

Ash Disposal Facility: Exemption Area Extension at the Majuba Power Station

Specialist Wetland Impact Assessment Review



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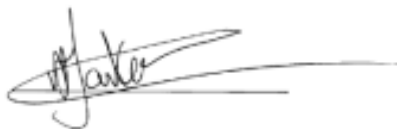
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The spatial and temporal extents of Ecotone's services are described in the proposal, and are subject to restrictions and limitations. Only a single survey was carried out and therefore a total assessment of all probable scenarios or circumstances that may exist on the study site was not undertaken. No assumptions should be made unless opinions are specifically indicated and provided. Data presented in this document may not elucidate all possible conditions that may exist given the limited nature of the enquiry.

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List of Abbreviations

ADF	Ash Disposal Facility
D	Duration
DEA	Department of Environmental Affairs
DS	Downstream
DWAF	Department of Water Affairs and Forestry
E	Extent
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EX	Exotic
GIS	Geographic Information System
HGM	Hydrogeomorphic
I	Intensity / Severity
MBCP	Mpumalanga Biodiversity Conservation Plan
NFEPA	National Freshwater Ecosystem Priority Areas
Min	Minimum
NSBA	National Spatial Biodiversity Assessment
P	Probability
PES	Present Ecological State
S	Significance Weighting
SANBI	South African National Biodiversity Institute
TWQR	Target Water Quality Range
US	Upstream
WMA	Water Management Area

1. Introduction

1.1. Project Background

Eskom, through Gemini GIS & Environmental Services, requested Ecotone to review the specialist wetland impact assessment associated with the Majuba Ash Disposal Facility (ADF) Exemption area, as was undertaken by Ecotone in 2014 (Proposed Continuous Ash Disposal Facility at the Majuba Power Station, Aquatic Specialist Study, Environmental Impact Assessment, April 2014). This area refers to approximately 30 ha exempt from installing a liner. In terms of the conditions of the Exemption Authorisation the Exemption period is valid for four years from June 2016 to 2020. The exception footprint can be divided into Portion A and B (**Figure 1-1**). The ground surface Portion A has been filled with ash. Ashing within Portion A started during March 2018. Currently the subsurface drainage for Portion B is being prepared in line with the conditions of the EA. The increase in duration of ashing within the authorised Exemption footprint prompted the Department of Environmental Affairs (DEA) to request a specialist wetland and aquatic ecology opinion regarding the potential impact on the receiving wetlands due to an increase in the duration of exemption (within the same footprint). This report provides the specialist wetland and aquatic ecology input into the revision.

