APPENDIX B
WETLAND IMPACT ASSESSMENT REVIEW

P.O.Box 84, Florida
Roodepoort, 1710
contact@ecotone-sa.co.za
www.ecotone-sa.co.za

M +27 84 585 7479
+27 82 422 2793
T +27 11 672 1375
F 088 011 672 1375

Ecotone Freshwater
Consultants CC
CK/2008/027022/23
Vat No: 4090245574

17 July 2019

To:

Fatima Matlou

GCS Water and Environmental Consultants

63 Wessel Road

Rivonia

Tel: +27 (0) 11 803 5726

Email: fatima@gcs-sa.co.za

www.gcs-sa.co.za

TUTUKA ASH DISPOSAL FACILITY EXEMPTION AREA: SPECIALIST WETLAND IMPACT ASSESSMENT REVIEW

Tutuka ashing operations will not utilise the full 54 ha of the Exemption area within the authorised four-year period due to an underestimation of the Generation Load Factor (GLF). An approximate extent of 11 ha will remain unused after the four-year period which ends in May 2020. Eskom, through GCS Water and Environmental Consultants (GCS) requested Ecotone freshwater Consultants (Ecotone) to review the aquatic (and wetland) specialist impact assessment associated with the Tutuka Ash Disposal Facility Exemption area, as was undertaken by Ecotone in 2014 (Proposed Continuous Ash Disposal Facility at the Tutuka Power Station, Aquatic Specialist Study, Environmental Impact Assessment, May 2014).

The residual wetlands associated with the Exemption area include parts of a channelled and unchanneled valley bottom system characterised by seasonal and temporary wetness. The wetlands are Seriously modified with little residual functionality or conservation significance.

During construction (preparation activity prior to ashing) impacts will be isolated to the residual wetlands within the Exemption footprint (approximately 5 ha). Impacts will relate to water quality, hydrology, habitat loss and encroachment of alien and invasive species. During the ashing (operational phase) impacts will relate to a loss in downstream flow augmentation and potential surface water pollution. In all instances the residual significance of impacts have been assessed as 'Low' after the implementation of mitigation measures.

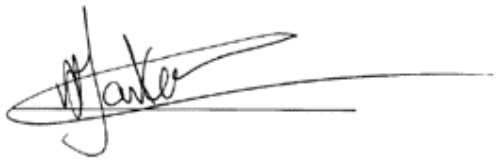
An extension of the duration of Exemption period to cover the residual area of 11 ha does not influence the residual significance of any of the anticipated impacts identified during the 2014 assessment. The affected wetlands drain a portion of the Wolwespruit catchment that is entirely intercepted by the pollution control of the existing facility. Residual functions such as water purification, flood attenuation and erosion control are thus represented within the

pollution control system. Conversely, a net loss in downstream flow augmentation and biodiversity functions have already occurred.

The net loss in flow augmentation may be mitigated through the removal of woody alien vegetation around the facility. This will contribute positively to the local water budget. Similarly, the net loss in biodiversity functions may be compensated for by improving functional integrity of degraded wetlands in close proximity to the Ash Facility through rehabilitation.

Authorised Representative

Michiel-Nell Jonker (Partner)



(MSc. Aquatic Health)
(MSc. Environmental Management)
Sacnasp Registrations 400275/12

Ash Disposal Facility: Exemption Area at the Tutuka Power Station

Specialist Wetland Impact Assessment Review

ecotone
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Prepared For:

GCS Water and Environmental Consultants
63 Wessel Road
Rivonia
Tel: +27 (0) 11 803 5726
Email: fatima@gcs-sa.co.za
www.gcs-sa.co.za

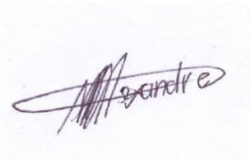
Prepared By:

Ecotone Freshwater Consultants
P.O Box 84, Florida, 1710
Tel: +27 (0) 11 672 1375
Cell: +27 84 585 7479
michiel@ecotone-sa.co.za
www.ecotone-sa.co.za

Report Authors

	Person	Qualifications	Professional Registration - SACNASP	Report Status
Report compiled by	Michiel Jonker	MSc (Aquatic health) UJ'09 MSc (Env. Man) UJ'11	*Pr. Sci. Nat*. (400275/12) Aquatic Science, Ecology & Zoology	First Draft and Review
	Marco Alexandre	MSc (Aquatic health) UJ'10	*Pr. Sci. Nat*. (400079/13) Aquatic Science & Zoology	
Members: Michiel Jonker & Marco Alexandre **Registration no:** CK 2008/027022/23				

Report Checked and Approved by



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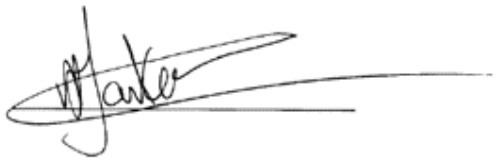
Full Name: Marco Alexandre
Title / Position: Aquatic Ecologist and Partner
Qualification(s): M.Sc. (Zoology)
Registration: *Pri. Sci. Nat.* (400079/13)



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Full Name: Michiel Jonker
Title / Position: Aquatic Ecologist and Partner
Qualification(s): M.Sc. (Aquatic Health), M.Sc. Environmental Management
Registration: *Pri. Sci. Nat.* (400275/12)

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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. 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

