Appendix J: Surface Water (Wetlands)

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/
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Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED CONTINUOUS ASH DISPOSAL FACILITY FOR THE MATIMBAPOWER STATION IN LEPHALALE, LIMPOPO PROVINCE

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4.2 The specialist appointed in terms of the Regulations_

I, Paul da Cruz, declare that --

General declaration:

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

[signature]

Signature of the specialist:

Royal HaskoningDHV

Name of company (if applicable):

14.04.16

Date:

Proposed Continuous Ash Disposal Facility for the Matimba Power Station, Limpopo Province EIR Phase Surface Water Impact Assessment Study

Eskom Holdings SOC Ltd

July 2014 revised June 2015

Eskom

Royal HaskoningDHV
Enhancing Society Together

DOCUMENT DESCRIPTION

Client:

Eskom Holdings SOC Ltd

Project Name:

Proposed Continuous Ash Disposal Facility for the Matimba Power Station, Limpopo Province - EIR Phase Surface Water Impact Assessment Study

Royal HaskoningDHV Reference Number:

E02.JNB.001222

Compiled by:

Paul da Cruz

Date:

July 2014 revised June 2015

Location:

Woodmead

Approval: Bronwen Griffiths (PrSciNat – Environmental Science – 400169/11)

Signature

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Glossary of Terms

Alluvial Material / deposits	Sedimentary deposits resulting from the action of rivers, including those deposited within river channels, floodplains, etc.
Anaerobic	The absence of molecular oxygen
Anthropogenic	Originating in human activity
Baseflow	The component of river flow that is sustained from groundwater sources rather than from surface water runoff
Catena	A repeated sequence of soil profiles that is related to relief features, indicating the same sequence when traced from the crest (interfluve) to the valley floor. Profiles change in character as one moves downslope (change in slope angle and drainage conditions), so that different degrees of leaching / translocation are encountered
Clast	An individual part or single constituent of a sedimentary rock, produced by the physical disintegration of a larger mass.
Colluvial	Relating to gravitational forces that result in the transport and deposition of soil and / or rock fragments down hillslopes to the base of the slope
Deflational	Relating to deflation – the process by which wind removes dry, unconsolidated silt and clay from land surfaces, especially in arid and semi-arid climatic regions – essentially wind-borne erosion
Deflocculate	A soil science term referring to the break up or dispersion of an aggregate through physical or chemical means
Drainage Density	A measure of the texture of a drainage system, expressed as the ratio of the total length of all stream channels within a catchment to the area of that catchment
Duplex Soil	A soil characterised by a relatively permeable upper (topsoil) horizon overlying a much more impermeable subsoil horizon
Ecotone	A narrow and relatively sharply defined transition zone between two different ecological communities. Ecotones are typically species rich.
Endorheic	A term given to an inward oriented pattern of drainage that is not connected to a wider drainage system
Episodic	Relating to rivers and drainage lines typically located within arid or semi-arid environments that only carry flow in response to isolated rainfall events
Eutrophication	The process of nutrient enrichment (usually by nitrates and phosphates) in aquatic ecosystems, such that the productivity of the system ceases to be limited in terms of the availability of nutrients; often results in algal blooms and is often a result of anthropogenic factors
Facultative	Occurring optionally in response to circumstances rather than by nature; applied to wetland plants in this context – a facultative species is a species usually found in wetlands, but occasionally found in non-wetland areas
Gleying	The process by which a material (soil) has been or is becoming subject to intense reduction as a result of prolonged saturation by water. Gleyed soils are characterised by grey (due to an absence of iron compounds), blue and green colours (due to an absence of ferrous compounds)
Herbaceous	A plant having little or no woody tissue and persisting usually for a single growing season
Hydric / Hydromorphic Soils	Soils formed under conditions of saturation, flooding or ponding for sufficient periods of time for the development of anaerobic conditions and thus favouring the growth of hydrophytic vegetation
Hydrology	The scientific study of the distribution and properties of water on the earth's surface

Hydromorphy	A process of gleying and mottling resulting from intermittent or permanent presence of free water in soil. Results in hydromorphic soils
Hydroperiod	The term hydroperiod describes the different variations in water input and output that form a wetland, characterising its ecology – i.e. the water balance of the wetland
Hydrophyte	A plant that grows in water or in conditions that are at least periodically deficient in oxygen as a result of saturation by water – these are typically wetland plants
Illuviation	The movement of soil material (soluble or insoluble) downwards into an underlying soil layer which has been removed by the action of percolating water
Intertropical Convergence Zone (ITCZ)	An area where the Northern and Southern Hemispheric trade winds converge, usually located between 10 degrees North and South of the equator. It is a broad area of low pressure where both the Coriolis force and the low-level pressure gradient are weak, occasionally allowing tropical disturbances to form. It fluctuates in location, following the sun's rays, so that during the Southern Hemisphere summer, the ITCZ moves southward over southern Africa
Marginal	Plants and habitat on the edge of waterbodies
Mesic	Relating to an environment or habitat containing a moderate amount of moisture, as opposed to xeric (arid) or hydric environments
Obligate	A species that almost always occurs in wetlands
Pedogenic	Relating to pedogenesis, the process of soil formation
Perched water table	A water table caused by the presence of water above an isolated relatively impermeable underlying layer, some height above the normal aquifer level
Reach	A portion / stretch of a river
Redoximorphic	Features within soil that are a result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic
Riparian Zone	The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas
Sweetveld	Veld (i.e. grassland or savannah) characterised by a relatively low amount of rainfall which allows nutrients to be retained in the soil, thus making grasses palatable to herbivores year round as they retain their nutritive status. This is contrasted with sourveld, found in higher rainfall areas in which nutrients are leached out of the soil resulting in grasses being less palatable outside of the growing season
Understorey	The part of the forest / woodland which grows at the lowest height level below the canopy
Wrack	Debris deposited by floods / spate flows

Acronyms

amsl – above mean sea level

DWA – Department of Water Affairs

EIA – Environmental Impact Assessment

EIR – Environmental Impact Assessment Report

HGM – Hydrogeomorphic

ITCZ – Intertropical Convergence Zone

VEGRAI – Riparian Vegetation Response Assessment Index

Specialist Declaration

I, **Paul da Cruz**, declare that I –

- act as a specialist consultant in the field of surface water assessment
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have 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 Environmental Impact Assessment Regulations, 2010; and
- will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.

PAUL DA CRUZ

1 INTRODUCTION

Eskom Holdings SOC Ltd. appointed **Royal HaskoningDHV** (RHDHV) to undertake an EIA study for the **proposed continuous ash disposal facility for the Matimba Power Station** in Lephalale, Limpopo Province.

One of the most important components of the biophysical environment in the study area is surface water features that would potentially be adversely affected or impacted by the proposed project. Surface water features (including wetlands and rivers) are a very important component of the natural environment, as they are typically characterised by high levels of biodiversity and are critical for the sustaining of human livelihoods through the provision of water for drinking and other human uses. As such surface water features are specifically protected under the National Water Act, 1998 (Act No. 36 of 1998) and generally under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (as amended). It is in this context that the potential impact of the proposed development on surface water features is being assessed.

A surface water screening study was undertaken in the scoping phase of the project in order to determine the nature and level of risk to surface water features posed by the expansion of the Matimba Power Station Ash disposal Facility. The screening facility identified surface water features within the footprint of both alternative sites proposed for the expansion of the Ash disposal facility, hence it was determined that a more detailed surface water study would need to be undertaken in the EIR-phase (impact phase) of the EIA. This report presents the findings of the assessment.