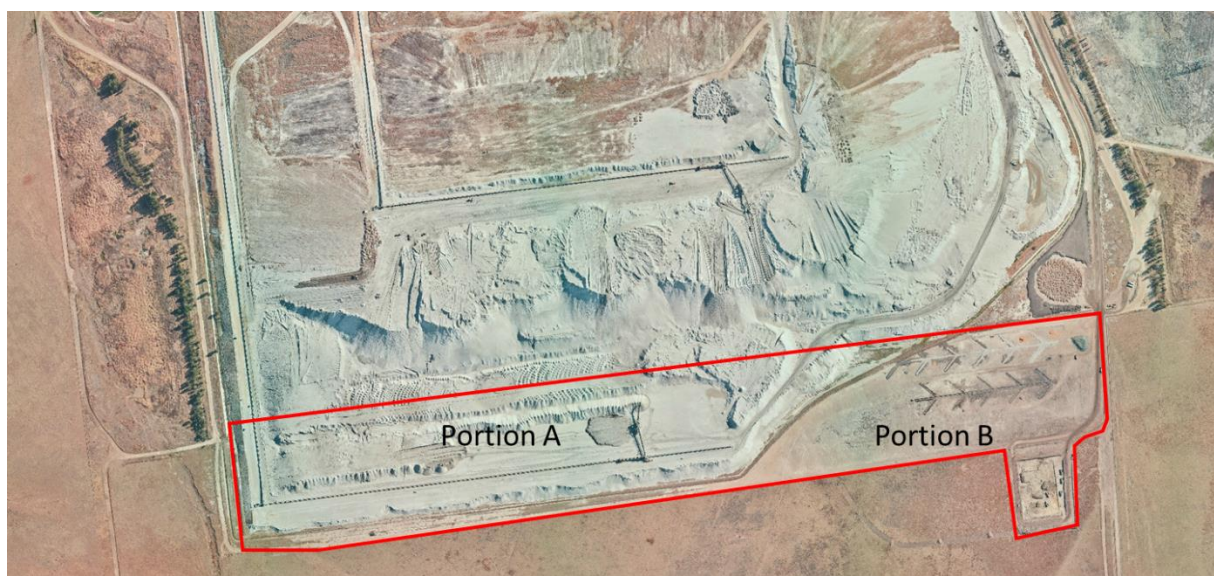


Figure 1-1: Aerial image showing the extent of the authorised Exemption area with an approximate indication of Portion A and Portion B.

1.2. Aims and Objectives

The aim of this report is to revise the wetland impact assessment completed for the exception area during 2014. This opinion statement includes specific consideration for extending the duration of ashing within the authorised Exemption area.

2. Method Statement

2.1. Literature Review

The following relevant reports have been reviewed:

- Proposed Continuous Ash Disposal Facility at the Majuba Power Station, Aquatic Specialist Study (Ecotone, 2014);
- Proposed Continuous Ash Disposal Facility at the Majuba Power Station, Groundwater Specialist Study (SLR, 2014);
- Soil Survey for Proposed Ash Disposal Facility, Majuba Power Station Mpumalanga (ARC, 2014);
- XRF analysis of ash composition (Talbot & Talbot, 2019);
- Majuba Power Station Pollution Plume Model (GHT Consulting Scientists, 2017);
- Eskom Majuba Power Station Source Pathway Receptor Assessment Model Investigation (Margen Industrial Services, 2018).

A literature survey and desktop study on the general study area was carried out using available information from reference works (i) National Spatial Biodiversity Assessment (NSBA - Nel *et al.*, 2004), (ii) Department of Water and Sanitation (DWS - DWS, 2014), (iii) National Freshwater Ecosystem Priority Areas (NFEPA - Nel *et al.*, 2011), (iv) Mpumalanga Biodiversity Conservation Plan (MBCP-Ferrar & Lötter, 2007) and (v) Chief Directorate – Surveys and Mapping (1: 50 000) and additional data reviewed include:

- Routine water quality monitoring data for one surface control location (PSR01) and one test locations PSR04 (located on the floodplain system downstream of the ADF).

2.2. Project Area

The field assessment was undertaken during November 2019 to revisit wetlands located within the Exemption area. **Figure 1-1** shows the study area in relation to Exemption area. A photo plate of areas within the Exemption area are provided in **Figure 2-1 A to D**. The locations of where the photos were taken are indicated by corresponding letters in **Figure 2-2**.



Figure 2-1: Photo plate of areas within the Exemption area.



Figure 2-2: Exemption area in relation to wetlands.

3. Summary of Wetland Information

3.1. Desktop Information (Sub-quaternary Reach)

The authorised Exemption area is located with the upper parts of the Witbankspruit catchment. The Witbankspruit drains in a north-westerly direction and joins the Vaal River upstream of the Grootdraai Dam. Desktop information regarding the Witbankspruit is summarised in **Table 3-1**.