AEV	Acute Effect values
BDI	Biological Diatom Index
CEV	Chronic Effect values
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
GLF	Generation Load Factor
HCl	Hydrochloric Acid
HGM	Hydro-geomorphic
I	Intensity / Severity
MAP	Mean Annual Precipitation
MAPE	Mean Annual Potential Evaporation
MAR	Mean Annual Run-off
MAT	Mean Annual Temperature
Max	Maximum
MBCP	Mpumalanga Biodiversity Conservation Plan
MFD	Mean Frost Days
NFEPA	National Freshwater Ecosystem Priority Areas
Min	Minimum
NSBA	National Spatial Biodiversity Assessment
%PTV	Percentage Pollution Tolerance Valves
P	Probability
PES	Present Ecological State
S	Significance Weighting
SANBI	South African National Biodiversity Institute

SPI	Specific-Pollution Sensitivity Index
TDS	Total Dissolved Solids
TWQR	Target Water Quality Range
US	Upstream
WMA	Water Management Area

Executive Summary

Tutuka ashing operations will not utilise the full 54 ha of the Exemption area within the authorised four-year period due to an underestimation of the Generation Load Factor (GLF). An approximate extent of 11 ha will remain unused after the four-year period which ends in May 2020. Eskom, through GCS Water and Environmental Consultants (GCS) requested Ecotone freshwater Consultants (Ecotone) to review the aquatic (and wetland) specialist mpact assessment associated with the Tutuka Ash Disposal Facility Exemption area, as was undertaken by Ecotone in 2014 (Proposed Continuous Ash Disposal Facility at the Tutuka Power Station, Aquatic Specialist Study, Environmental Impact Assessment, May 2014).

The residual wetlands associated with the Exemption area include parts of a channelled and unchanneled valley bottom system characterised by seasonal and temporary wetness. The wetlands are *Seriously* modified with little residual functionality or conservation significance.

During construction (preparation activity prior to ashing) impacts will be isolated to the residual wetlands within the Exemption footprint (approximately 5 ha). Impacts will relate to water quality, hydrology, habitat loss and encroachment of alien and invasive species. During the ashing (operational phase) impacts will relate to a loss in downstream flow augmentation and potential surface water pollution. In all instances the residual significance of impacts have been assessed as 'Low' after the implementation of mitigation measures.

An extension of the duration of Exemption period to cover the residual area of 11 ha does not influence the residual significance of any of the anticipated impacts identified during the 2014 assessment. The affected wetlands drain a portion of the Wolwespruit catchment that is entirely intercepted by the pollution control of the existing facility. Residual functions such as water purification, flood attenuation and erosion control are thus represented within the pollution control system. Conversely, a net loss in downstream flow augmentation and biodiversity functions have already occurred.

The net loss in flow augmentation may be mitigated through the removal of woody alien vegetation around the facility. This will contribute positively to the local water budget. Similarly, the net loss in biodiversity functions may be compensated for by improving functional integrity of degraded wetlands in close proximity to the Ash Facility through rehabilitation.

1. Introduction

1.1. Project Background

Eskom, through GCS, requested Ecotone to review the specialist wetland impact assessment associated with the Tutuka Ash Disposal Facility Exemption area, as was undertaken by Ecotone in 2014. This area refers to a 54 ha space, exempt from installing a liner. In terms of the conditions of the authorisation, the Exemption period is valid for four years (from May 2016 to May 2020). Due to changes in the Generation Load Factor (GLF), a footprint of 11 ha will not be utilised within the exemption period. A subsequent request to the Department of Environmental Affairs (DEA) from Eskom to extend the duration of ash disposal within the same authorised footprint prompted the DEA to request a specialist revision of the Environmental Impact Assessment (EIA). This study provides the specialist wetland input into the requested EIA revision.

1.2. Aims and Objectives

The aim of this study is to revise the wetland impact assessment completed for the 54 ha exception area during 2014. This revision will include specific consideration for extending the duration of ashing within the authorised Exemption area. The revision further seeks to contextualise the implications of extending the duration of ashing within the area under Exemption, given differences between baseline wetland data (collected during 2013) and present-day conditions.

2. Method Statement

2.1. Literature Review

The following relevant reports have been reviewed:

- Proposed Continuous Ash Disposal Facility at the Tutuka Power Station, Aquatic Specialist Study (Ecotone, 2014);
- Tutuka Power Station Routine Monitoring Report Phase 49 (GHT, 2015);
- Tutuka Power Station Routine Monitoring Report Phase 50 (GHT, 2016);
- Tutuka Power Station Routine Monitoring Report Phase 51 (GHT, 2016);
- Tutuka Power Station Routine Monitoring Report Phase 52 (GHT, 2016);
- Tutuka Power Station Pollution Plume Model (GHT, 2016);
- Tutuka Power Station Hydrocensus Report (GHT, 2017).

A literature survey and desktop study on the general study area was carried out using available information from reference works (DWAF, 2002; Nel *et al*., 2004; Mucina & Rutherford, 2006; DWAF, 2007) and additional specialist studies reviewed include:

- Assessment for the proposed construction and operation of an evaporation pond at New Denmark Colliery (Golder & Associates, 2010);
- Proposed extension of the existing general waste disposal site at the Tutuka Power Station (Zitholele Consulting, 2010);
- An aquatic study associated with the proposed New Denmark Colliery weirs in the Leeuspruit (Golder & Associates, 2011); and
- Proposed brine and groundwater treatment works (Aurecon, 2010) and proposed brine evaporation expansion process (Aurecon, 2011) at Tutuka Power Station.

2.2. Project Area

The field assessment was undertaken during May 2019 to revisit wetlands located within the Exemption area. **Figure 2-2** 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 Values 1A, 2B, 3C and 4D in **Figure 2-2**.

