Impacts

Although the majority of the riparian habitat remains intact, the riparian system has been impacted by various anthropogenic activities such as bush clearing, farming, grazing, construction activities and mining. All these factors contribute to an increase in sedimentation and erosion in the river. The unchannelled valley was grazed and various anthropogenic activities such as construction and farming have taken place in and around this wetland area. The two seepage wetlands have also been impacted by activities such as construction and farming. The one seepage wetland is located adjacent a water treatment plant.

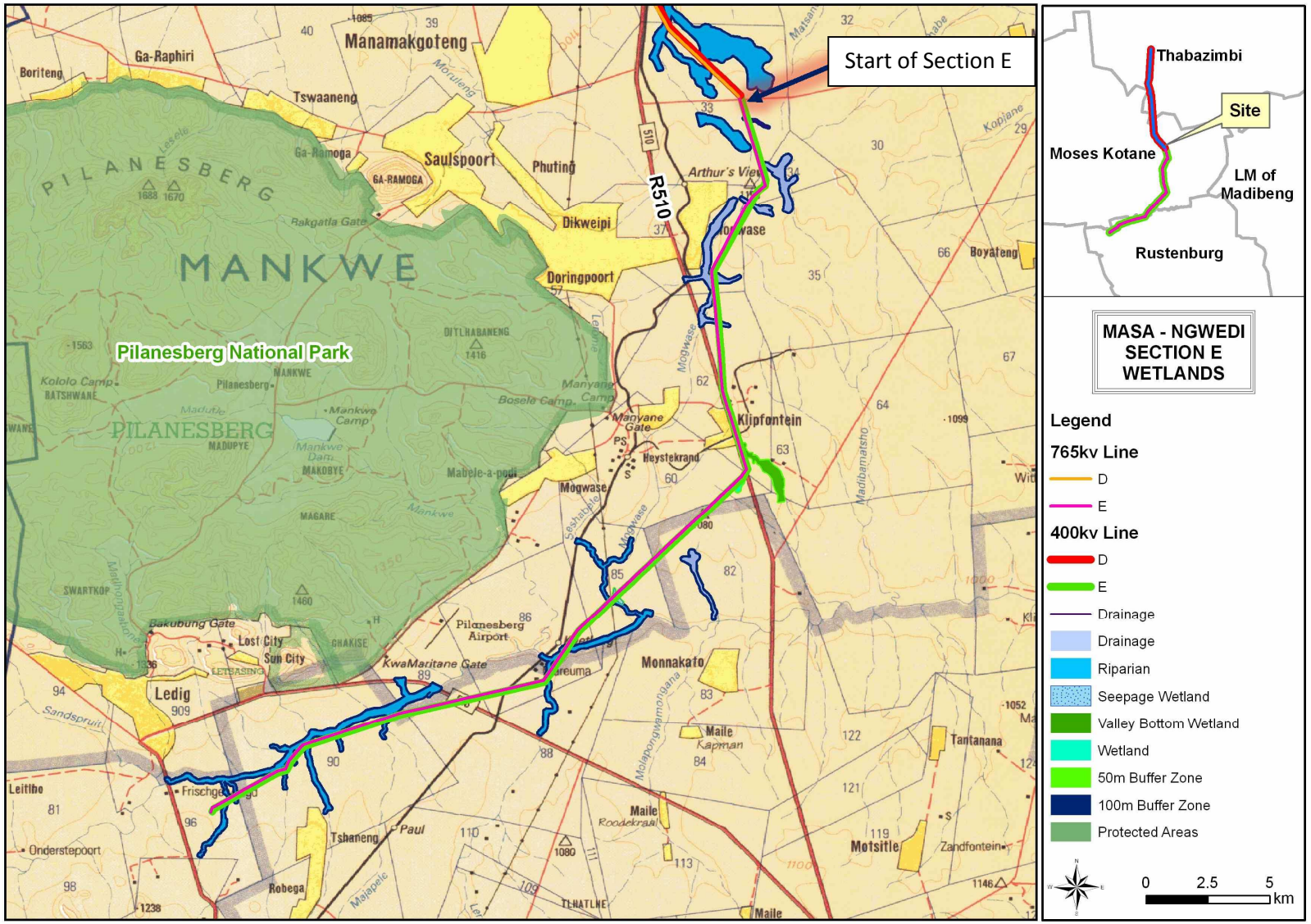


Figure 1: Watercourses delineated along the powerline alignments of Section E

3.4 Present Ecological State

The PES (Present Ecological Score) of the riparian area together with all its drainage lines and tributaries was calculated using a level 3 VEGRAI assessment. The PES score was calculated as a C (Limosella Consulting, 2013). Table 2 provides descriptions of the health scores.

Table 2: Generic ecological categories for EcoStatus components (modified from Kleynhans, 1996 & Kleynhans, 1999)

ECOLOGICAL CATEGORY	DESCRIPTION	SCORE (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	**Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.**	**60-79**
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

3.5 Wetland Health

A level 1 health assessment was done for the wetlands recorded. The PES (Present Ecological State) scores of the unchannelled valley bottom are C/D, while the seepage wetlands scored a C and a C/D. Table 3 provides descriptions of the PES scores obtained during this assessment.

Table 3: Health categories used by WET-Health for describing the integrity of wetlands (Macfarlane *et al*, 2007)

Description	Impact Score Range	PES Score	Summary
Unmodified, natural.	0.0.9	A	Very High
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.	1-1.9	B	High
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	**2-3.9**	**C**	**Moderate**
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	**4-5.9**	**D**	**Moderate**

Description	Impact Score Range	PES Score	Summary
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	E	Low
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.10	F	Very Low

3.6 Summary of tower positions in proximity to watercourses and relevant notes

It is important to note that a Water Use Licence (WUL) issued from the Department of Water Affairs (DWA) is required for any structures that are placed within the 1:100 flood-line or within the edge of a riparian area as well as structures within 500m from a delineated wetland area (DWA, 2010).