1.1 Aims of the Study

The aims of the study are to:

- characterise the surface water features on the alternative sites of the proposed development in terms of their hydrological, hydromorphological and vegetative characteristics
- delineate all riparian zones on the alternative sites of the proposed development
- assess the impacts of the proposed development on these surface water features, and suggest suitable mitigation measures, if relevant, to ameliorate or remove these predicted impacts

1.2 Assumptions and Limitations

Only surface water features within the footprint of the alternative sites and immediate surrounds were assessed in the field as part of this study; the study does not include an assessment of the wider catchments within which the surface water resources on the sites are located, although potential downstream impacts have been taken into account.

The VEGRAI methodology has been partly applied in this study as the drainage lines on both of the alternative sites differ in terms of their hydrology and morphology from typical fluvial environments that are defined by a central channel. Conversely the drainage systems in the study area are amorphous in terms of channel structure, with a significant component of the hydrological inputs into these systems are believed to be subterranean. It was thus difficult for certain aspects of the VEGRAI template to be applied to the drainage lines. Nonetheless the VEGRAI template was applied where possible.

It should be noted that a worst-case scenario has been investigated in the context of assessment of impacts in this report. It is recognised that such a worst-case scenario may not necessarily materialise, however in the interests of risk aversion, and without more detailed design information, the worst-case scenario has been assumed.

1.3 Definition of Surface Water Features, Wetlands, Hydric Soils and Riparian Zones

1.3.1 Surface Water Features

In order to set out a framework in which to assess surface water features, it is useful to set out what this report defines as surface water resources. In this context the National Water Act is used as a guideline. The Act includes a number of features under the definition of water resources, i.e. watercourses, surface waters, estuaries and aquifers. The latter two do not apply in the context of this study as estuaries are marine features and this report does not consider groundwater, thus surface waters and water courses are applicable in this context. The Act defines a watercourse as (inter alia):

- a river or spring;
- **a natural channel in which water flows regularly or intermittently;**
- a wetland, lake or dam into which, or from which, water flows

The definition of a water course as used in the Act is taken to describe surface water features in this report. It is important to note that the Act makes it clear that **reference to a watercourse includes, where relevant, its bed and banks**. This is important in this report, as the riparian habitat associated with most linear drainage features in the study area have been included as an important part of surface water features and are thus given consideration in this report.

It is equally important to note that the Act does not discriminate on the basis of being perennial, and any natural channel, however ephemeral, is included within the ambit of water resources. This definition is applied in this report.

In the context of the section below, not all surface water features are wetlands. In fact in the context of the study area, ‘true wetlands’ as defined in this report are scarce due to the arid nature of the study area and its associated hydrological characteristics.

1.3.2 Wetlands

The National Water Act defines a wetland as:

"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

This definition alludes to a number of physical characteristics of wetlands, including wetland hydrology, vegetation and soil. The reference to saturated soil is very important, as this is the most important factor by which wetlands are defined.

Another widely used definition of wetlands is the one used under the Ramsar Convention; wetlands are defined as:

"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres"

However the presence / absence of hydric soils is the primary determining factor used to define a surface water feature as a wetland. Wetland soils can be termed hydric or hydromorphic soils. Hydric soils are defined by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) as being "soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part". These anaerobic conditions would typically support the growth of hydromorphic vegetation (vegetation adapted to grow in soils that are saturated and starved of oxygen) and are typified by the presence of redoximorphic features. The presence of hydric (wetland) soils on the site of a proposed development is significant, as the alteration or destruction of these areas, or development within a certain radius of these areas would require authorisation in terms of the National Water Act (36 of 1998) and in terms of the Environmental Impact Assessment Regulations promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998).

1.3.3 Riparian Habitat and Riparian Zones

The National Water Act defines riparian habitat as:

"the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas"

As detailed in the then Department of Water Affairs and Forestry (DWAF, now DWA) 2005 guidelines for the delineation of wetlands and riparian areas, riparian areas have typically perform important ecological and hydrological functions, some of which are the same as those performed by wetlands. It is thus important that both wetlands and riparian areas be taken into consideration when making mandatory management decisions affecting water resources and biodiversity (DWAF, 2005).

Riparian areas include plant communities adjacent to and affected by surface and underground water features such as rivers, streams, lakes, or drainage lines. It is important to note that these areas may be a few metres wide along smaller systems or more than a kilometre in floodplains. Both perennial and non-perennial streams support riparian vegetation (DWAF, 2005).

Because riparian areas represent the interface between aquatic and upland ecosystems, the vegetation in the riparian area may have characteristics of both aquatic and upland habitats. Many of the plants in the riparian area require plenty of water and are adapted to shallow water table conditions. Due to water availability and rich alluvial soils, riparian areas are usually very productive. Tree growth rate is high. This is certainly the case in riparian zones in the study area as they typically contain trees and shrubs of a height, density and species diversity that is not present in the surrounding woodland.

Riparian areas are important as they perform the following functions (DWAF, 2005):

- storing water and thus assisting to reduce floods
- stabilising stream banks
- improving water quality by trapping sediment and nutrients;
- maintaining natural water temperature for aquatic species;
- providing shelter and food for birds and other animals;
- providing corridors for movement and migration of different species;
- acting as a buffer between aquatic ecosystems and adjacent land uses;
- can be used as recreational sites; and
- providing material for building, muti, crafts and curios.

These ecosystems may be considered 'critical transition zones' as they process substantial fluxes of materials from closely connected, adjacent ecosystems (Ewel et al, 2001)

As discussed below riparian habitat is important from a legislative perspective – in terms of the National Water Act. Section 3.3 of this document should also be referred to for a synopsis of the VEGRAI (Riparian Area Characterisation and Assessment) Template

1.4 Legislative Context

The following section briefly examines the legislation that is relevant to the scope of the surface water assessment. The stipulations / contents of the legislation and policy that is relevant to the study are explored.

1.4.1 The National Water Act

It is important to note that water resources, including wetlands are protected under the National Water Act (Act No. 36 of 1998) (NWA). 'Protection' of a water resource, as defined in the Act entails:

- Maintenance of the quality of the quality of the water resource to the extent that the water use may be used in a sustainable way;
- Prevention of degradation of the water resource

- The rehabilitation of the water resource

In the context of the current study and the identification of potential threats to the surface water features posed by the proposed expansion of the Ash disposal Facility, the definition of pollution and pollution prevention contained within the Act is relevant. ‘Pollution’, as described by the Act is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (inter alia)-

- less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.

The inclusion of physical properties of a water resource within the definition of pollution entails that any physical alterations to a water body, for example the excavation of a wetland or changes to the morphology of a water body can be considered to be pollution. Activities which cause alteration of the biological properties of a watercourse, i.e. the fauna and flora contained within that watercourse are also considered pollution.

In terms of section 19 of the Act owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include measures to (inter alia):

- cease, modify, or control any act or process causing the pollution
- comply with any prescribed waste standard or management practice
- contain or prevent the movement of pollutants
- remedy the effects of the pollution; and
- remedy the effects of any disturbance to the bed and banks of a watercourse

These general stipulations of the Act have ramifications for the proposed development as impacts on surface water associated with the proposed development would be relevant in terms of the above sections.

1.4.1.1 The National Water Act and Riparian Areas

Riparian habitat is afforded protection under the National Water Act in a number of ways.

Firstly reference in the National Water Act to a watercourse includes its banks, on which riparian habitat is encountered. Riparian areas are thus afforded the same degree of protection as the river beds and channels alongside which they occur.