Table 3-1: Desktop characterisation of the Witbankspruit associated with the study area

Desktop Information	Details/Category/Class
River	Witbankspruit
River Order	1
Hydrological Class	Perennial
River Signature	Highveld 3
Conservation Status (Nel <i>et al.</i> , 2004)	Critically Endangered
C-Plan (MBCP- Ferrar & Lötter, 2007)	Ecosystem Maintenance
River NFEPA (Nel <i>et al.</i> , 2004)	Upstream Management Area

Proposed Continuous Disposal of Ash in Exemption Area

Desktop Information	Details/Category/Class
Water Management Area	Upper Vaal
Aquatic Ecoregion	Highveld
Quaternary Catchment	C11J
Sub-Quaternary Reach Name	C11J-040000
Present Ecological State (PES- DWS 2014)	C (Moderately Modified)
Ecological Importance and Sensitivity (EIS)	High

3.2. Wetlands Associated with the Exemption Area

The Exemption area occupies about 30 ha of the upper parts of the Witbankspruit catchment. Two hydrogeomorphic (HGM) units are directly affected by the footprint of this area, these include a seasonal seep (AS1) associated with a seasonal pan system (AP1) connected to a floodplain (AF2) flanking the eastern boundary of the ADF (**Figure 2-2**). Jointly, the two HGM units represented approximately 21.17 ha of seasonal wetland during the April 2013 baseline assessment.

The 2013 PES assessment indicated that both units fell into a C PES, indicating a *Moderately Modified* state. During the 2013 assessment approximately 30% of the catchment of wetlands AS1 and AP1 has been occupied by the existing ADF. This along with substantial grazing pressure resulting in hydrological, geomorphological water quality disturbances to these wetland units.

The expansion of the ADF, along with supporting infrastructure (i.e. pollution control facility), will ultimately occupy most of the wetland units AS1 and AP1. The ecological functions associated with these wetlands will be lost. The 2013 functional ecosystem services assessment indicated likely functions associated with water purification, erosion control and maintenance of biodiversity.

The trade-off between the ADF expansion and loss in wetland functions were informed by the following:

- The expansion remained in close proximity to the existing infrastructure thus avoiding additional risks associated with the construction of linear infrastructure (conveyors etc.);
- The southward expansion meant occupying the same local catchment that has already been impacted by the existing infrastructure, thus largely limiting the number of potential contamination pathways;

- The weathered zone of the affected pan and seep system is generally clay rich with a relatively low permeability, thus likely to be a good control for surface contaminants;
- The buffer zone allocated to the floodplain system (AF2) and the buffering capacity of the floodplain itself further mitigates potential water quality impacts to the downstream water resources;
- The design considerations associated with sub-surface drainage and pollution control within the affected wetland units compensate the wetland functions associated with water purification;
- Similarly design and operational consideration compensates for wetland functions associated with erosion control.

3.3. Water Quality

Water quality monitoring data have been extracted for two surface water monitoring points: a control location PSR01 located on the floodplain system upslope of the ADF and location PSR04, downstream of the ADF (**Figure 3-1**). pH and Electrical Conductivity (EC) were selected as proxies for water quality and the data was divided into two groups for each site (pre- and post-ashing within the Exemption area).

The water quality data reviewed generally reflected alkaline pH values with moderately high salt loads (**Figure 3-1 A and B**). The control location (PSR01) reflects less temporal variation in pH and EC than the test location (PSR04) for periods before and after ashing commenced within the Exemption area. Notably, the variation in EC after ashing commenced increased for site PSR04, sometimes exceeding the *Marginal* threshold for freshwater ecosystems. The spatial and temporal variation in water quality associated with the downstream location suggest additional contamination after the expansion of the ADF into the Exemption area commenced. However, this variation does not exceed *Unacceptable* thresholds for the freshwater ecosystems.