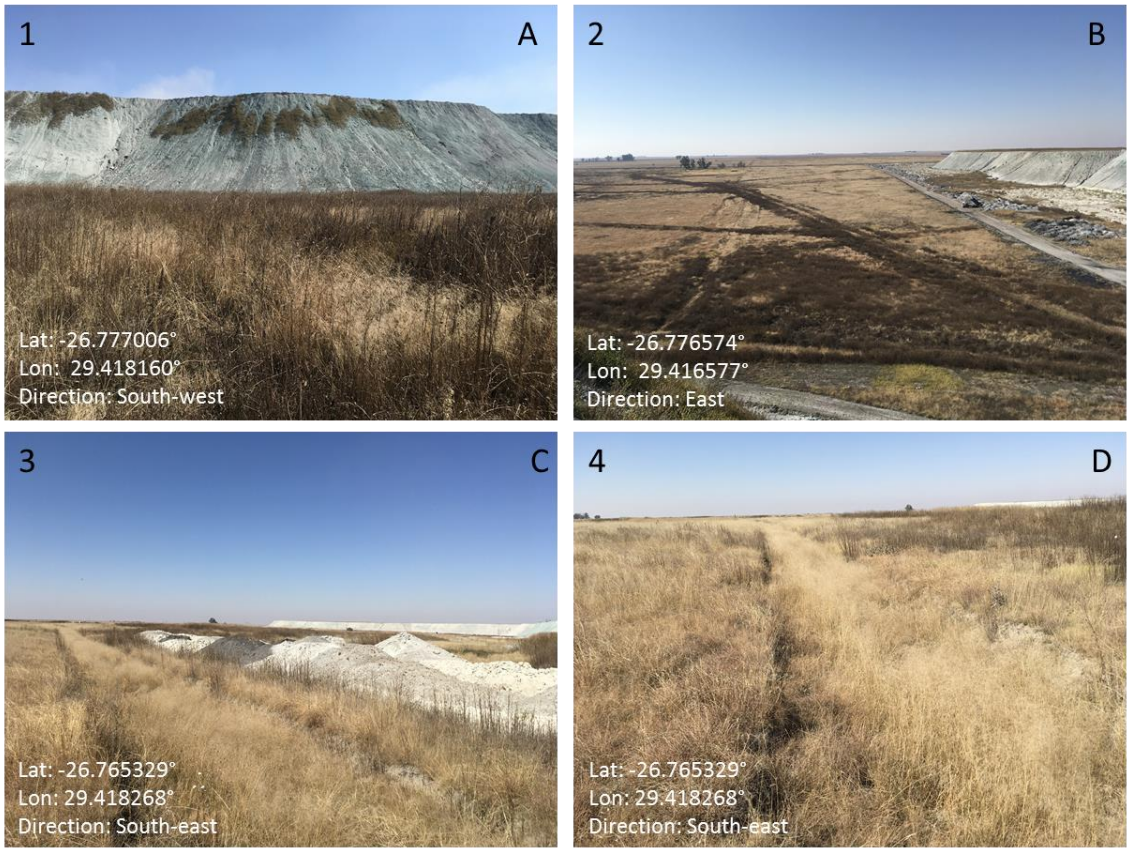

Figure 2-1: Photo plate of areas within the Exemption area.