Riparian habitat is also important in the context of resource quality objectives that are a critical part of the Act. In terms of Section 13(1) of the Act resource quality objectives must be determined for every significant water resource, and are central part of data type specifications relating to national monitoring systems and national information systems as determined in Section 137(2) and Section 139(2) of the Act respectively. Under Section 27 of the Act resource quality objectives must be taken into account in the issuing of any licence or general authorisation, and form a critical part of the duties of catchment management agencies. The purpose of resource quality objectives in the Act is to establish clear goals relating to the quality of the water resources. Resource quality is important in the context of riparian habitat as resource quality as defined in the Act means the quality of all aspects of a water resource and **includes the character and condition of the riparian habitat**. In terms of Section 26(4) of the Act, the need for the conservation and protection of riparian habitat must be taken into account in the determination and promulgation of regulations under the Act.

The above stipulations of the Act have implications for the proposed development; as identified further on in this report the proposed development may be associated with certain direct or indirect impacts on surface water features in the area, some of which may affect the physical characteristics of the feature. The activities that result in these impacts are likely to be needed to be licensed under the Act. The National Water Act also stipulates requirements for permitting which would need to be followed.

1.4.1.2 Government Notice 1199 - implications regarding Section 21c) and i) Water Uses

Government Notice (GN) 1199 was published in Government Gazette 32805 of 2009 and replaced GN 398 of March 2004 as it pertains to water uses under Sections 21 c)&i) of the NWA. This notice has important implications in terms of the definition and associated conditions for the altering of the bed, banks, course or characteristics of a watercourse (a water use under Section 21i) of the Act), and thus needs to be considered in the context of any development that would potentially cause lead to the Section 21i) occurring.

It is important to note that as specified by the Notice, the definition of “altering the bed, banks, course or characteristics of a watercourse" means any change affecting the ***resource quality within the riparian habitat*** or 1:100 year flood line, whichever is the greater distance…;

A number of **conditions of the notice** are important in the context of the current study:

- The water use must not cause a potential, measurable or cumulative detrimental impact on the characteristics of a watercourse.

- Structures and hardened surfaces associated with the water use must not (inter alia) be erosive.

- The water use must not result in a potential, measurable or cumulative detrimental –
  a) change in the stability of a watercourse;
  b) change in the physical structure of a watercourse;
  c) scouring, erosion or sedimentation of a watercourse; or
  d) decline in the diversity of communities and composition of the natural, endemic vegetation

- The water use must not result in a potential, measurable or cumulative detrimental change in the water quality characteristics of the watercourse.

- The water use must not result in a potential, measurable or cumulative detrimental change on the –
  a) breeding, feeding and movement patterns of aquatic biota, including migratory species;
  b) level of composition and diversity of biotopes and communities of animals and microorganisms or;
  c) condition of the aquatic biota.

- Upon completion of the water use –
  a) a systematic rehabilitation programme must be undertaken to restore the watercourse to its condition prior to the commencement of the water use;
  b) all disturbed areas must be re-vegetated with indigenous vegetation suitable to the area; and
  c) an active campaign for controlling new exotic and alien vegetation must be implemented within a disturbed area.

This notice and its associated conditions have important implications for the proposed development, as a physical impact to the riparian zones of rivers crossed is likely to eventuate due to the clearing of all vegetation from the riparian zones within the 8m-wide strip along the power line centre line, and due to the selective trimming of other indigenous vegetation within the servitude area (refer to Table 1 in section 2.1.2.2 below). These activities could have an impact (albeit localised) on the resource quality of affected riparian habitat, thus the need to undertake a

General Authorisation process under GN 1199 of the NWA would apply. It is also important to note that the GN does not apply to the use of water in terms of section 21 (c) and (i) **within a 500 metre radius from the boundary of any wetland**. As explored further in section 4 below, wetlands have been identified in the area, and thus a full Water Use Licence process rather than a general authorisation process may apply to certain parts of the route. The DWS would need to be consulted in this regard.

1.4.2 National Forest Act (Act No 84 of 1998)

This Act provides *"for the protection, management and utilisation of forests; the protection of certain plant and animal life; the regulation of trade in forest produce; the prevention and combating of veld, forest and mountain fires; the control and management of a national hiking way system and National Botanic Gardens; and matters connected herewith."*

The Act enforces the necessity for a permit to be obtained prior to any clearing of indigenous vegetation. The Act also provides a list of protected tree species. This list was promulgated in 1976 and has since been updated. This act has relevance to the proposed project in relation to surface water features, as many of the protected trees that may be affected by the proposed project occur within the riparian zone and even in the bed of many of the surface water features crossed. If tree / shrub specimens of these species potentially need to felled or cut back, then a permit for this activity will need to be acquired from the Department of Agriculture, Fisheries and Forestry (DAFF).

It should be noted that in the case of any protected plant species located along any of the surface water features on the site being needed to be felled or cleared, the stipulations of this Act would apply.

2 PROJECT DESCRIPTION

2.1 Project Technical Description

2.1.1 Need and Background

The Matimba Power Station, located in the Limpopo Province close to Lephalale (Ellisras), is a 3990MW installed capacity base load coal fired power station, consisting of six (6) units. Matimba is a direct dry cooling power station, an innovation necessitated by the severe shortage of water in the area where it is situated. The station obtains its coal from the Exxaro Grootegeluk Colliery for the generation of electricity.

Ash is generated as a by-product from combustion of coal from the power station and Matimba produces approximately 4.8 million tons of ash annually. This ash is currently being disposed by means of 'dry ashing' approximately three kilometres (3km) south of the existing power station on the Eskom owned Farm Zwartwater 507 LQ.

Matimba Power Station envisages the continuation of ash disposal via dry ashing and therefore, Eskom requires the licensing of its proposed continuous ash disposal facility in terms of the National Environmental Management Waste Act (NEM:WA) (Act No. 59 of 2008), the National Water Act (Act No. 38 of 1998) and the EIA Regulations (2010) promulgated under the National Environmental Management Act (NEMA) (Act No. 107 of 1998) (NEMA) (as amended).

Eskom proposes the continuous ash disposal facility to continue from the existing ash facility on Farm Zwartwater 507 LQ. The proposed continuous development is an ash disposal facility site with the following specifications:

- Capacity of airspace of 297 million m^3 (remaining); and
- Ground footprint of 651 hectares (Ha) (Remaining fenced area including pollution control dams).
- This ash disposal facility will be able to accommodate the ash disposal requirements of the power station for the next 44 years, from 2012 to 2055.

However, the EIA process requires the investigation of alternatives and as such an eight kilometre (8km) radius has been delineated from the Matimba Power Station (source of the ash) to identify any potential alternative sites. It is within this 8km radius that a technically feasible and environmentally least sensitive site has been identified, resulting in two alternative sites to be assessed in the EIR phase.

2.2 Site Location and Description

The Study Area is located within the area to the north-west of Lephalale town in the north-western part of the Limpopo Province. The Matimba Power Station is located to the north-west of the town, with the closest part of the town being the Onverwacht suburb. In addition to the Matimba Power Station and its associated ash disposal facility which have a large physical footprint, the Medupi Power Station is currently being constructed to the west of the Matimba Power Station. The Grootegeluk coal mine is located immediately to the north of the Matimba power station. Thus large parts of the area surrounding the ash disposal facility are highly industrialised. Apart from the rapidly-expanding housing areas in Onverwacht and the settlement of Marapong to the east of the Matimba Power Station, there are some undeveloped properties to the south and west of the existing ash disposal facility that are used for either cattle farming or game farming. The area to the north of Marapong and the Grootgeluk Mine is more rural and consists of cattle and game farms as well as the Manketti Nature Reserve (owned by Exarro Coal) .The study area thus has a mix of urban, industrial and rural land uses.