Table 4 below indicates all the towers within 500m and/or 100m from the watercourses as well as the areas where the line will need to span across a watercourse. A brief summary of potential impacts is provided in this table. The towers within 500m from a watercourse are indicated for mitigation purposes, as a 500m buffer zone from the edge of the riparian area is considered as potentially sensitive to activities associated with construction. All the towers within a 100m buffer zone are highlighted due to potential implications of General Notice 1199 of the National Water Act, 1998 (Act 36 of 1998) and may require a water use license. This legislation is also applicable to activities (including access roads) that are located within the 1:100 year floodline or riparian habitat (whichever is the greatest) (DWA, 2010).

Table 4: The tower numbers highlighted as potentially impacted by the power line together with a summary of potential impacts

Tower number (756kV)	Tower Number (400kV)	Classification of Watercourses (NWA, 1998) observed during the field survey	Notes	Present Ecological State (PES) *
341	327	• Within 500m from a drainage line	• Should be regarded as sensitive area. • Follow best practice principles	**C**
342	328	• Within 100m of a drainage line. • 342 Located directly within the drainage line	• Tower 342 (765kV line) should be moved so it is not located directly within the drainage line. • Mitigation for erosion should be followed. • Where necessary, soil compaction, sedimentation and loss of natural vegetation should be rehabilitated. • Monitor for establishment of alien invasive vegetation.	**C**
343, 344, 345	329, 330, 331	• Within 500m of a riparian area.	• On the 765kV line the line will span the riparian area between the following towers: 342 & 343.	**C**

Tower number (756kV)	Tower Number (400kV)	Classification of Watercourses (NWA, 1998) observed during the field survey	Notes	Present Ecological State (PES) *
			• On the 400kV line the line will span the riparian area between the following towers: 328 & 329. • Care should be taken not to drive though these areas. • Where necessary, soil compaction and loss of natural vegetation should be rehabilitated.	
345, 346, 347	331, 332, 333	• Within 500m of a drainage line.	• Follow best practice principles	**C**
351, 352, 353, 354, 355, 356, 357, 358,359, 360, 361, 362, 363, 364	336, 337, 341, 342, 344, 345, 346, 347	• Within 500m of a drainage line.	• On the 765kV line the line will span the drainage line between the following towers: 351 & 352, 358 & 361, 362 &363. • On the 400kV line the line will span the drainage line between the following towers: 336 & 337, 342 & 344, 346 & 347. • Care should be taken not to drive though these areas. • Where necessary, soil compaction and loss of natural vegetation should be rehabilitated.	**C**
358, 360	342, 344, 346	• Within 100m of the drainage line	• Erosion mitigations should be followed.	**C**
359	343	• Located directly within a drainage line.	• Towers should be moved so it is not located directly within the drainage line. • Mitigation for erosion should be followed. • Where necessary, soil compaction, sedimentation and loss of natural vegetation should be rehabilitated. • Monitor for establishment of alien invasive vegetation.	**C**
373, 374, 375, 376	356, 357, 358, 359	• Located within 500m of an unchannelled valley bottom wetland.	• On the 765kV line the line will span the wetland between the following towers: 373 & 375 • On the 400kV line the line will span the wetland between the following towers: 357 -358.	**C**

Tower number (756kV)	Tower Number (400kV)	Classification of Watercourses (NWA, 1998) observed during the field survey	Notes	Present Ecological State (PES) *
			• Care should be taken not to drive though these areas. • Where necessary, soil compaction and loss of natural vegetation should be rehabilitated.	
374		• Located directly within a unchannelled valley bottom wetland	• Tower should be moved so it is not located directly within the wetland or its buffer zone. • Mitigation for erosion should be followed. • Where necessary, soil compaction and loss of natural vegetation should be rehabilitated.	**C**
376, 377, 378	359, 360, 361	• Located within 500m of a seepage wetland.	• On the 765kV line the line will span the wetland including its buffer zone between the following towers: 377 & 378 • On the 400kV line the line will span the wetland and its buffer zone between the following towers: 360 & 361. • Care should be taken not to drive though these areas. • Where necessary, soil compaction and loss of natural vegetation should be rehabilitated.	**C/D**
391, 392, 393, 394	373, 374, 375	• Located within 500m of a seepage wetland	• On the 765kV line the line will span the wetland and its buffer zone between the following towers: 391 & 393. • On the 400kV line the line will span the wetland and its buffer zone between the following towers: 373 & 374. • Care should be taken not to drive though these areas. • Where necessary, soil compaction and loss of natural vegetation should be rehabilitated.	**C**
392	374	• 392 Located directly within a seepage wetland. • 374 located very close to a seepage wetland.	• Towers should be moved so they are not located directly within the wetland or its buffer.	**C/D**

Tower number (756kV)	Tower Number (400kV)	Classification of Watercourses (NWA, 1998) observed during the field survey	Notes	Present Ecological State (PES) *
			• Where necessary, soil compaction and loss of natural vegetation should be rehabilitated. • Mitigation for erosion should be followed.	
392, 393, 394	374, 375	• Located within 500m of a riparian area.	• On the 765kV line the line will span the riparian area between the following towers: 393 & 394. • On the 400kV line the line will span the riparian area between the following towers: 374 & 375. • Care should be taken not to drive though these areas. • Where necessary, soil compaction and loss of natural vegetation should be rehabilitated.	**C**
393	375	• Located within 100m of a riparian area.	• Mitigation for erosion should be followed.	**C**
399, 400, 401, 402, 403, 404	380, 381, 382, 383, 384, 385	• Located within 500m of a riparian area	• On the 765kV line the line will span the riparian area between the following towers: 401 & 402, 403 & 404. • On the 400kV line the line will span the riparian area between the following towers: 380 & 381, 383 & 384. • Care should be taken not to drive though these areas. • Where necessary, soil compaction and loss of natural vegetation should be rehabilitated.	**C**
400, 401, 403, 404	381, 383, 384	• Located within 100m of a riparian area.	• Mitigation for erosion should be followed.	**C**
409, 410, 411	389, 390	• Located within 500m of a drainage line.	• On the 765kV line the line will span the drainage line between the following towers: 409 & 410. • On the 400kV line the line will span the drainage line between the following towers: 389 & 390. • Care should be taken not to drive though these areas.	**C**
410		• Located within 100m of a drainage line.	• Mitigation for erosion should be followed.	**C**