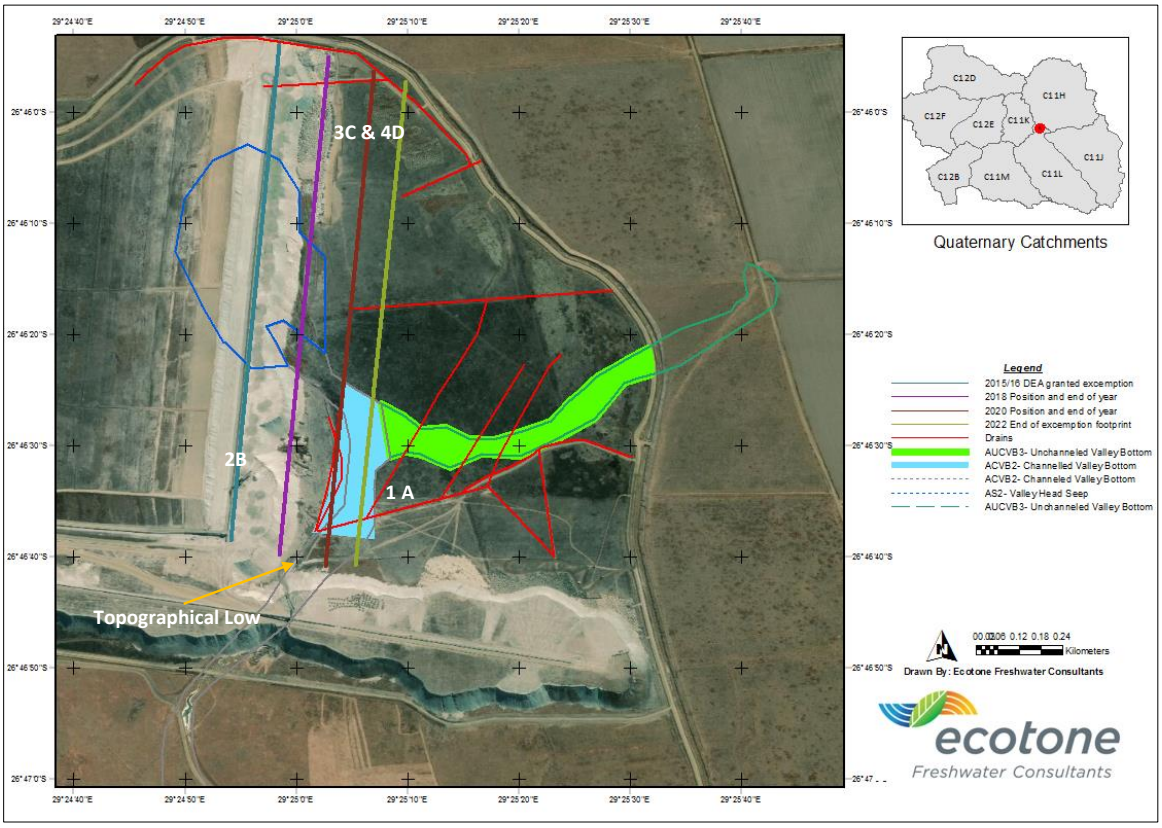

Figure 2-2: Map showing the three proposed alternatives associated with the proposed Dry Ash Disposal Facility and water quality sites (DWAF, 1995; DWAF, 2004; Nel *et al.,* 2004; SANBI, 2010; Chief Directorate – Surveys and Mapping).

2.3. Wetland Assessment

The following wetland assessment methods have been applied after the May 2019 field assessment:

- A *WET-Health* level 2 assessment was undertaken to ascertain variation in the PES between the 2013 and 2019 assessments. Wetland PES assessment was completed according to the methodology by Macfarlane *et al*. (2009);
- A WET-EcoServices level 2 assessment was used to assess the "ecological goods and services" provided by each particular HGM wetland unit. The tool provides information on the importance of a wetland in delivering different ecosystem services under a number of different categories (Kotze et al., 2009);
- Ecological Importance and Sensitivity (EIS) scores were calculated using the RDM (Kleynhans, 1999) methods.

2.4. Revision of the Impact Assessment

The same impact assessment methodology applied during the baseline assessment was used during this revision. The assessment utilised the severity and incidence approach, where severity consists of magnitude and probability, while incidence considers duration and extent.

The significance of each potential impact was calculated as follows: Significance = (E+D+M)*P, where: E = Extent, D = Duration, M = Magnitude, P = Probability. The Significance Rating was calculated by multiplying the Severity Rating with the Probability Rating. The significance rating should influence the development project as described below (**Table 2-1**).

Table 2-1: Significance rating categories showing values for Low, Medium and High significance

Significance	Rating
Low Environmental Significance	0 - 30
Medium Environmental Significance	31 – 60
High Environmental Significance	61 -100

3. Summary of Wetland Information

3.1. Desktop Information

The authorised Exemption area is located with the upper parts of the Wolwespruit catchment. The Wolwespruit drains into the Grootdraai Dam which in turn, is drained by the Vaal River. Desktop information regarding the Wolwespruit is summarised in **Table 3-1**.

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

Desktop Information	Details/Category/Class
River	Wolwespruit
River Order	1
River Length	23.2 km
Hydrological Class	Non-perennial
River Signature	Highveld 3
Conservation Status (Nel *et al.,* 2004)	Critically Endangered
C-Plan (MBCP- Ferrar & Lötter, 2007)	Ecosystem Maintenance
River NFEPA (Nel et al., 2004)	Upstream Management Area
Water Management Area	Upper Vaal
Aquatic Ecoregion	Highveld
Quaternary Catchment	C11L
Sub-Quaternary Reach Name	C11L-01825
Present Ecological State (PES- DWS 2012)	**D**
Ecological Importance and Sensitivity (EIS)	Moderate

3.2. Wetland Associated with the Exemption Area

The Exemption area occupies about 54 ha of the upper parts of the Wolwespruit catchment. Two hydrogeomorphic (HGM) units are directly affected by the footprint of this area, these include a valley head seep (AS2) and a channelled valley bottom system (ACVB2) (**Figure 2-2**). Jointly, the two HGM units represented approximately 18 ha of residual seasonal and temporary wetland extent during the 2014 baseline assessment (**Table 3-2**).

The 2014 PES assessment indicated that both units fell into an E PES, indicating a *Seriously* Modified state. The poor PES was attributed to hydrological, geomorphological and other physical disturbances. For example, a review of historical aerial images shows that the valley head seep was drained during 2009 (see red arrow in **Figure 3-2 A**). Similarly, hydrological connectivity with the upslope catchment has partially been lost pre-dating 2009 (**Figure 3-2 A**), with a further loss associated with the expansion of the cut-off trench during 2014 (**Figure 3-2 B**) and complete hydrological isolation of the wetlands affected by the expansion of the cut-off trench around the southern parts of the ash disposal facility (**Figure 3-2 E**).

A revision of the PES indicated a further loss of functional integrity from an E to an F category as assessed during May 2019. The residual wetland extent on the Exemption footprint comprised approximately 5 ha. The valley head seep (HGM AS1) and a portion of the channelled valley bottom wetland (ACVB2) have been ashed over. The examination of the historical aerial images also indicated that additional hydrological modification occurred due to the draining of an unchanneled valley bottom system flowing into HGM ACVB2 (**Figure 3-2 E**). The spatial relationship between the residual wetland ACVB2 and AUCVB3 are provided in **Figure 2-2**.

The 2014 functional ecosystem services assessment of the wetlands indicated likely functions associated with flow augmentation, water purification, erosion control and maintenance of biodiversity (**Table 3-2**). The 2019 revision reflected a lower average Eco-Services score. The decrease in ecosystem services relates to the hydrological isolation of the HGM units associated with the Exemption area and the Ash Facility at large. Similarly, the EIS category decreased from *Moderate* (important and sensitive on a local scale) during 2014 to *Low/Marginal* (not important or sensitive at any scale) during 2019 (**Table 3-2**). The decrease in EIS may be attributed to the decrease in wetland extent (direct loss of wetland habitat) and the hydrological isolation of the HGM units as part of the stormwater management and pollution control for the ash disposal area.