Topographically the area is relatively flat around the Onverwacht / Matimba power station area. This marks a change from the area to the south where much more hilly and incised topography – forming part of the Waterberg foothills – exists. The change in topography is mirrored by the underlying geology as discussed below. The flat nature of the topography has an influence on surface drainage, with drainage being relatively poorly defined in these very flat areas, as explored below.

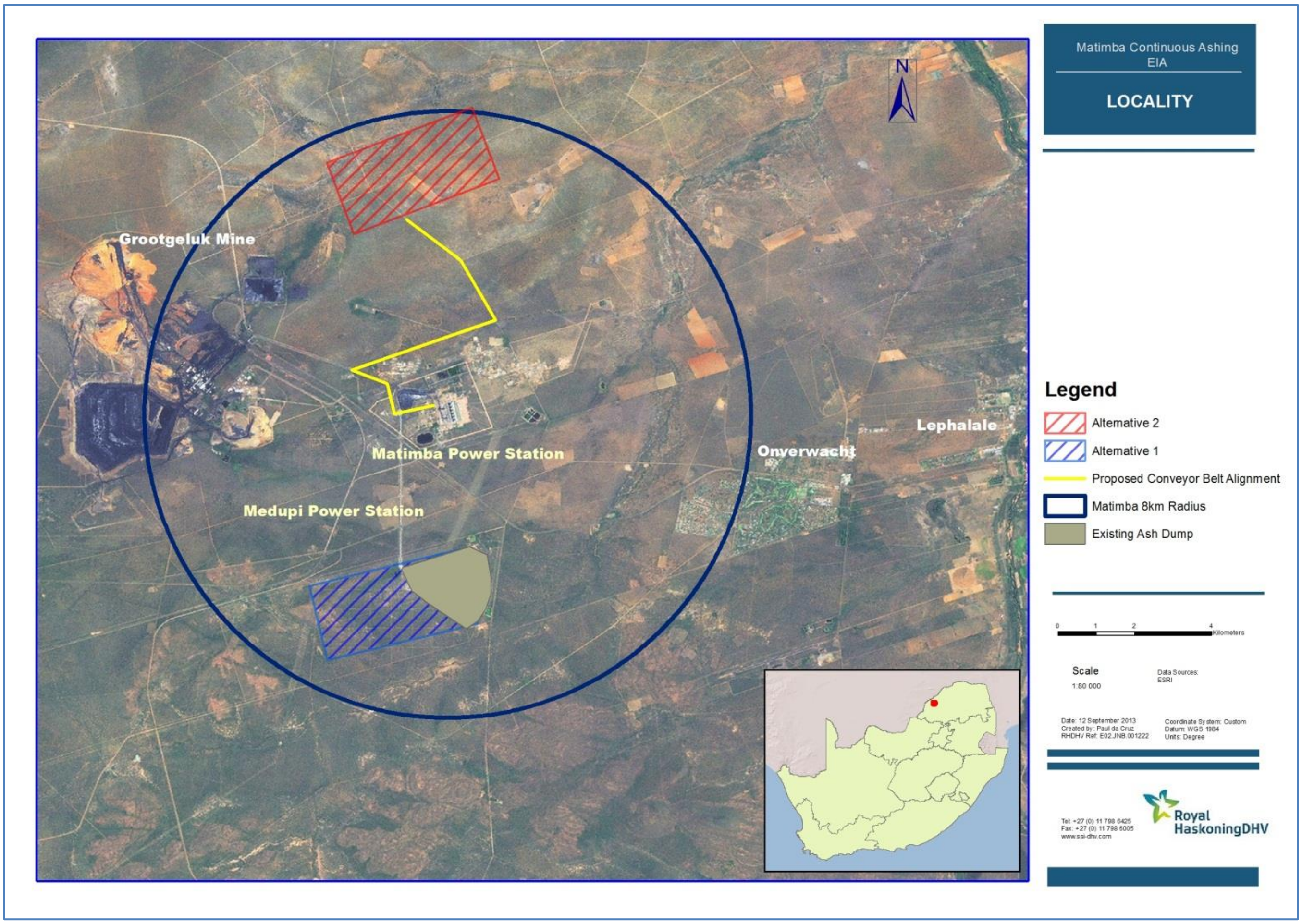

Figure 1 – Study Area Map showing the two alternative sites for the Ash Dump expansion

3 METHODOLOGY FOR ASSESSMENT

3.1 Preliminary Desktop Delineation

Prior to the site assessment, a preliminary desktop-based delineation of surface water features on the two alternative sites was undertaken to identify the parts of the sites which would need to be assessed in the field. The desktop delineation was undertaken using colour satellite imagery. A shapefile of riparian zones associated with the ephemeral drainage lines on the site was created.

3.2 Field Assessment and Riparian Zone Delineation

The two primary drainage lines on each of the sites were visited in the field in order to characterise their riparian zones associated. The riparian zones were traversed on foot in order to gain a sufficient understanding of the physical characteristics of these features and to acquire a good understanding of the profile of the riparian zone and to characterise it in terms of its physical and vegetative components, thus allowing the riparian zone to be delineated in the field.

Use was made of a GPS to identify important points (e.g. boundaries between different vegetation units). These GPS points were converted into a GIS shapefile to allow these points to be mapped and to facilitate the delineation of the riparian boundaries.

Notes were taken regarding the predominant type of vegetation present within different parts of these riparian areas.

Riparian zone delineation was based upon the 2005 DWA(F) guidelines for the delineation of wetlands and riparian zones, with riparian assessment being guided by the VEGRAI template (see section 3.3 below). The guideline specifies that quantitative indicators for the delineation of riparian areas have not yet been developed, and that determining the boundary of riparian areas therefore relies heavily on professional judgement. The guideline specifies the use of three (3) key indicators:

- topography associated with the watercourse
- vegetation
- alluvial soils and deposited material

3.3 Riparian Area characterisation and assessment template

This section briefly introduces riparian zones in terms of the hydromorphological and vegetation classification as per the VEGRAI (Riparian Vegetation Response Assessment Index) assessment methodology (Kleynhans et al, 2007), which has been used to classify riparian zones in this report.

In terms of the VEGRAI structure, riparian areas are divided up into three (3) vegetation zones:

- Marginal Zone
- Lower Zone
- Upper Zone

This vegetation zone classification has been based upon:

- periodicity of hydrological influence
- marked changes in lateral elevation or moisture gradients
- changes in geomorphic structure
- changes in plant species distribution or community composition along lateral gradients

In spite of these zones being vegetative, they are also distinguished based on a combination of other factors including geomorphic structure and elevation along with vegetation. Elevation within the riparian zone is used as a surrogate for hydrological activation, which is taken to be moistening or inundation of the substrate by water in the channel. Figure 2 below (from Kleynhans *et al*, 2007) indicates a typical riparian zone:

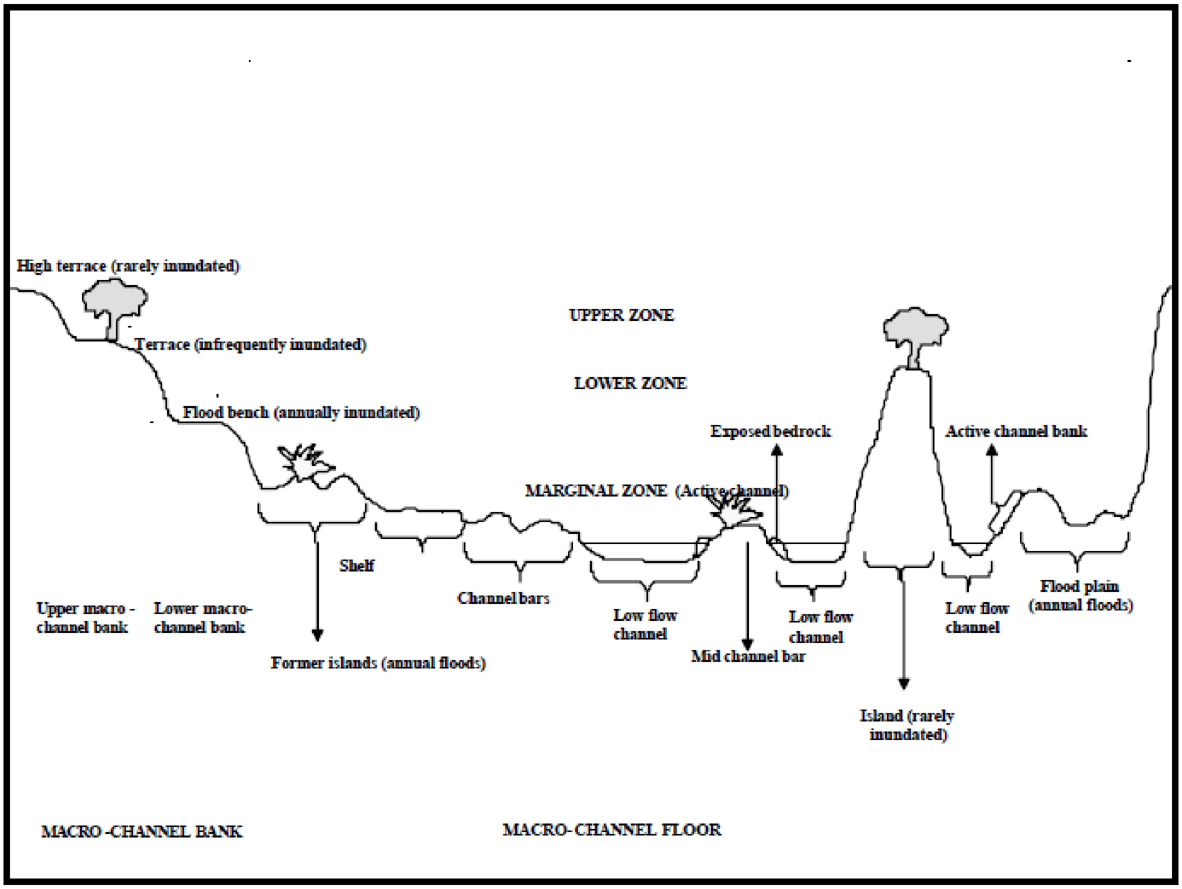

Figure 2 – Schematic diagram indicating the three zones within a riparian area relative to geomorphic diversity (Kleynhans et al, 2007)

Marginal Zone

The marginal zone incorporates the area from the water level at low flow (where present – if flow is not present areas that would be subject to baseflows would be included) to those features that are more or less permanently inundated. Vegetatively the marginal zone is typically characterised by the presence of hydrophytes that are vigorous in terms of abundance due to the near-permanent availability of moisture.

Lower Zone

The lower zone is the area of seasonal inundation (hydrological activation in this context is yearly inundation during high flows, or every 2-3 years), extending from the edge of the marginal zone to the point at which there is a marked increase in lateral elevation. This change in elevation may or may not be characterised by an associated change in species distribution patterns.

- Upper Zone

The upper zone is characterised by hydrological activation on an ephemeral basis (less than every 3 years) and extends from the end of the lower zone to the end of the riparian corridor. The upper zone is usually characterised by steeper slopes and the presence of both riparian and terrestrial species, the latter typically having an enlarged structure as compared to the areas outside of the riparian area.

VEGRAI uses a number of metrics (measurement or ratings) for different riparian characteristics to define and rate riparian state:

- Abundance (how much indigenous vegetation there is under present condition)
- Cover (a measure of the extent to which the ground is covered by vegetation, and is measured as canopy cover)
- Recruitment (the arrival and establishment of new individuals into riparian populations / communities)
- Population structure (the relative abundance of life stages within respective populations of selected indicator species)
- Species composition (the arrangement of species in the riparian community that comprise the riparian assemblage in the study area)

All of these characteristics of riparian areas can be measured in terms of the level of divergence from what would be considered a reference state. Reference conditions for riparian zones are usually natural, i.e. conditions prior to significant human interaction with riparian structure and function. It is important that reference state be defined in terms of an understanding of the nature of impacts on a riparian corridor.

The VEGRAI methodology has defined six (6) different types of riparian vegetation to guide assessments of reference state:

- Tree-dominated state,
- Shrub-dominated state,
- Grass-dominated state,
- Herbaceous-dominated state,
- Reed-dominated state,
- Open-dominated state (substrate such as sand/rock).

There are degrees of flux between these different states that may be influenced by impacts on the riparian zone – e.g. the removal of woody vegetation from the riparian zone.

The key impacts that act on riparian zones include:

- **Vegetation Removal** – resulting in increases in water temperature, effecting aquatic primary production, and adversely affecting the ability of riparian areas to retain water
- **Exotic Invasion** – resulting in displacement of indigenous species and subsequently to a change in ecosystem properties, bank instability due to the exclusion of natural riparian vegetation due to vigorous growth, decrease of organic input, or a reduction in riparian habitat diversity
- **Water quantity change** (change in volume and seasonality of flows) – resulting in increased stream widths or down cutting of the streambed that can lead to the loss of riparian vegetation

- **Water quality change** – resulting in impacts on indigenous riparian plants and possible excessive growth of exotic riparian vegetation in the case of eutrophication.

In terms of impacts acting on a riparian corridor condition of riparian vegetation can be assigned into the following categories:

- None (natural/close to natural)
- Small
- Moderate
- Large
- Very large
- Extreme

3.4 Identification of Surface Water and Riparian Zone Impacts and Mitigation Measures

All potential impacts that could be caused by the proposed expansion of the Ash Dump and that would affect surface water features on the alternative sites have been identified. Impacts specifically relating to the riparian areas, and the likely nature and intensity of the impact on the riparian areas on the sites have been detailed. Mitigation measures to either ensure that the identified impact does not materialise, or to ameliorate / limit the impact to acceptable levels have been stipulated.

3.5 Surface Water Mapping

All surface water features on the development sites and their immediate surrounds were mapped. The desktop-delineated GIS shapefile of riparian areas was revised based on the results of the field assessment.

4 FINDINGS OF ASSESSMENT

4.1 Surface Water Sensitivity – Limpopo Conservation Plan

The Limpopo Conservation Plan version 2 provides a spatial component to the Limpopo Bioregional Plan. The plan provides spatial information on areas of biodiversity sensitivity in the Limpopo Province. The plan has identified Critical Biodiversity Areas (CBAs) as well as Ecological Support Areas (ESAs) and the following sub-categories under each category.

CBAs include:

CBA Category 1 - are considered "irreplaceable" in that these areas are required to be protected to meet targets. If CBA 1 areas are not maintained in a natural state then targets cannot be achieved

CBA Category 2 – represent areas where there are spatial options for achieving targets and the selected sites are the ones that best achieve targets within the landscape design objectives of the Plan

ESAs include two categories split on the basis of landcover:

ESA Category 1 – areas in a largely intact state

ESA Category 2 – areas that are no longer intact but potentially retain significant importance from a process perspective (e.g. maintaining landscape connectivity)

Land parcels designated under one of the above categories can be considered to be priority categories for conservation.