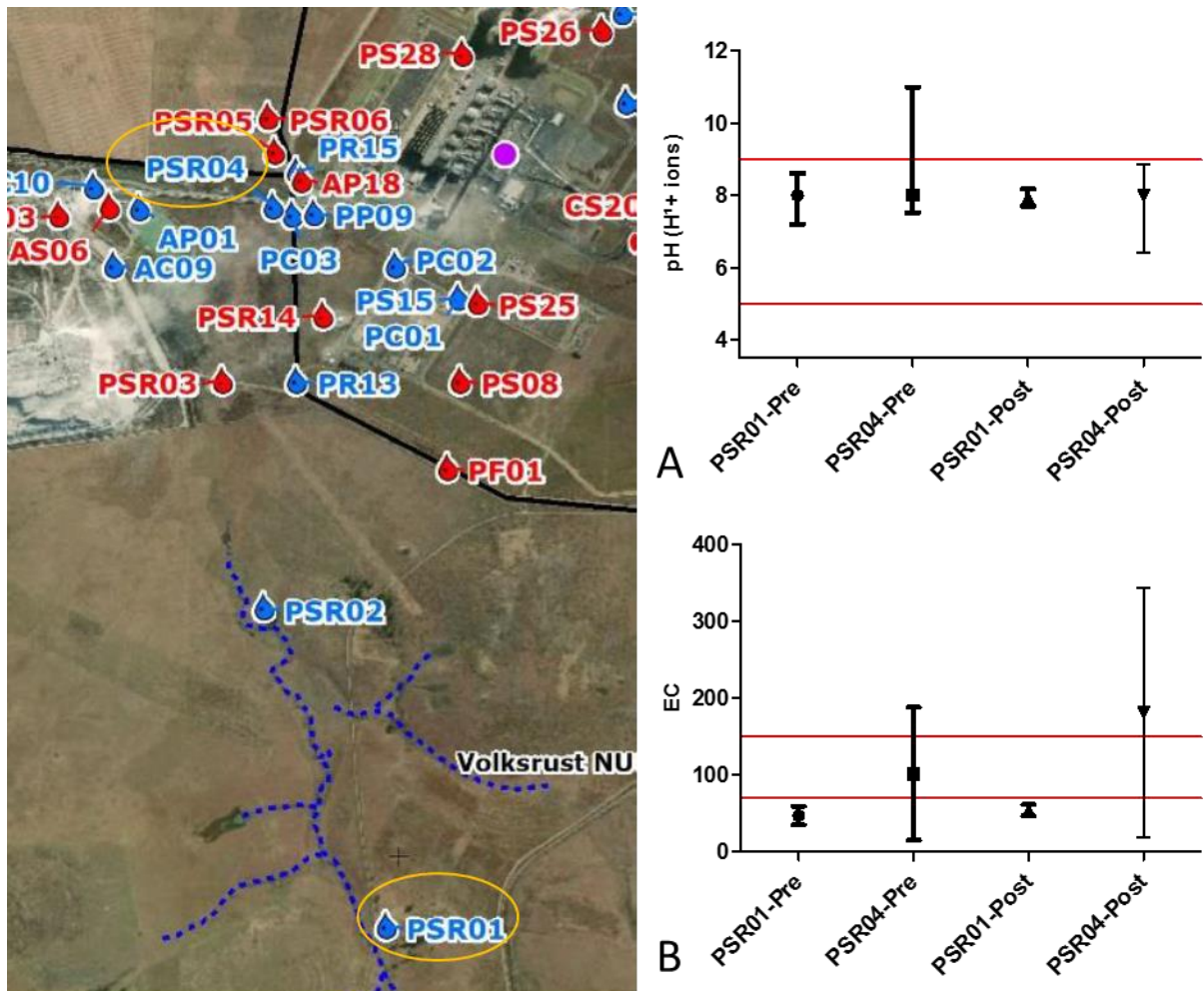


Figure 3-1: Map showing the relevant surface water quality monitoring points on the floodplain draining to the east of the ADF. Graphs showing the median with range for (A) pH and (B) EC. Site PSR01 is a control location upslope of ADF activity and site PSR04 is immediately downstream of the ADF. The postfix ‘Pre’ refers to the data range prior to the onset of ashing within the Exemption area (March 2018) and the ‘Post’ refers to the data range after ashing commenced. The red lines indicate *Ideal* thresholds for aquatic freshwater systems.