The 2014 assessment (*inter alia*) identified and assessed the wetlands within the footprint of the exemption area. It was expected that the residual functions associated with these wetlands will be completely compromised after ashing. The additional loss in function described in the preluding paragraphs is expected and considered within the 2014 assessment. It follows that residual wetland functions will remain (albeit constraint) until the affected wetland unit is completely ashed over. Of critical consideration is the downslope environment in relation to an extended exemption period.

Section 4 makes specific reference to the potential implications of increasing the duration of ashing within the residual Exemption area.

Table 3-2: Total wetland size within primary and secondary study area, PES totals, indirect ecosystem service scores and EIS score for Alternative A

Wetland (HGM ACVB2)	ACVB2
Residual Wetland Extent on Exemption Footprint (2014)	18 ha
Residual Wetland Extent on Exemption Footprint (2019)	5 ha
PES (2014)	**E**
PES (2019)	**E/F**
PES of receiving watercourses	**E/F**
Eco-Services Score (Average 2014)	2.16
Eco-Services Score (Average 2019)	1.50
EIS (Median 2013)	Moderate
EIS (Median 2019)	Low

3.3. Background Water Quality

Water quality monitoring data have been extracted from the relevant GHT reports. Surface water quality data relevant to the area downslope of the Ash Facility include monitoring locations WSS61, WSS32 and WSS06 (**Figure 3-1**). The 2015/2016 monitoring data for these sites are presented in **Table 3-3**. Site WSS61 were dry during this monitoring period. Site WSS32 are situated upslope of any runoff or seepage from the Ash Facility and therefore represented the control site. Site WSS06 are located further downstream on the Wolwespruit, but generally represented stagnant water.

The water quality data reviewed reflected alkaline pH values with moderately high salt loads. The September 2015 survey dot not reflect any spatial variation between the control (WSS32) and test (WSS06) sites that may suggest point source pollution from the ash disposal facility. However, the June 2016 data measured a notable increase in Calcium, Magnesium and Sulphate levels at the test site, relative to the control site (**Table 3-3**). Thus, indicating some intermittent influence on the downstream water quality from the pollution control dams.

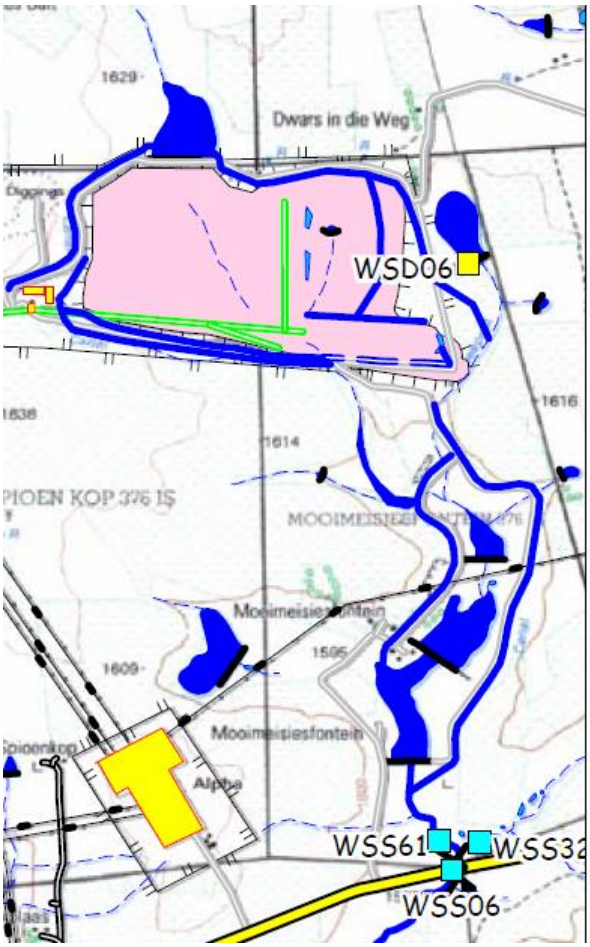

Figure 3-1: Map showing the relevant surface water quality monitoring points on the Wolwespruit (extracted from the Monitoring report- GHT, 2016).

Table 3-3: Extract of water quality monitoring data for GHT monitoring reports for surface site located on the Wolwespruit (WSS06) and upstream of the Wolwespruit confluence (WSS32)

Sites	Date	pH	EC mS/m	TDS ppm	Na mg/L	Mg mg/L	Ca mg/L	Cl mg/L	SO4 mg/L	F mg/L	K mg/L
WSS32	Sep-15	8.1	88.4	565	46.8	72.4	51.7	32.9	93.7	0.296	3.4
WSS32	Mar-16	Dry									
WSS32	Jun-16	8.2	64	506	40.3	45	36	32.4	72.5	0.3	5
WSS32	Oct-16	Dry									
WSS06	Sep-15	8.2	87.7	555	46.8	71.3	49.9	37.2	97.4	0.306	33
WSS06	Mar-16	8.7	68	430	36.3	47	48	26.5	35.7	0.4	9
WSS06	Jun-16	8.2	94	765	40.3	82	68	35.5	218.4	0.37	6
WSS06	Oct-16	8.57	131	818	80.8	111	73.4	58.4	60.5	0.523	12

Figure 3-2: Historical aerial images of the ash disposal facility showing the advancement between October 2009 and April 2019

4. Revision of the Wetland Impact Assessment

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;
7. Impact on surface water quality during operations.