The other non-priority categories include:

- Protected Areas
- Other Natural Areas
- Areas with no Natural Habitat Remaining

4.1.1 Analysis

Figure 3 below indicates the spatial distribution of Conservation Plan Categories in the study area.

It is important to note that both classes of CBA occur in the wider area, but are mainly represented by the CBA 1 class. An irreplaceable CBA is centred on the Sandloop watercourse that drains the area to the south-west and west of Lephalale. Due to the linear nature of the CBA following the course of the Sandloop River that drains into the Mokolo River, the watercourse and the ecological processes with which it is associated are central to the CBA.

Part of Site Alternative 1 (i.e. the portion not within the footprint of the current ash disposal facility) and most of its immediate surrounds are designated as an ESA 1. Site Alternative 2 is located within a large area designated as an ESA 1, incorporating a radius of over 4km from the centre of the site. The route of the conveyor belt to Site Alternative 2 largely falls within this ESA area.

The feature lookup attribute for the CBA 1 area located in relatively close proximity to each of the sites indicates that the aquatic-related importance of the CBA relates to the presence of wetland clusters surrounding a number of isolated pan wetlands (not located in immediate proximity of the two development sites), as well as its location within the catchment of a FEPA, (Freshwater Ecosystem Priority Area) and being located within 5km of a FEPA. The two alternative sites are located within the catchment of the Sandloop River which is a tributary of the Mokolo River which has been designated as a wetland FEPA. Although the Sandloop watercourse has not been designated as a FEPA, its correct management is important as it drains into a FEPA, thus entailing that any downstream impacts on the Sandloop and its tributaries would be of particular significance. The potential impact of the proposed development needs to be considered in this context.

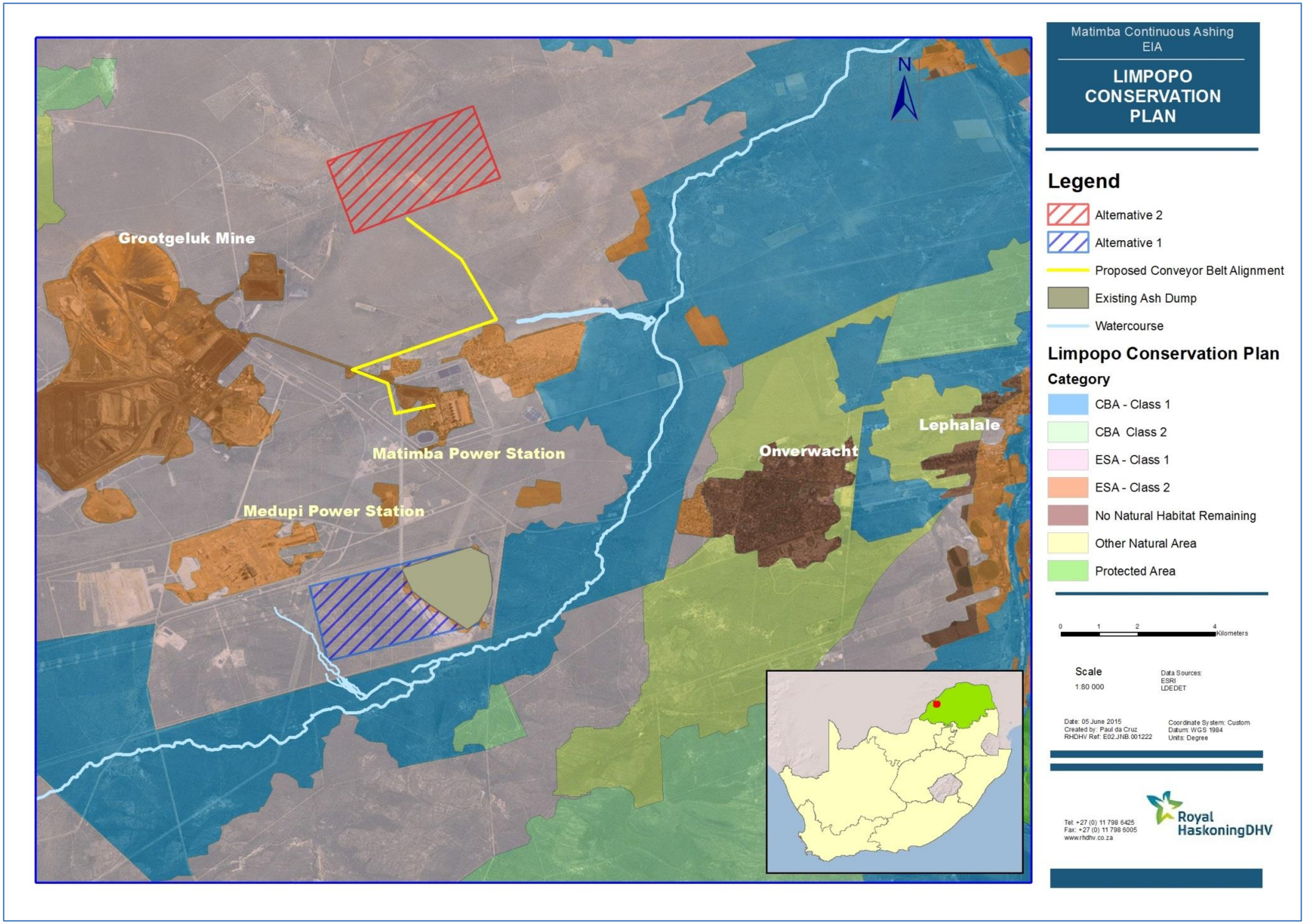

Figure 3 – Limpopo Conservation Plan area designation for the study area

4.2 Study Area Biophysical Characteristics and how these relate to / affect surface water features

4.2.1 Climate

The study area is located in the bushveld areas of the northern interior of South Africa. The region is thus located in a summer rainfall area, and as such rainfall in the area is highly seasonal. The occurrence of rainfall is related to the southward movement of the Intertropical convergence zone (ITCZ) towards southern Africa from the equatorial regions in the summer months, which feeds moisture towards the southern African interior plateau.

The mean annual rainfall figure for the Matimba power station area is around 440mm (South Africa Rainfall Atlas). Most of this rainfall occurs in the months of December, January and February (South Africa Rainfall Atlas). This annual rainfall figure places the study area in a transitional area between the more mesic savannahs to the east and the much more arid Kalahari Basin to the west.

The area typically experiences hot summer temperatures, whilst winters are generally mild with a low incidence of frost (Mucina & Rutherford, 2006).

The high seasonality of rainfall is an important driver of the hydrology of rivers and drainage lines within many parts of the study area. The relatively low amount of precipitation entails that localised rivers are non-perennial (with the exception of rivers such as the Mokolo River that rises in the Waterberg), responding only to rainfall events in terms of flow.

4.2.2 Geology, Macro-geomorphology and Topography

The site of the current ash disposal facility (**Alternative 1**) and its immediate surrounds are underlain by the Mogalakwena Formation of the Waterberg Group. The Formation is comprised of coarse grained purplish brown sandstone. The Waterberg Group underlies the area to the south of the study area and comprises the Waterberg foothills to the south of the site.