4. Impact Revision and Opinion Statement

The baseline wetland impact assessment identified the following main impacts:

1. Impact associated with the alteration in wetland hydrology due to changes in surface roughness during construction;
2. Impact on surface water quality due to construction activity;
3. Impact on wetland vegetation and disturbance of wetland habitat during construction;

4. Impact related to increase alien invasive/pioneer vegetation in areas disturbed by construction activity;
5. Impact on residual wetland functionality and associated ecosystem goods and services;
6. Hydrological impacts on downstream wetlands during operations; and
7. Impact on surface water quality during operations.

Operation activity occurs concurrently with construction activity and involves the spreading and stacking of dry ash, prepared during the construction phase. Construction activities entail removing vegetation and topsoil in the area immediately required for the advancement of the ashing facility, and preparation of the area. The ashing facility footprint is moving in a southern direction and occupies a portion of the Witbankspruit sub quaternary catchment. Surface runoff and interflow from the Exemption footprint and general ashing facility will be intercepted and directed to a pollution control facility located within a natural topographical low associated with the pan wetland (AP1).

4.1. Impact Associated with the Alteration in Wetland Hydrology During Construction and Operation

Clearing of vegetation results in decrease surface roughness and change in runoff characteristics. The residual area that will be cleared of vegetation within the Exemption area is approximately 10 ha. The natural topography of this area drains east towards a topographical low point (subsurface drains currently being installed into Portion B). The surface and soil hydrology in this area is intercepted by drains and the hydrological functioning of wetlands AS1 and AP1 will be lost. The downstream extent of hydrological alteration is very localised for the following reasons: (i) runoff from the area is naturally intercepted by the pan system. (ii) The extent of the affected local catchment accounts for less than 6% of the larger catchment associated with the receiving floodplain systems (AF2). Because of these reasons the hydrological impacts associated with an increase in runoff rates due to changes in surface roughness will be limited to the Exemption footprint and the pollution control system. Increasing the duration of ashing within the Exception area will not have an additional impact on the hydrology of the downslope receiving floodplain system.

4.2. Impact on Surface Water Quality Due to Construction Activity

The clearing of vegetation and top soil in preparation for ashing will result in increased sediment loads, as well as other pollutants derived from spillage and leakage etc. of construction machinery operating within the Exemption area during construction. The impact on water quality during construction will be relatively limited due to the following: (i) surface water will drain into the topographical low, which is the pan wetland and the downslope floodplain system is relatively well buffered. (ii) The intensity of seepage is likely to be low due to a clay gradient associated with the depression wetland. Extending the duration of construction within the existing Exemption area will not pose an additional risk to water quality of the downstream water resource.

4.3. Impact on Wetland Vegetation and Disturbance of Wetland Habitat During Construction

The completion of the sub surface drainage and pollution control system within Portion B of the Exemption area will not impact on the wetland vegetation or wetland habitat of the adjacent floodplain system, irrespective of the duration of activities within the Exemption area. Portions of the seep (AS1) and pan (AP1) wetlands will remain partially intact during the exemption period.

4.4. Impact Related to Increase of Alien/Pioneer Vegetation in Areas Disturbed by Construction Activity

Disturbances to the wetlands on site will provide opportunity for invasion by alien and invasive species. The additional spread of alien and invasive species into floodplain system and surrounding areas (to the east of the Exemption area) may impact on the ecological integrity of the receiving wetlands. However, the significance of the impact of alien and invasive encroachment due to construction activity will not increase due to the extension of the Exemption period; as the primary driver relates to the extent of soil disturbance in preparation for ashing. According to the construction method statement, vegetation and soil preparation only commences immediately prior to ashing. As such areas prepared during construction for ashing are not left for extended periods of time to allow the spread of alien and invasive species.