The following sections provide a revision of these impacts for the construction and operation phases. In each instance the nature of the impact is described followed by an assessment of the significance before and after mitigation. Relevant mitigation measures are provided for each impact. The impact assessment considers the likely variation in significance that may result due to an extension in the duration of the approved Exemption footprint.

4.1. Construction Phase

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 an easterly direction and occupies a portion of the Wolwespruit catchment which is draining in a southern direction. Surface runoff and interflow from the Exemption footprint and general ashing facility are intercepted and directed to pollution control dams located within the natural drainage of the Wolwespruit.

The following impacts have been identified and assessed for the construction phase: (i) hydrological impacts due to changes in runoff characteristics during construction. (ii) Water quality related impacts (iii) Disturbance of wetland vegetation and loss of wetland habitat. (iv) Increase in alien, invasive and pioneer vegetation in disturbed areas during construction. (v) A loss in ecosystem goods and services due to a loss in wetland extent. The following section elaborates on each of these construction- related impacts.

4.1.1. Impact Associated with the Alteration in Wetland Hydrology due to Changes in Surface Roughness during Construction

Impact Description

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 11 ha. The natural topography of these 11 ha drains south towards a topographical low point indicated in **Figure** 2-2. The surface and soil hydrology in this area is intercepted by 'fish bone' drains (**Figure** 2-2**, Figure 3-2 E** and **F**). The downstream extent of hydrological alteration is limited for the following two reasons: (i) all runoff from the area is intercepted by the southern portion of the ash disposal facility which results in localised ponding. (ii) Runoff is temporarily retained and drained underneath the ash disposal facility in the direction of three pollution control dams (the pollution control dams are located on the Wolwespruit. (iii) The underlying soils within the Exemption area predominantly consist of vertic soils with low hydrological conductivity. It follows that the majority of the hydrological maintenance of the downstream wetlands will be through surface runoff. 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 dams.

Impact Significance Rating

For the revision of the impact assessment, the duration of the potential impact has been adjusted to accommodate a longer construction period. The resultant impact significance remains 'Low' prior mitigation (**Table 4-1**). The significance of the impact on hydrology due to changes in surface roughness during construction is assessed as 'Low' prior to mitigation.

Table 4-1: Pre- and post-mitigation significance ratings for the impact associated with hydrology due to changes in surface roughness during construction

Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)	
without mitigation	2	3	2	4	**28**	**Low**
with mitigation	1	2	2	3	**15**	**Low**

Mitigation Measures

The following mitigation measures are recommended:

- Minimize peripheral vegetation clearing to the smallest possible extent and for the smallest possible time during construction;
- Stormwater management will require draining the topographical low point associated with the Exemption area, into the downslope pollution control dams. No flows will be released from the pollution control dams that may influence the hydrology of the downstream water resources.

Mitigation measures aim to reduce the extent and duration of changes in runoff characteristics during construction. The impact can further be reduced but will remain of 'Low' significance after mitigation (**Table 4-1**).

4.1.2. Impact on Surface Water Quality Due to Construction Activity

Impact Description

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 significance of the impact is assessed as 'Low' prior to mitigation for the following reasons: (i) surface water is intercepted by the stormwater system and becomes part of the 'dirty 'water which is directed into the pollution control dams. (ii) The intensity of seepage is likely to be low due to the underlying vertic soils.

Extending the duration of construction within the existing Exemption area will not pose an additional risk to water quality of the downstream water resource.

Impact Significance Rating

The pre-mitigation impact on surface water quality during construction is assessed as 'Low' prior to mitigation (**Table 4-2**).

Table 4-2: Pre- and post-mitigation significance ratings for impacts on surface water quality due to construction activity

Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)	
without mitigation	3	2	2	4	**28**	**Low**
with mitigation	2	2	2	3	**18**	**Low**

Mitigation Measures

Embedded controls are associated with the stormwater management during construction and relate to the following:

- Interception of sediment-laden (and otherwise contaminated) runoff through stormwater management of the construction area into the existing dirty water systems;
- Discharge of contaminated runoff will occur into the pollution control facilities and or reapplied within the existing as disposal facility footprint.

Implementation of the mitigation measures will further reduce the probability of water quality related impacts within the downstream environment and the residual impact significance is assessed as 'Low' after mitigation (**Table 4-2**).

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

Impact Description

The residual wetland extent within the Exemption area is approximately 5 ha (see HGM ACVB2 in **Figure 2-2**). The associated wetland vegetation that will be cleared during construction is largely transformed either through direct disturbances, alien vegetation encroachment (for example the high abundance and cover of *Bidens Formosa*- Cosmos) or terrestrialisation due to extensive draining of the wetland (**Figure 3-2 E** and **F**).

Impact Significance Rating

The loss of wetland vegetation and associated wetland habitat is assessed as 'Medium' significance prior to mitigation during construction (**Table 4-3**). The significance of the impact is independent of an extension in the duration of the construction activities and the significance of the impact will remain the same if the construction period is increased.

Table 4-3: Pre- and post-mitigation significance ratings for the impact on wetland vegetation and disturbance during construction activity

Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)	
without mitigation	4	3	2	5	**45**	**Medium**
with mitigation	3	3	2	3	**24**	**Low**

Mitigation Measures

Limit the extent of vegetation clearing to the authorised footprint.

The mitigation measure aims to reduce the extent of vegetation clearing. The likelihood of wetland habitat loss impact to the adjacent wetland (particularly HGM AUCVB3- see **Figure 2-2**) will be further reduced. The residual significance related to impacts associated with the loss of wetland vegetation and wetland habitat is assessed is 'Low' (**Table 4-3**).