A fault – the Daarby Fault – separates the Waterberg Group to the south from the Karoo Supergroup sediments that predominate to the north of Lephalale and which underlie the **Alternative 2** site. Alternative 2 is underlain by the Clarens Formation that consists of fine grained cream coloured sandstone. The intervening area between the 2 sites (north of the Daarby Fault line) is underlain by the Swartrant and Grootgeluk Formations of the Karoo Supergroup. The Swartrant Formation consists of sandstone, gritstone, mudstone and coal and the Grootgeluk Formation consists of mudstone, carbonaceous shale and coal.

A system to classify the macro-drainage characteristics of South Africa has been developed; in terms of this classification the study area is found within the Limpopo Flats Geomorphic Province (GP) which is characterised as an open inselberg-studded plain dominated by gentle slopes. In the Limpopo Flats GP, much of the former soft Karoo Supergroup geological strata has been removed, but in some areas (such as in the study area) these sediments have been preserved in down-faulted blocks. Most of the rivers in the western Limpopo Flats meander freely on wide, sandy floors. Rivers in the part of the geomorphic province in which the study area falls are typically characterised by wide valley cross-sectional profiles and flat valley longitudinal slopes, typical of the very flat terrain (Partridge et al, 2010).

4.2.3 Vegetation Types

Only one vegetation type occurs in the study area – the Limpopo Sweet Bushveld type. This vegetation type from the savannah biome is characterised by short open woodlands on plains (sometimes undulating or irregular) (Mucina and Rutherford, 2006). It should be noted that this vegetation type is characterised as sweetveld and thus naturally is able to support a diversity of herbivores.

4.3 Study Area Surface Water Characteristics

4.3.1 Macro-drainage Characteristics

Overall all rivers in the study area drain into the Limpopo primary catchment. Within this wider context they form part of the Crocodile River sub-catchment, which drains much of the Highveld and western Bushveld. The Study area falls within 1 sub-catchment (quarternary catchment) – namely, A42J. This is the catchment of the lower-most reaches of the Mokolo River that drains north from the Waterberg Hills into the Limpopo River. The Sandloop River, which runs in close proximity to the south of the existing ash disposal facility, forms a part of this catchment. This river is a tributary of the Mokolo River. Drainage from the study area is thus eastward-flowing into this river. The development sites are located approximately 12-13km west of this river.

4.3.2 Surface Water Typology

The classification of surface water form has been based upon the most updated surface water classification system for South Africa – the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al*, 2013). The system uses a six-tiered approach for classifying inland aquatic systems, including wetlands. Levels 4 and 5 (hydrogeomorphic (HGM) unit and hydrological regime respectively) are the focal points of the classification system – i.e. these describe the functional unit (Ollis *et al,* 2013).

Surface water drainage is relatively poorly defined in the wider study area and there is a low drainage density in the study area. The low drainage density is likely to be due to the flat terrain, along with the sandy nature of soils) and relatively low rainfall. In terms of the Ollis *et al* (2013) classification system, the level 3 descriptor – landscape unit – for the entire area is the plain. an extensive area of low relief. Plains are generally characterised by relatively level, gently undulating or uniformly sloping land with a very gentle gradient that is not located within a valley. Gradient is typically less than 0.01 or 1:100 (Ollis et al, 2013). This very flat topography is responsible for the lack of drainage overall in the study area.

At the level of the hydrogeomorphic (HGM) unit, the most commonly-occurring expression of surface water drainage in the study area is the ephemeral drainage line. Distinct linear / fluvial drainage features occur very sparsely, however drainage lines do occur on both of the alternative sites selected for EIR-phase assessment. The largest drainage features are three ephemeral watercourses (the Sandloop that drains the area to the west and south of the Alternative 1 Site and two of its tributaries which emanate from the area to the north of Marapong and the part of the Alternative 2 site respectively) which are tributaries of the Mokolo. The three watercourses are relatively poorly defined in terms of hydromorphological structure. Under the Ollis *et al* (2013) classification system the surface water features on the site are best described as rivers, although the poorly defined morphological form of these features does not fit into the typical definition of a river or channel The only perennial river in the wider area is the Mokolo –draining the Waterberg hills to the south where a greater amount of rainfall occurs. The proposed development is expected to be too distant to adversely affect this river, although it is a downstream surface water receptor.

Typical wetlands (i.e. palustrine habitats) were found to be relatively rare in the context of the two sites and the intervening area, with hydric soils only occurring within very limited parts of the sites, including within depressions along certain of the watercourses on the sites and within a small isolated pan wetland on the Alternative 2 site. The tributary of the Sandloop that rises to the north of Marapong displays hydric soils within depressions along its length. As certain of these areas of hydric soils are most like pan / depression wetlands, the nature of this wetland type warrants further exploration.

Pan / depression wetlands are characterised by their endorheic character and are circular to oval shape. They occur in relatively small enclosed basins and are typically ephemeral in nature, typically being filled with shallow water levels during the rainy season. Areas in which pans are typically found in great density are typically characterised by a lack of integrated drainage and an average slope of one degree (Allan *et al*, 1995). Pan formation is typically influenced by a number of complex interlinking factors, including climate, geologically susceptible surfaces, animal-related and salt-related surficial disturbances, the lack of integrated drainage, and deflational processes (Allan *et al*, 1995). The last process is believed to be an important factor in the formation of the basins through scouring during the dry season when pans dry out and vegetation die back occurs, leaving dry soils exposed. Similarly the action of large mammals as a formative process is stressed in terms of the trampling action that limits the growth of vegetation and keeping soils exposed, as well as the carrying away of substrate adhering to the grazing and drinking animals. The relatively flat terrain in the study area, along with the presence of sedimentary strata of the Karoo Supergroup on which much of the pans within South Africa occur (Allan *et al*, 1995) and the current and historical presence of large herbivores within this sweetveld vegetation type, suggests conditions favourable for the formation of pans in the study area. Pans occur all over the wider study area, however they occur somewhat sparsely.

4.3.3 Hydromorphology (Hydrology and Geomorphological Processes) of Ephemeral Drainage lines in the study area

Hydrological and geomorphological processes are the major drivers of surface water feature formation. Surface water features can be characterised in terms of their hydrological and geomorphological characteristics as discussed in this section. Rivers and drainage lines as surface water features are defined by their position in the landscape (typically occurring in valley bottoms) and typically by the presence of a distinctive channel. The ephemeral drainage lines in the study area however do not typically display a distinctively incised channel, with certain reaches displaying only a very shallow depression (<30cm deep) that would barely constitute a channel. Some 'reaches' even display no clear channel, rather being characterised by bare patches of soil (typical of sodic areas – see below) or being characterised by different vegetation cover to the surrounding woodland (less woody vegetation and a more grassy substrate).

A number of small pan-like depressions were encountered along these ephemeral drainage lines, particularly along the drainage line on the Alternative 2 site. These depressions occurred in the context of a very flat gradient, and are areas of collection of surface water flow along the drainage system. The flat gradient in which these drainage lines occur is believed to account for the indistinct hydromorphological definition of the drainage lines. The formation of these depressions may be related to the formative processes in pans discussed above, as these depressions typically consist of clayey substrate that becomes 'sticky' and muddy when wet.

In certain reaches of the drainage lines assessed a reach downstream of an upstream reach that displayed a channel became very indistinct, being difficult to distinguish from the surrounding woodland. Thus these drainage systems appear to vary between slightly more hydromorphologically defined reaches in areas of slightly increased slope to areas where there appears to be no defined channel, with only a change in vegetation structure indicating a surface water or drainage feature.