Tower number (756kV)	Tower Number (400kV)	Classification of Watercourses (NWA, 1998) observed during the field survey	Notes	Present Ecological State (PES) *
414, 415	393, 394	• Located within 500m of a drainage line	• On the 765kV line the line will span the drainage line between the following towers: 414 & 415 • On the 400kV line the line will span the drainage line between the following towers: 393 & 394. • Care should be taken not to drive though these areas. • Where necessary, soil compaction and loss of natural vegetation should be rehabilitated.	**C**
414	393	• Located within 100m of a drainage line.	• Mitigation for erosion should be followed.	**C**
414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435	393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 413, 414, 415, 416, 417	• Located within 500m of a riparian area or one of the associated tributaries or drainage lines.	• On the 765kV line the line will span the riparian area between the following towers: 417 & 418, 422 & 423, 424 & 425, 426 & 427, 428 & 429, 432 & 433, 433 & 434. • On the 400kV line the line will span the riparian area between the following towers: 393 & 394, 402 & 403, 404 & 405, 406 & 407, 408 & 409, 412 & 414. • Care should be taken not to drive though these areas. • Where necessary, soil compaction and loss of natural vegetation should be rehabilitated.	**C**
417, 418, 422, 423, 424, 427, 428, 429, 433	397, 398, 407, 408, 409, 414	• Located within 100m of a riparian area or one of the associated tributaries or drainage lines.	• Mitigation for erosion should be followed.	**C**
425	405, 413	• Located directly within a riparian area or one of the associated tributaries or drainage lines.	• Towers should be moved so it is not located directly within the drainage line. • Mitigation for erosion should be followed.	**C**

* PES for Riparian areas and Drainage lines was calculated using a Level 3 VEGRAI (Riparian Vegetation Response Assessment Index) Assessment.

4 BUFFER ZONES

A buffer zone is defined as a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted (DWAF, 2005). A powerline development could have several impacts on a watercourse. The development could change habitats, the ecological environment, infiltration rates, amount of runoff and runoff intensity of the construction site, and therefore the water regime of the entire site. An increased volume of stormwater runoff, peak discharges, and frequency and severity of flooding is therefore often characteristic of transformed catchments.

Buffer zones have been shown to perform a wide range of functions and have therefore been widely proposed as a standard measure to protect water resources and their associated biodiversity. These include (i) maintaining basic hydrological processes; (ii) reducing impacts on water resources from upstream activities and adjoining land uses; (iii) providing habitat for various aspects of biodiversity. The assessment report suggests that a generic 100m buffer zone be applied to the outer edge of the riparian habitat delineated and a generic 50m buffer zone be applied to the edge of the wetland areas (Limosella Consulting, 2013). Furthermore, tower positions within 500m are also flagged as their proximity to watercourses could lead to indirect impacts.

5 EXPECTED IMPACTS

This report assumes that in general, new towers and power lines have relatively contained impacts on vegetation, wetlands and riparian areas and can successfully be mitigated to limit the negative impacts. If remedial and mitigation measures are correctly employed (e.g. ESKOM's erosion guidelines, environmental policies and rehabilitation as set out by this report), the areas around the base of tower structures could rehabilitate very well over time, and long term impacts could thus be minimal. The impacts of the access roads or servitudes, when compared with extensive agriculture, rural settlements or urbanisation, can be considered as medium – especially if the existing roads or servitudes are employed (Limosella Consulting, 2013).

The most important impact is where tower positions are directly within watercourses. This leads to an impediment of water or a change in the flow of water within the river / drainage line / wetland. These tower positions must be moved to outside a 100m buffer zone from the riparian edge, or the 1:100 floodline, whichever is the greatest.

Clearing/destruction/degradation of natural vegetation: Another significant impact is the removal of vegetation and compaction of soil around the tower footprint, as well as along the servitude, access roads and construction camps. The plants that grow on riverbanks and in wetlands are vital for preventing erosion, they play a role in the purification of water, reducing the severity of floods and regulating water, especially during droughts. The moment the vegetation is destroyed, these valuable functions disappear. In addition, vegetation around watercourses, especially upslope, holds soil in place and slows down water runoff during rainy events. The vegetation thus promotes groundwater recharge, while protecting soils from eroding, subsequently causing sedimentation in watercourses. If not remediated, loss of vegetation can result in erosion and subsequent sedimentation of watercourses. Therefore, the successful re-establishment or re-growth of vegetation is imperative in order to limit impacts on watercourses.

Compaction of soils: Construction activities may compact soils from heavy equipment access which could inhibit seed germination, reduce water infiltration, inhibit root establishment, and result in bare soil exposure. In particular, soil compaction can lead to an increase in runoff during rainy events, which in

drainage lines and slopes could result in erosion of the servitudes. Soil compaction is expected to occur during clearing of the servitude, construction (including stringing) as well as during maintenance.

Exposure to erosion: Removal of stream bank vegetation, vegetation against slopes and compaction of soils expose the resulting bare soils to erosion during rainfall events. Erosion removes the top soil layer, thereby preventing the successful establishment of indigenous vegetation on eroded soils. Eroded areas are likely to be colonised by alien invasive and pioneer plants, or in severe cases, no vegetation will establish causing high velocity runoff during rainfall events and continuous erosion.

Sedimentation of rivers and wetlands: Soil erosion could lead to increased sedimentation and turbidity in nearby watercourses, which in turn affects the flow of water through the system. If sedimentation is allowed to continue, riparian areas could lose their function and likely become invaded by alien invasive plant species.