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

Impact Description

Disturbances to the wetland (HGM ACVB2) on site will provide opportunity for invasion by alien and invasive species. Species such as *Bidens formosa* (Cosmos) which are already occurring with a high abundance and cover, within and outside the HGM unit. The additional spread of alien and invasive species into wetland unit AUCVB2 (to the east of the Exemption area) may further reduce the ecological integrity of the wetlands on site. 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.

The potential impact of alien and invasive species encroachment should be contextualised in relation to the poor state of the baseline vegetation assemblages within the effected HGM units and their immediate catchments. An additional consideration is the upslope cut-off trench (**Figure 3-2 B**, **C**, **D**, **E** and **F**) that effectively isolates upslope wetlands, from the wetlands directly located within the Exemption area.

Impact Significance Rating

The impact of alien and invasive species encroachment during construction is assessed to be of 'Low' significance prior to mitigation (**Table 4-4**).

Table 4-4: Pre- and post-mitigation significance ratings for the impact related to alien vegetation encroachment

Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)	
without mitigation	2	2	2	4	**24**	**Low**
with mitigation	1	2	2	3	**15**	**Low**

Mitigation Measures

Mitigation measures to further reduce the impact of alien and invasive species encroachment include the following:

- The extent of vegetation clearing and soil preparation prior to ashing will be limited to the absolute minimum at any given moment during the construction phase. This mitigation measure will also assist erosion control and the rate at which the receiving pollution control facility silts up;
- Control the spread of alien and invasive species from disturbed areas into the neighbouring areas, through the application of an alien and invasive species monitoring programme.

The effective implementation of the mitigation measures will further reduce wetland impacts associated with alien and invasive encroachment. The post-mitigation impact is assessed as Low (**Table 4-4**).

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

Impact Description

Hydrogeomorphic unit ACVB2 reflects a residual extent of approximately 5 ha (**Figure 2-2**). The HGM represents a seasonal and temporary channelled valley bottom system. The loss in wetland habitat, and flow maintenance will result in a decrease in ecosystem services associated with this wetland. However, this wetland unit falls into an E/F PES state (**Table 3-2**) and its residual capacity to provide ecological goods and services are largely lost (see **Section 3**). Moreover, the rehabilitation potential for this wetland unit is virtually sterilised. The upslope hydrological pathways have been lost and the downslope drainage is intercepted by the ash disposal facility and directed into the pollution control system. The impact significance is assessed as 'Medium' prior to and after mitigation (**Table 4-5**).

Impact Significance Rating

Although, the duration and extent (approximately 5 ha of residual wetland extent) is relatively limited the probability of the impact is certain, subsequently resulting in a 'Medium' significance prior to and after mitigation (**Table 4-5**).

Table 4-5: Pre- and post-mitigation significance ratings for the impact of losing residual wetland functionality and associated ecosystem goods and services

Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)	
without mitigation	2	2	4	5	**40**	**Medium**
with mitigation	2	2	4	5	**40**	**Medium**

Mitigation Measures

The current direction of ashing will unavoidably sterilise HGM ACVB2 and the residual ecosystem functions, goods and services will be lost. Functionality related to erosion control, water purification and stormwater attenuation will largely be substituted through the stormwater and pollution control system. However, the actual loss of wetland habitat and associated biodiversity cannot be readily mitigated. This impact assessment assumes a net loss within the biodiversity functions associated with HGM ACVB2 and the post-mitigation impact significance remain 'Medium' (**Table 4-5**).

However, a review of the baseline wetland report (Ecotone, 2014) indicate a number of similar HGM units in and around the ash disposal facility. 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 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.

It is possible to mitigate the net loss of wetland functions associated with the Exemption area through rehabilitation of degraded wetlands around the existing and future ashing facility. The residual significance of this impact can be reduced to be of 'Low' significance.

4.2. Operational Phase

Two main wetland related impacts have been identified for the operational phase: (i) hydrological impacts on the downstream wetlands and (ii) the deterioration of downstream water quality due to leachate and runoff from the Ash Facility.

In terms of the scope of this assessment the operational impacts will not be affected by increasing the duration of ashing within the authorised Exemption area for the following reasons: (i) all drainage associated with the Exemption area is already intercepted and directed into the pollution control system and (ii) the extent of downstream water pollution is mitigated by the existing separation of clean and dirty water. Dirty water that will arise from runoff is directed into the pollution control system.

For the sake of completeness, operational impacts and associated mitigation measures are revised in the following sections with a specific reference to increasing the duration of ashing within the authorised Exemption area.

4.2.1. Hydrological Impacts on Downstream Wetlands During Operations

Impact Description

Wetland unit ACVB2 drains a catchment of approximately 250 ha. This catchment is almost completely occupied by the existing Ash Facility footprint. The north-eastern portion of this catchment remains open veld, but is earmarked for the future expansion of the Ash Facility. The catchment of HGM ACVB2 drains into Tributary 1 which drains into the Wolwespruit, which in turn flows into the Grootdraai Dam. Tributary 1 represents a subcatchment of approximately 480 ha, while the Wolwespruit drains about 10 000 ha at its confluence with the Grootdraai Dam. It follows that the proportional water contribution of the ACVB2 catchment is about 52% that of the Tributary 1 catchment and 2.5% that of the Wolwespruit catchment (at the location where it flows into the Grootdraai Dam).