4.5. Impact on Residual Wetland Functionality and Associated Ecosystem Goods and Services

The wetland within the Exemption footprint represents a seasonal seep and pan system. The loss in wetland habitat, and flow maintenance will result in a decrease in ecosystem services associated with this wetland. Main functions relate to water quality and sediment control as well as some biodiversity features. Water quality and sediment control functions have been compensated for within the design and operation of the ADF. The functional integrity of the adjacent floodplain wetland is well buffered and is unlikely to be affected by increasing the duration of ashing within the Exemption area. However, the actual loss of the wetland habitat and associated biodiversity cannot be readily mitigated. This impact assessment assumes a net loss within the biodiversity functions associated with wetland AS1 and AP1. However, a review of the baseline wetland report (Ecotone, 2014) indicate a number of wetlands in and around Majuba Power Station. Nearly all of the wetlands reflect some loss in functionality. An opportunity exists, to regain some wetland goods and services through the rehabilitation of wetland units offsite from the Exemption and expansion footprint. The ecological gain associated with the implementation of this mitigation measure may not be justified solely in the context of the residual impact of ashing within the Exemption footprint. However, in the context of the cumulative loss of wetlands associated with the larger extension of the facility, a wetland rehabilitation and management plan is prudent to mitigate the net loss of wetland habitat and particularly biodiversity functions associated with these wetlands.

4.6. Impact on Surface Water Quality During Operations

Seepage or leakage of polluted water out of the ADF into adjacent wetlands may result in a deterioration of water quality within the receiving surface watercourses. The GHT (2017) pollution plume model report describes the probability of seepage as low, mainly due to the groundwater flow direction. However, contamination of surface water may also occur through wind. The extent of the pre-mitigation impact has been assessed as 'Medium' due to existing differences in surface water quality upstream and downstream of the ADF.

It is not clear what the reason is for the variation in water quality between control and test locations discussed in **Section 3.3**. However, the observed variations mostly remain within the threshold criteria for aquatic ecosystems and it is unlikely that extending the duration of ashing within the Exemption Proposed Continuous Disposal of Ash in Exemption Area

area will exacerbate surface water contamination. The completion of the subsurface drains and pollution control system and effective wind pollution control measures will mitigate an impact on water quality.

5. Summary and Conclusion

Majuba ashing operations will utilise the full 30 ha footprint of the Exemption area within the Exempted four-year period; however, would not have reached the ashing height of 80m. Portion A of the Exemption footprint is in operation while the subsurface drainage and pollution control facility are being installed on Portion B. The wetlands associated with the Exemption area include parts of a seep and a pan wetland characterised by seasonal saturation. The affected wetlands are in a compromised state with little residual functionality or conservation significance. A floodplain system immediately east of the Exemption area remains intact and well buffered from ashing activities.

Impacts to wetlands will largely be isolated to the wetlands within the Exemption footprint. Impacts will relate to water quality, hydrology, habitat loss and encroachment of alien and invasive species. During the ashing impacts will relate to potential surface water pollution. In all instances the residual significance of impacts will remain unaffected by increasing the duration of ashing with the Exemption area.

An extension of the duration of the Exemption period (to cover the residual area of Portion B and to continue ashing in both Portions A and B) does not influence the residual significance of any of the anticipated wetland impacts.

6. References

- DWAF. (2007). Comprehensive Reserve Determination for the Upper Vaal Water Management Area, South Africa.
- DWS. (2014). A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Secondary: C1. Compiled by RQIS-RDM: https://www.dwa.gov.za/iwqs/rhp/eco/peseis_model.aspx.
- Ferrar, A., & Lötter, M.C. (2007). *Mpumalanga Biodiversity Conservation Plan Handbook*. Nelspruit: Mpumalanga Tourism and Parks Agency.
- Mucina, L. & Rutherford M.C. (2006). *The Vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria, South Africa.
- Nel, J., Maree, G., Roux, D., Moolman, J., Kleynhans, N., Sieberbauer, M. & Driver, A. (2004). *South African National Spatial Biodiversity Assessment*. Technical Report, Volume 2. SANBI.
- Nel, J.L., Driver, A., Strydom, W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J., Nienaber, S., van Deventer, H., Swartz, E., & Smith-Adao, L.B. (2011). *Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources*. WRC Report No. TT 500/11.