Mobilisation of pollutants: Accidental pollution or illegal disposal and dumping of construction material such as cement or oil, as well as disposal or discharge of human (including partially treated and untreated sewage) into water resources will influence the water quality of watercourses, thereby influencing its functionality and the persistence of vegetation.

Invasion by alien invasive vegetation: During construction, vegetation will be removed and soil disturbed. The seeds of alien invasive species that occur on and in the vicinity of the construction area could spread into the disturbed or stockpiled soils. In addition, the construction vehicles and equipment were likely used on various other sites and could introduce alien invasive plant seeds to the construction sites. From these construction sites, alien invasive plant species can easily spread downstream, likely resulting in offsite impacts.

6 MITIGATION PLAN:

On site mitigation can limit the impact of construction activities and reduce the need for expensive rehabilitation and the need for corrective action. In addition, sedimentation is very difficult and sometimes impossible to rehabilitate without further impacting on watercourses. Therefore, sedimentation should be prevented through mitigation. Table 5 list the mitigation measures that should be implemented during the planning and construction phase in order to limit the need for rehabilitation.

Table 5: Mitigation plan

<table>
<tr><th>Project Phase</th><th>Mitigation Objective</th><th>Mitigation to Limit Impact and Size of the Area to be Rehabilitated</th></tr>
<tr><td>Pre-construction planning</td><td>Do not construct in watercourses</td><td>

Where possible, plan the final route alignment to have no structures within watercourses and the recommended 100m buffer
The table below summarises the towers positions within 100m of a watercourse at the time that this plan was drafted

<table>
<tr><th>Tower number (756Kv)</th><th>Tower Number (400Kv)</th></tr>
<tr><td>342</td><td>328</td></tr>
<tr><td>358</td><td>342</td></tr>
<tr><td>360</td><td>344</td></tr>
<tr><td>393</td><td>346</td></tr>
<tr><td>400</td><td>375</td></tr>
<tr><td>401</td><td>381</td></tr>
<tr><td>403</td><td>383</td></tr>
<tr><td>404</td><td>384</td></tr>
<tr><td>410</td><td></td></tr>
<tr><td>414</td><td>393</td></tr>
<tr><td>417</td><td>397</td></tr>
<tr><td>418,</td><td>398</td></tr>
<tr><td>422</td><td>407</td></tr>
<tr><td>423</td><td>408</td></tr>
<tr><td>424</td><td>409</td></tr>
<tr><td>427</td><td>414</td></tr>
<tr><td>428</td><td></td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Project Phase</th><th>Mitigation Objective</th><th>Mitigation to Limit Impact and Size of the Area to be Rehabilitated</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>429</td><td></td></tr>
<tr><td>433</td><td></td></tr>
</table>

The table below indicate the towers within wetland areas at the time that this plan was drafted

<table>
<tr><th>Tower number (756Kv)</th><th>Tower Number (400Kv)</th><th>Wetland type</th></tr>
<tr><td>374</td><td></td><td>unchannelled valley bottom wetland</td></tr>
<tr><td>392</td><td></td><td>Located directly within a seepage wetland.</td></tr>
<tr><td></td><td>374</td><td>located very close to a seepage wetland</td></tr>
</table>

The table below indicate the towers within riparian areas at the time that this plan was drafted

<table>
<tr><th>Tower number (756Kv)</th><th>Tower Number (400Kv)</th></tr>
<tr><td>342</td><td>405</td></tr>
<tr><td>359</td><td>343</td></tr>
<tr><td>425</td><td>413</td></tr>
</table>

Avoid tower positions that run parallel to rivers, especially within 100 – 500m. The tower positions below run parallel to the Elands River and in some instances within 100m thereof. The towers must be moved to at least 100m from the riparian edge or the 1:100 year floodline – whichever is the greatest

<table>
<tr><th>Tower number (756Kv)</th><th>Tower Number (400Kv)</th></tr>
<tr><td>414-430</td><td>393-410</td></tr>
</table>
</td></tr>
</table>

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
	Limit the footprint of access roads and constructing camps, thereby reducing compaction and destruction of natural vegetation	• Project engineers should compile a method statement, outlining the construction methodologies. The required mitigation measures to limit the impacts on the watercourse and associated buffers should be contained within the method statement. The method statement must be approved by the Environmental Control Officer (ECO) and be available on site for reference purposes • Avoid linear disturbances that run parallel to a watercourse • Plan access roads in such a way as to not cross watercourses, and where impossible, to minimise impact on watercourses • Plan construction activities that necessitate water crossings to only cross watercourses at a single designated point • Plan construction camps to be placed outside of watercourses and their associated buffer zones • Planning of construction site must include eventual rehabilitation / restoration of indigenous vegetative cover
	Limit the footprint of **construction** thereby reducing compaction and destruction of natural vegetation	• Where possible, plan the construction of the new structures to be followed directly by stringing. This will likely reduce the time that the environment is exposed to the impact and speed up rehabilitation and recovery time. • Avoid linear disturbances that run parallel to a watercourse • Demarcate the buffer to the watercourse to prevent access to these sensitive environs and ensure that all workers adhere to the restriction • Access areas must be designated in the planning phase to prevent contractors taking “short-cuts” through watercourses and buffers • Where possible, plan the final route alignment to have no structures within watercourses and the recommended 100m / 50m buffer • Construction within riparian areas buffers must be planned to take place in the drier winter months • Plan construction activities to have the smallest possible footprint • No stockpile areas should be located within river boundaries, or within the associated buffer zone. • No vehicles and access of persons should be allowed through any watercourse, except where approved by the relevant authority
	Limit the footprint of **Stringing** thereby reducing compaction and destruction of natural vegetation	• Consider the various methods of stringing and select whichever method(s) that will have the least impact on watercourses e.g. shooting a pilot cable and pull cables with a winch • Stringing should preferably not make use of vehicles in watercourses • If unavoidable, plan stringing activities in wetlands areas to take place within the drier winter months • Plan to use equipment with the smallest possible footprint e.g. quad bikes