All of the flows from the ACVB2 catchment is intercepted and directed into the pollution control facility, subsequently decreasing the water budget for the downstream watercourses. From the

analyses, the proposal contribution associated with the ACVB2 catchment to the downstream environment is relatively small and insignificant at the location of where the Wolwespruit flows into the Grootdraai Dam. The magnitude of the impact is further reduced due to the poor PES (E/F category) of Wolwespruit (**Table 3-1**).

Impact Significance Rating

The hydrological impact on the downstream wetlands during operations, specifically assessed in terms of the Exemption area will be of 'Low' significance prior to mitigation (**Table 4-6**). Extending the duration of the ashing within the authorised Exemption area will not influence the significance of the impact associated with hydrological changes to the downslope water resources. As all flows from this area are already intercepted and managed by the existing Ash Facility.

Table 4-6: Pre- and post-mitigation significance ratings for hydrological impact on downstream wetlands during operation

Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)	
without mitigation	1	5	0	5	**30**	**Low**
with mitigation	1	5	0	5	**30**	**Low**

Mitigation Measures

The hydrological contribution associated with HGM ACVB2 (that fall within the footprint of the Exemption area) will be lost. As a related measure the control of alien and invasive species (particularly wattle and blue gum species) around the pollution control dams will contribute positively to the local water budget. The implementation of such measures is likely to further reduce the residual significance hydrological impact to the downstream environment.

4.2.2. Impact on Surface Water Quality During Operations

Impact Description

Seepage or leakage of polluted water out of the ash disposal facility into adjacent wetlands is likely to result in a deterioration of water quality within the receiving watercourses. Decreasing water quality within the downslope environment is likely to have a deleterious effect on the biodiversity supported by these wetlands, as well as making the water less fit for use for downstream water users. Downstream water users at a local scale include farmers using the water for livestock watering and irrigation, while further downstream the water enters the Grootdraai Dam and the Vaal River.

Impact Significance Rating

The extent of the pre-mitigation impact has conservatively been assessed as 'Medium' as the pollution control dams are located within the Wolwespruit with no buffer to the downstream drainage system if spillage should occur during larger flood events (**Table 4-7**). Additional factors influencing the extent of water quality deterioration is ash deposition through wind. Wind poses the risk of mobilizing ash dust particles and depositing it into receiving watercourses.

The proportional contribution of seepage to the deterioration of water quality in the downslope wetlands are likely to be small. The pollution plume modelling (Pollution Plume Modelling- GHT, 2016) indicated that the plume will be localised, but with a southern trajectory. The localised nature of the pollution plume extent may be attributed to the following: (i) the relatively low permeability of the underlying vertic soils (ii) the embedded control associated with dry ashing, (iii) the containment and isolation of runoff into the pollution control system.

An extension of the duration of the ashing period within the authorised Exempted area will not influence the significance of downstream wetland impacts related to water quality.

Table 4-7: Pre- and post-mitigation significance ratings of water quality related impacts on downstream receiving wetlands during operation

Mitigation	Extent (E)	Duration (D)	Magnitude (M)	Probability (P)	Significance (S=(E+D+M)*P)	
without mitigation	3	5	4	5	**60**	**Medium**
with mitigation	2	2	2	3	**18**	**Low**

Mitigation Measures

Mitigation measures aim to reduce the extent, duration, magnitude and probability of water pollution through the following measures:

- Contaminated runoff will be intercepted and isolated from the downstream drainage;
- Surface water quality monitoring for sites WSS61, WSS32 and WSS06 (refer to Routine Monitoring Report- GHT 2016) will continue. These monitoring points are located downstream of pollution control dams on the Wolwespruit;
- The continuation of proper management of the dirty / clean water separation system south and east of the Ash Facility is critical to control water pollution along the natural drainage system of the Wolwespruit;
- Effective suppression of dust during operations will further reduce the extent of surface water pollution through wind.

The implementation of effective dirty water separation and containment through the pollution control system and effective dust control in conjunction with surface water monitoring along the Wolwespruit will reduce the residual impact of water quality deterioration to 'Low' during operation (**Table 4-7**).

5. Summary and Conclusion

Tutuka ashing operations will not utilise the full 54 ha of the Exemption area within the Exempted four-year period due to a reduction in GLF which happened after acquisition of the Exemption approval. An approximate area to the extent of 11 ha will remain unused after the four-year period, which ends in May 2020. The residual wetlands associated with the Exemption area include parts of a channelled and unchanneled valley bottom system characterised by seasonal and temporary wetness. The wetlands are *Seriously* modified with little residual functionality or conservation significance.

During construction (preparation activity prior to ashing) impacts will largely be isolated to the residual wetlands within the Exemption footprint (approximately 5 ha). Impacts will relate to water quality, hydrology, habitat loss and encroachment of alien and invasive species. During the ashing (operational phase) impacts will relate to a loss in downstream flow augmentation and potential surface water pollution. In all instances the residual significance of impacts have been assessed as 'Low' the implementation of mitigation measures.

An extension of the duration of Exemption period to cover the residual area of 11 ha does not influence the residual significance of any of the anticipated impacts identified during the 2014 assessment. The affected wetlands drain a portion of the Wolwespruit catchment that is entirely intercepted by the pollution control of the existing facility. Residual functions such as water purification, flood attenuation and erosion control are thus represented within the pollution control system. Conversely, a net loss in downstream flow augmentation and biodiversity functions have already occurred.

The net loss in flow augmentation may be mitigated through the removal of woody alien vegetation around the facility. This will contribute positively to the local water budget. Similarly, the net loss in biodiversity functions may be compensated for by improving functional integrity of degraded wetlands in close proximity to the Ash Facility.

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