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
		• Plan stringing through watercourses to take place at pre-determined points such as where the watercourse width (and thus area to be impacted) is the smallest • Where possible, plan stringing to take place upon completion of the new structures, thereby limiting the time that the watercourses are exposed to impacts
Construction phases	Limit the construction footprint and related impacts	• Only use access roads as designated during the planning phase • Should a section of the line be affected by a watercourse, the edge of the riparian or wetland area and associated buffer must be clearly demarcated in the field with poles, sticks, or any solid structure that will last for the duration of the development. These indicators could be coloured as follows (from Bohlweki-SSI Environmental, 2010): Red – Indicating the edge / boundary of the riparian area / wetland Orange – Indicating the edge of the buffer zone • Only cross watercourses at designated points • Crossings to be undertaken with only one vehicle that have the minimum footprint as decided on during planning • Limit the removal of indigenous vegetation around the construction footprint • Limit compaction by not working in wet conditions and limiting vehicular access • 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 (DAWF, 2005) • Watercourse boundaries and buffers must be clearly marked in the field with signs and/or highly visible flagging until construction-related ground disturbing activities are complete • Only necessary traffic should be allowed within these demarcated areas • Limit clearing of vegetation between servitude and construction camps • Demarcate each construction area around the tower footprint, before the contractors begin construction • Contractors should refrain from impacting areas beyond the demarcated construction area • Minimise disturbance and loss of soil • No structures are allowed to be stored in riparian habitats or buffers • The contractor must avoid traffic or storing of equipment and material in vegetated areas that will not be cleared
	Prevention of pollution	• Contractors must sign a declaration stating that they will adhere to all stipulations of the Environmental Management Plan relating to watercourse crossings, as well as measures as set out by this report

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
Construction phases		• The contractors must provide and maintain a method statement for "cement and concrete batching". The method statement must provide information on proposed location, storage, washing & disposal of cement, packaging, tools and plant storage • Cement should only be mixed within mixing trays. Washing and cleaning of equipment should also be done within a bermed area, in order to trap any cement or plaster and avoid excessive soil erosion. These sites must be rehabilitated prior to commencing the operational phase • The mixing of concrete should only be done at specifically selected sites on mortar boards or similar structures to contain run-off into drainage lines, streams and natural vegetation • Materials such as fuel, oil, paint, herbicide and insecticides must be sealed and stored in bermed areas or under lock and key, as appropriate, in well-ventilated areas • These substances must be confined to specific and secured areas within the contractor's camp, and in a way that does not pose a danger of pollution even during times of high rainfall • Storage of materials as described above may not be within the 1:100 floodline, watercourses or associated buffer areas • In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water Affairs (DWA) must be informed immediately and corrective action taken • All equipment should be parked overnight and/or fuelled at least 500 meters from a watercourse • Drip trays (minimum of 10cm deep) must be placed under all vehicles that stand for more than 24 hours. Vehicles suspected of leaking must not be left unattended, drip trays must be utilised. • Drip trays must be utilised during repairs and maintenance of all machinery. The depth of the drip tray must be determined considering the total amount / volume of oil in the vehicle. The drip tray must be able to contain the volume of oil in the vehicle. • Provision of adequate sanitation facilities located outside of the wetland/riparian area or its associated buffer zone • Remove all construction equipment and material on completion of construction • No water should be abstracted from any river • Run-off from the camp site must not discharge into neighbours' properties or into adjacent wetlands, rivers or streams • Management of on-site water use and prevent stormwater or contaminated water directly entering the watercourse • Management of point discharges

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
	Prevent/limit sedimentation	• Contractors must sign a declaration stating that they will adhere to all stipulations of the Environmental Management Plan relating to wetland / stream crossings as well as measures as set out by this report • Increased run-off during construction must be managed using berms and other suitable structures as required to ensure flow velocities are reduced; this must be done in consultation with the ECO • Storm water, wherever possible, should be allowed to soak into the land and natural attenuation areas. Special care must be given to ensure velocity is slowed before reaching the attenuation area • The contractor shall ensure that excessive quantities of sand, silt and silt-laden water do not enter watercourses. Appropriate measures, e.g. erection of silt traps, or drainage retention areas to prevent silt and sand entering drainage or watercourses must be taken • Sediment barriers should be installed immediately after initial disturbance of the watercourse or adjacent upland • Where watercourses are adjacent to the construction areas and these areas slopes toward the wetland, install sediment barriers along the edge of the construction areas as necessary to prevent sediment flow into the wetland. • Sediment barriers must be properly maintained throughout construction and reinstalled as necessary until replaced by permanent erosion controls or restoration of adjacent upland areas is complete • It is important that topsoil should be conserved in areas where bedrock is shallow to avoid sedimentation • Run-off from the camp site must not discharge into neighbours' properties or into adjacent wetlands, rivers or streams. • No development, or activity of any sort associated with camp, is allowed below the 1:100 year flood line of any water system.
	Preventing spread of alien invasive	• Construction equipment must be cleaned prior to site access. This will prevent alien invasive seed from other sites to spread into disturbed soils • Alien invasive species that were identified within servitudes should be removed prior to construction related soil disturbances. This will prevent seed spreading into disturbed soils • Manual removal methods are preferred to chemical control
	Limit the impact on watercourses and associated buffers during stringing	• Contractors must sign a declaration stating that they will adhere to all stipulations of the Environmental Management Plan relating to wetland / stream crossings as well as measures as set out by this report • If vehicles are used for stringing: only cross watercourses at designated points, with dedicated vehicle that have the least possible impact (as determined during the planning phase) • The vehicle could cross over timber riprap, prefabricated equipment mats, or terra mats to reduce soil impact and soil turning.

Project Phase	Mitigation Objective	Mitigation to Limit Impact and Size of the Area to be Rehabilitated
		• Crossings should preferably be undertaken during the dry season, where feasible and as soon after construction of the structures as possible • Limit the removal of indigenous vegetation, compaction of soils and damage to already rehabilitated areas • Remove all project-related material upon completion of stringing and prepare for rehabilitation • Where any damage to watercourses / rehabilitated areas are noted during stringing, follow the rehabilitation and monitoring steps as per Table 6 and 7 below

7 REHABILITATION PLAN

Rehabilitation in this document refers to the reinstatement of the temporarily disturbed areas affected by the construction or due to construction related activities, to a state that resemble the conditions prior to the disturbances. It therefore does not address the rehabilitation of the watercourses situated along the proposed powerline route from for example a management category D to a C (Kleynhans, 1996 & Kleynhans, 1999). In order to improve the management category, the current impacts due to mining, farming and other anthropogenic impacts should be address and these fall outside the scope of this document and are not part of Eskom's mandate.

This rehabilitation plan recognises that the construction will take place in three phases:

- Phase 1: Removal / pruning of vegetation;
- Phase 2: Construction of the new structures; and
- Phase 3: Stringing of the conductors (electrical cables).

Due to the uncertainty of the time lapse between the removal of vegetation, construction of the new tower structures and the stringing of the conductors, this document recommends that rehabilitation around the construction footprint takes place immediately after disturbances in order to limit detrimental effects resulting from for example, rainfall events after construction of the new infrastructure, but prior to stringing. Therefore it is imperative that rehabilitation of disturbed areas takes places after each construction phase. In addition, stringing could have direct impacts on the watercourses not necessarily affected by construction of a tower e.g. if stringing takes places by vehicle through watercourses, whereas the new structures are placed outside the watercourse and buffers.

However, where the footprint will be re-used for stringing, it might be unfeasible to rehabilitate the areas if disturbance by the follow-up construction e.g. stringing will take place within 4 weeks. During the lapse the area should be monitored once a week until such time that construction is completed and the areas rehabilitated. Note that if the time lapse is greater than 4 weeks, temporary rehabilitation must be implemented to prevent loss of topsoil and invasion by alien invasive plant species. It is thus recommended that the construction footprint be rehabilitated immediately after the construction of new structures and prior to stringing activities. Stringing activities should take cognisance of the rehabilitation efforts and endeavour not to impact on it, while monitoring during this phase is crucial. After stringing, the areas affected by stringing should be rehabilitated and the tower footprint monitored. Table 6 list the rehabilitation measures that should be undertaken post construction as well as corrective action when monitoring has established that the listed impacts are taking place.

Table 6: Rehabilitation plan

Impacts	Rehabilitation	Time frame
Removal of vegetation for new structures Areas where vegetation will be impacted include the area directly impacted on by the construction of the towers, the temporary work area, and access roads. Areas where vegetation has been removed or destroyed should be kept to a minimum. Disturbance of slopes, for example by the removal of vegetation, may result in slope instability and erosion by rain and surface runoff.	• Stripping of vegetation for construction must occur in a phased manner and must be restricted to the building footprint to reduce the risk of erosion during times of precipitation • Where possible, remove grassland vegetation as sods that can be replanted as part of the rehabilitation of vegetation around the tower footprint. Store sods in already cleared areas or degraded areas and water at least once week. In addition plants such as *Aloe's* and bulbs can easily be removed and stored to use during rehabilitation • Where soils are removed, the topsoil and subsoil must be stockpiled separately in low heaps (Topsoil are deemed to be the top layer of soil containing organic material, nutrients and plant grass seed. For this reason it is an extremely valuable resource for the rehabilitation and vegetation of disturbed areas) • After construction, compacted areas should be ripped and topsoil replaced from the areas where it was removed. Areas around the tower footprint can be re-vegetated using the sods or plants that were removed prior to construction. The sods should be placed level, or slightly deeper than surrounding vegetation, on ripped soils. Against slopes, the sods should be pegged to ensure that it does not wash away before the roots establish • Ripping shall be done to a depth of 250mm in two directions at right angles. • All sloped areas must be re-vegetated by either using removed sods or by seeding with a grass mixture containing species naturally occurring in the area. Sloped areas where vegetation has been removed or destroyed should be replanted immediately after completion of construction to avoid erosion • Badly damaged areas and areas where grazing, water collection or washing commonly takes place (e.g. in proximity to township areas), should be fenced in to allow for rehabilitation to take place without further impacting on the areas. The reason for fencing must be communicated to the community using the areas and should be monitored regularly • 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	• Immediately after construction • Immediately after stringing if stringing resulted in these impacts • At any time during operational phase of the transmission line, when maintenance activities might have destroyed natural vegetation • As and when monitoring indicate degradation of vegetation along the servitude

Impacts	Rehabilitation	Time frame
	• If natural re-vegetation is unsuccessful, corrective action should be taken and includes seeding and planting by an appropriate specialist as stipulated in the EMP • All rehabilitated areas must be monitored for the presence of exotic and alien plant species. • Should the presence of exotic/alien plant species be observed it should be removed appropriately • All disturbed areas will requiring rehabilitation must be mulched to encourage vegetation re-growth. Mulch used must be free from alien seed. These areas must be cordoned off so that vehicles or construction personnel cannot gain access to these areas • Ideally, the rehabilitated tower footprints, especially on slopes and along riparian and wetland areas, must be fenced to prevent livestock grazing and trampling. Once rehabilitation was observed to be successful during monitoring, the fenced may be removed (at least two years)	
Erosion Erosion and sedimentation is likely to occur where vegetation has been cleared and where excavated material is stored in close proximity to a watercourse. Disturbance of steep slopes by the removal of vegetation may result in slope instability and erosion by rain and surface run-off.	• The contractor shall be responsible for rehabilitating all eroded areas in such a way that the erosion potential is minimised after construction has been completed • All slopes that are disturbed during construction should be stabilised immediately to prevent erosion • Re-vegetation should be done immediately after construction, especially in sloped areas • Disturbances on site should be kept to a minimum to reduce the loss of material by erosion • Disturbed areas that require rehabilitation should be mulched to encourage vegetation re-growth. • Stockpiled soil should be protected from erosion due to water runoff • Near vertical slopes of 1(V):1(H) or 1(V):2(H) must be stabilised using hard structures, preferably with a natural look, and with facilities allowing for plant growth. The EO / ECO will specify a solution in terms of the most appropriate approved method and technology. One or more of the following methods may be required: o Retaining walls (loffel or otherwise) (DWAF 2005) o Stone pitching. o Gabions.	• During and immediately after any construction phase • Immediately after stringing where stringing resulted in erosion or damage that could lead to erosion over time • As and when monitoring indicate erosion is taking place

Impacts	Rehabilitation	Time frame
	o Shotcrete. • Protect the slopes of all river diversions. One or more of the following methods may be used, as specified by the EO / ECO: (DWAF, 2005) o Sandbags. o Reno mattresses. o Plastic liners and / or coarse rock (undersize rip-rap) • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within work areas • Sensitive areas such as watercourses (wetlands, pans, and riparian areas) should be cordoned off so that vehicles and construction personnel cannot gain access to these areas. • Where access cannot be avoided into sensitive areas, the amount of vehicle and personnel traffic should be kept to a minimum and should make use of only one route • Where crossings of watercourses are unavoidable eco-friendly soft options (such as wooden poles) should be placed over the wet area to be driven over • Where all preventative measures have failed and erosion persists soft and hard rehabilitation options, such as eco-logs or weirs, should be considered in conjunction with an engineer and wetland specialist • Erosion control of all banks must take place so as to reduce erosion and sedimentation into river channels	
Soil Compaction Soil compaction is likely to occur on access roads, and temporary work platforms where heavy vehicles and personnel move around. Soil compaction will decrease permeability of the soil, negatively impact the sub-	• Areas where soil has been compacted should be ripped to encourage vegetation growth • Ripping shall be done to a depth of 250mm in two directions at right angles. • Do not rip and / or scarify areas under wet conditions, as the soil will not break up and compaction will be worsened • 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 (DAWF, 2005)	• Immediately after any construction phase (except where the next phase follows immediately and makes use of the same construction footprint)

Impacts	Rehabilitation	Time frame
surface flows and compromise vegetation establishment.	• Rip and / or scarify all disturbed (and other specified) areas of the construction site, including temporary access routes and roads, compacted during the execution of the Works. (DWAF, 2005)	• Immediately after stringing where stringing resulted in compaction • As and when monitoring indicate severe compaction due to maintenance
Mobilisation of pollutants The mobilisation of sediments, excavations, removal and disturbances to vegetation, mobilisation of sulphur, hydrocarbon and pyrite compounds could have various negative impacts on wetlands and their associated functionality.	• In case of emergencies or unforeseen events, the problem must be remediated immediately and any spillage into any watercourses be reported to the Department of Water Affairs. In addition, the soil must be stabilised (import additional topsoil if necessary) and re-vegetated as soon as possible. Re-vegetation should include seeds from the adjacent grassland and any rescued protected plants and/or plants of conservation concern that might have been impacted upon by the emergency / unforeseen event. • Remove all project-related material / support equipment immediately on completion of any of the construction phases	• Immediately after a construction phase • Immediately after stringing where pollution may have arisen • At any time during operational phase of the line, when maintenance activities might have resulted in pollution
Spread of Alien Invasive Species	• Appointment of alien plant working group / assign this duty to specific staff • Alien invasive species that were identified within the servitudes should be removed prior to construction related soil disturbances. This will prevent seed spreading into disturbed soils or to downstream areas • All alien seedlings and saplings must be removed as they become evident for the duration of construction • Manual / mechanical removal is preferred to chemical control • If herbicide must be used it should be registered for aquatic use • Acquire the necessary equipment for removal and control • Planned sequence of areas to be cleared of invasive plants	• During and after construction phases • Immediately after stringing if monitoring during stringing recorded alien invasive species within the servitude

Impacts	Rehabilitation	Time frame
	• A register of the methods used, dates undertaken, as well as herbicides and dosage used must be kept and available on site. The register must also include incidents of poisoning or spillage • Ensure that contractors can identify the relevant plants and are aware of the removal procedures • All construction vehicles and equipment, as well as construction material should be free of plant material. Equipment and vehicles should be thoroughly cleaned other prior to access on to the construction site.	
Sedimentation	• Sedimentation should be prevented though sufficient mitigation throughout construction as well as during the operational phase • If structures are used on sensitive sloped areas it is important that sediment does not pass through these structures e.g. gabions should be lined • Should sedimentation be observed to accumulate and smother vegetation, a wetland specialist should be consulted to find a suitable solution for the specific wetland and its species composition.	• During and after construction • Immediately after stringing if monitoring during stringing recorded sedimentation within watercourses

8 MONITORING PLAN

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. The monitoring plan aims to establish whether rehabilitation was successful, whether maintenance or related activities have impacts and whether the constructed towers have detrimental impacts on the watercourses after construction (Table 7). Four monitoring frequencies are recommended:

Once-off Monitoring:

1. Monitoring during stringing: Due to the uncertain time lapse between construction of a tower and the stringing thereof, rehabilitation should take place immediately after construction (especially around the tower footprint and areas where vegetation was removed). During stringing, rehabilitation efforts must be monitored and impacts on already rehabilitated areas monitored and corrective action taken where needed. In addition, additional impacts resulting from stringing must be rehabilitated directly after stringing at the particular tower and watercourse is completed.

2. Monitoring after stringing: Once stringing is completed, the whole line should be monitored to evaluate success of rehabilitation and to identify corrective action where needed. This monitoring activity can also provide lessons for further rehabilitation.

Routine Monitoring:

3. Seasonal monitoring: 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 stringing was completed.

4. 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 took place.

5. Annual monitoring: after three years, provided that all rehabilitation where found to be successful and no additional problems arised, monitoring can take place once a year after the first seasonal rainfall.

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 (e.g. mend broken fences). If problems arise due to the constructed transmission line that was not pre-empted in this plan, an engineer and wetland specialist should be consulted as soon as possible.

It is recommended that fixed point photography is used to monitor vegetation and soil stability. This involves taking pictures of the areas monitored from the same point during each monitoring event. The images can be compared and serves as a record of the success of rehabilitation or the failure thereof.

Table 7: Monitoring plan

Variables	Methods	Monitoring Frequency	Indicator	Corrective Action
Integrity of rehabilitations structures where used	• On-site inspection • Fixed point photography.	• After stringing • Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Arresting of erosion/head cut. • Sedimentation behind structure	• Structures should be fixed where possible or new structures should be implemented
Vegetation cover	• 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 construction of new structures • After stringing • Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Spreading and distribution of dominant plant species in specified wet zones • No bare soils • Wetland re-vegetation shall be considered successful if the cover of herbaceous and/or woody species is at least 80 percent of the type, density, and distribution of the vegetation in adjacent wetland areas that were not disturbed by construction	• If natural re-vegetation does not occur replanting of indigenous plants should be done at sites of concern • Prevent livestock or pedestrian traffic from entering rehabilitated areas • If re-vegetation is not successful at the end of 3 years, develop and implement (in consultation with a professional wetland ecologist) a remedial re-vegetation plan to actively re-vegetate the wetland. Continue re-vegetation efforts until wetland re-vegetation is successful • If wetland vegetation rehabilitation is successful at the end of 3 years, report on the status of the vegetation (e.g. using photographic record) and only monitor annually or if maintenance activities might have disturbed the area again
Plant species composition	• Fixed transect to determine the species composition	• Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Presence/absence of species in specified wet areas.	• If natural re-vegetation does not occur replanting of indigenous plants should be done at sites of concern. • If exotic plants have colonised the area the exotic plants should be removed.

Variables	Methods	Monitoring Frequency	Indicator	Corrective Action
Erosion	• On-site inspection • Fixed point photography • Compare to adjacent land	• After construction of new structures • After stringing • Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually.	• Areas where vegetation cover is limited or nil and where soil has started to erode • Bare soil patches or ditches	• Should erosion occur, soft options such as hay bales, eco-logs and replanting should be considered, if erosion is too great a rehabilitation method should be discussed with an engineer and wetland specialist
Sedimentation	• As determined by ECO • Visual observations and site inspections • Fixed point photography	• After construction of new structures • After stringing • Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Excess sediment in wetlands /rivers • Bare soil upslope from watercouses	• Cause of sedimentation should be identified and dealt with appropriately • Should sedimentation be observed to accumulate and smother vegetation, a wetland specialist should be consulted to find a suitable solution for the specific wetland / river and its plant species composition.
Alien Invasive Plant Species	• Monitor the emergence of alien invasive plant species in or around rehabilitated areas and the servitude in general • On-site inspection • Fixed point photography	• Prior to construction to verify that the servitude has been cleared of invasive plant species • After construction of new structures • After stringing • Seasonal for the first three years and rapidly after heavy rainfall • Thereafter annually	• Establishment of alien invasive plant species in rehabilitated areas or in watercourses	• Remove emergent invasive vegetation from the servitudes as well as rehabilitated footprint as soon as it becomes apparent • Manual labour is preferred above chemical or manual removal. • Do not use herbicides or pesticides in or within 200 meters of wetland / riparian areas

9 REFERENCES

Bohlweki-SSI Environmental (2010): Environmental Management Plan (EMP) for the Fourteen (14) Eskom 88kv Line Rebuild Sections in Midrand and Johannesburg, Gauteng Province. Report drafted for Eskom Distribution (Central Region). May 2010

Braack A.M, Walters, D. And Kotze D.C. (unknown): Practical Wetland Management. Mondi Wetlands Programme

Brinson, M. (1993). A hydrogeomorphic classification for wetlands. Prepared for US Army Corps of Engineers. 101pp. Wetlands Research Programme Technical Report WRP-DE-4

Cowden C, and Kotze D (2009) WET-RehabEvaluate: Guidelines for monitoring and evaluating wetland rehabilitation projects. WRC Report No.TT 342/09

Department of Water Affairs and Forestry, (2005): Environmental Best Practice Specifications: Construction for Construction Sites, Infrastructure Upgrades and Maintenance Works. Version 3

Department of Water Affairs (2010): National Water Act, 1998 (Act No 36 of 1998) S21(c) & (i) Water Uses. Version: February 2010. Training Manual.

Kleynhans, C.J. (1996): A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River. Journal of Aquatic Ecosystems Health 5: 41-54

Kleynhans, C.J. (1999): A procedure for the determination of the determination of the ecological reserve for the purpose of the national water balance model for South African Rivers. Institute for Water Quality Studies Department of Water Affairs and Forestry, Pretoria.

Kotze D C, (1999): A system for supporting wetland management decisions. Ph.D. thesis. School of Applied Environmental Sciences, University of Natal, Pietermaritzburg.

Limosella Consulting, (2013): Masa-Ngwedi EMP D. The Proposed Construction of a 40km 400Kv and 765Kv Powerline. Wetland / Riparian input report, December 2013. Compiled for Mandara Consulting Solutions

Marneweck G C, and Batchelor A L, (2002). Wetland classification, mapping and inventory. In: PALMER R W, TURPIE J, MARNEWECK G C, and BATCHELOR A L. Ecological and economic evaluation of wetlands in the upper Olifants River Catchment, South Africa. WRC Report No. 1162/1/02. Water Research Commission, Pretoria

Macfarlane D.M., Kotze D.C., Ellery W.N., Walters D, Koopman V, Goodman P and Goge C. (2007). WET-Health: A technique for rapidly assessing wetland health. Water Research Commission, Pretoria

Macfarlane D.M., Teixeira-Leite A., Goodman P., Bate G and Colvin C. (2010) Draft Report on the Development of a Method and Model for Buffer Zone Determination. Water Research Commission project K5/1789. The Institute of Natural Resources and its Associates

Sieben E, Braack M, Ellery W, and Kotze D (2009). WET-RehabMethods: National guidelines and methods for wetland rehabilitation. WRC Report No. 341/09