Figure 4 – Very shallow flow depression within the northern riparian corridor of the Alternative 2 Site

From a hydrological perspective, these systems are likely to carry overland flow on an episodic basis relating to rainfall events. Many of South Africa's rivers display such seasonal / ephemeral flow characteristics and rivers in South Africa typically have highly variable flow regimes and thus a very high coefficient of flow variability (Dollar, 2000). It is likely that there is a strong interrelationship between irregular periods of surface flow in these systems, and a more permanent sub-surface presence of water in the form of shallow groundwater. The permeable nature of much of the substrate within these ephemeral drainage lines (although areas of clay accumulation do occur in places as evidenced by the presence of shallow pan-like depressions) allows the infiltration of surface flow into the substrate that is likely to move below the surface along these drainage lines as shallow groundwater (with flow mimicking topography). According to the geotechnical report for the EIA study (Pather, 2013), the presence of perched groundwater tables across the study area during high rainfall events is likely, typically in the range 1.0 to 3.0 metres below existing ground level. In the context of the respective sites, this perched water table will likely occur above the bedrock horizon on Alternative Site 1 and above the calcrete horizon that exists on Alternative Site 2. These drainage lines are likely to be areas of groundwater recharge, with no areas of groundwater discharge (springs or seepages) noted.

4.3.4 Characteristics of the Watercourses and their riparian zones on the two alternative sites

In spite of the ephemeral nature of surface water features in the study areas they display distinct riparian vegetative characteristics. This report has focussed on riparian zones as riparian zones are important in the context of the National Water Act, as explored in Section 1.4 above.

4.3.4.1 Alternative 1

As described in the scoping-phase surface water report, two ephemeral drainage features were identified in the south-western part of the Alternative 1 site. The Sandloop River runs to the south of the current Ash disposal site, and two small tributaries are indicated as draining south from the Alternative 1 site (the Zwartwater property) towards the Sandloop River on the 1:50,000-scale topographical maps. Interestingly one of these drainage lines is shown to ‘disappear’ before reaching the Sandloop. Both of these drainage lines were visited in the field to confirm their existence and to characterise them in terms of their riparian characteristics.

The more easterly drainage line as indicated on the 1:50,000 topographical maps does not appear as a distinctive drainage feature on colour aerial photo imagery. This was confirmed in the field where analysis at two points in the field did not reveal any distinct morphological or vegetative features indicating the presence of a drainage line. No channel or evidence of any flow or depressions was noted, only a very slightly perceptible low point within the terrain. Importantly the vegetation did not display any difference in structure and composition to the surrounding woodland. As a confirmatory measure the soils were sampled in this low point; soils revealed a brown Orthic A horizon underlain by a yellow-brown apedal B horizon (typical of the wider Clovelly soil form), with no signs of any hydromorphism in the form of gleying that would suggest lateral movement of water within the upper part of the soil profile. It was thus concluded that there was no drainage feature at this point, rather a localised low point in the flat terrain.

The drainage line as indicated in the south-western corner of the site displayed more distinct hydromorphological characteristics that identified it as a watercourse, albeit without an incised channel or other very distinctive morphological features. The primary hydromorphological feature noted was a very shallow channel (more akin to a very shallow depression) or open area of sandy, alluvially transported sediment as is commonly encountered within ephemeral drainage systems. In one location along the reach a small depression or wallow was encountered. This area consisted of highly gleyed clayey soils that displayed hydromorphic characteristics in terms of the reduced matrix and the presence of small iron mottles. It is thus clear that this small localised area of clayey soils is seasonally inundated (it was dry at the time of the assessment), with sufficient periods of inundation to enable the development of hydromorphic soils, albeit in a very localised area. The ‘channel bed’ was typically 3-5m in width and was flanked by thick vegetation, comprising mainly of shrubs and some trees, forming a thicket-like cover. At a certain point just outside of the development site the drainage line had been dammed. The channel immediately downstream of the dam was most pronounced with the presence of cobbles in the channel bed and evidence of flow-deposited wrack on the margins of the channel.

Figure 5 – Alluvial material with a very indistinct area of flow

Figure 6 – Channel with alluvial material and flow wrack downstream of the dam

This drainage line drains an area to the north-west with the large Medupi Power Station construction site located within the head of its catchment. In this context it is not certain whether stormwater runoff from the developed site would be discharged into this drainage line (if this were to occur the discharge of stormwater and its subsequent drainage down this system would be likely to have an important hydromorphological impact on this drainage system which would be likely to have a concomitant impact on the riparian habitat). Upstream of the site this drainage line is intersected by a number of parallel-running power line servitudes within which all of the woody riparian vegetation has been cleared, thus constituting an impact on it.

In a natural context (without taking the presence of the Medupi Power Station into account), this drainage system has a relatively small catchment with a resultant relatively minor degree of surface water runoff, as demonstrated by the highly indistinct channel profile and riparian vegetation (as discussed below). Analysis of aerial photography after the site visit revealed numerous 'channels' within the area that would be encompassed by this drainage feature (refer to figure 8). It thus appears as if drainage in the very flat context of this part of the study area is spatially spread over a wider area, thus possibly accounting for the un-incised nature of the drainage features and absence of a single channel that would carry overland flow.

In the context of the VEGRAI template, the atypical morphological cross-sectional profile of this riparian zone makes it difficult to assign zones. The narrow 'channels' could arguably comprise the marginal zone of the riparian corridor, even though they would be inundated for short periods of time. Under this scenario, unlike the classical cross-section of a riparian corridor, a series of alternating marginal zones with intervening lower zones would be present. However if differing degrees of hydrological activation across this riparian corridor are examined, a case could be made that the marginal zone is absent, and that the 'channels' comprise lower zones and intervening areas of the riparian corridor the upper zone. This altered template appears to best describe the hydro-vegetative profile of this riparian corridor[1].

Riparian vegetation was noted to consist mostly of low shrubs forming a dense thicket. Due to the presence of the dense coverage of woody vegetation, grass was limited within the understorey. The most common shrub species encountered along the drainage line included *Dichrostachys cinerea*, *Pterocarpus rotundifolius, Acacia nigrescens, Ziziphus mucronata,* and *Grewia flava.* In a few areas taller *Spirostachys africana* trees formed small groves. Riparian vegetation flanking the small dam took the form of larger trees, but his greater structural growth reflects the impoundment of water within the dam, rather than a natural state. Under the VEGRAI classification of riparian reference state, this reference state for the riparian corridor of this drainage line falls within the category of shrub-dominated state. No alien invasive vegetation was noted within the riparian zone of this drainage line, thus reflecting a 100% abundance of indigenous vegetation within this reach. In spite of the presence of these linear un-vegetated areas, coverage by the shrubby vegetation within the riparian corridor was noted to be almost complete.

It should be noted that a distinct change between the vegetation composition and structure between the riparian zone and the surrounding woodland vegetation (as evident on the Alternative 2 site – see section 4.2.4.2 below) was not noted at this watercourse, making it more difficult to use vegetation to delineate the boundaries of the riparian zone.

[1] The VEGRAI methodology has been developed for fluvial systems characterised by a typical fluvial regime where inundation / hydrological activation is based primarily on flow within the channel and increased inundation outwards into the outer parts of the river cross-sectional profile during periods of increased (spate) flows along the drainage system. The hydromorphological template thus reflects this classical fluvial system, as opposed to drainage systems which are ephemeral in nature, or where a significant or dominant portion of the hydrological through flows within the system are expressed as groundwater flows, as is the case in the current study. In spite of this distinction, the VEGRAI template has been applied where possible to the drainage systems within the study area as a method to characterise the riparian corridors. This report has applied a slightly altered hypothesis of riparian zonation to that applied in the classical VEGRAI model.

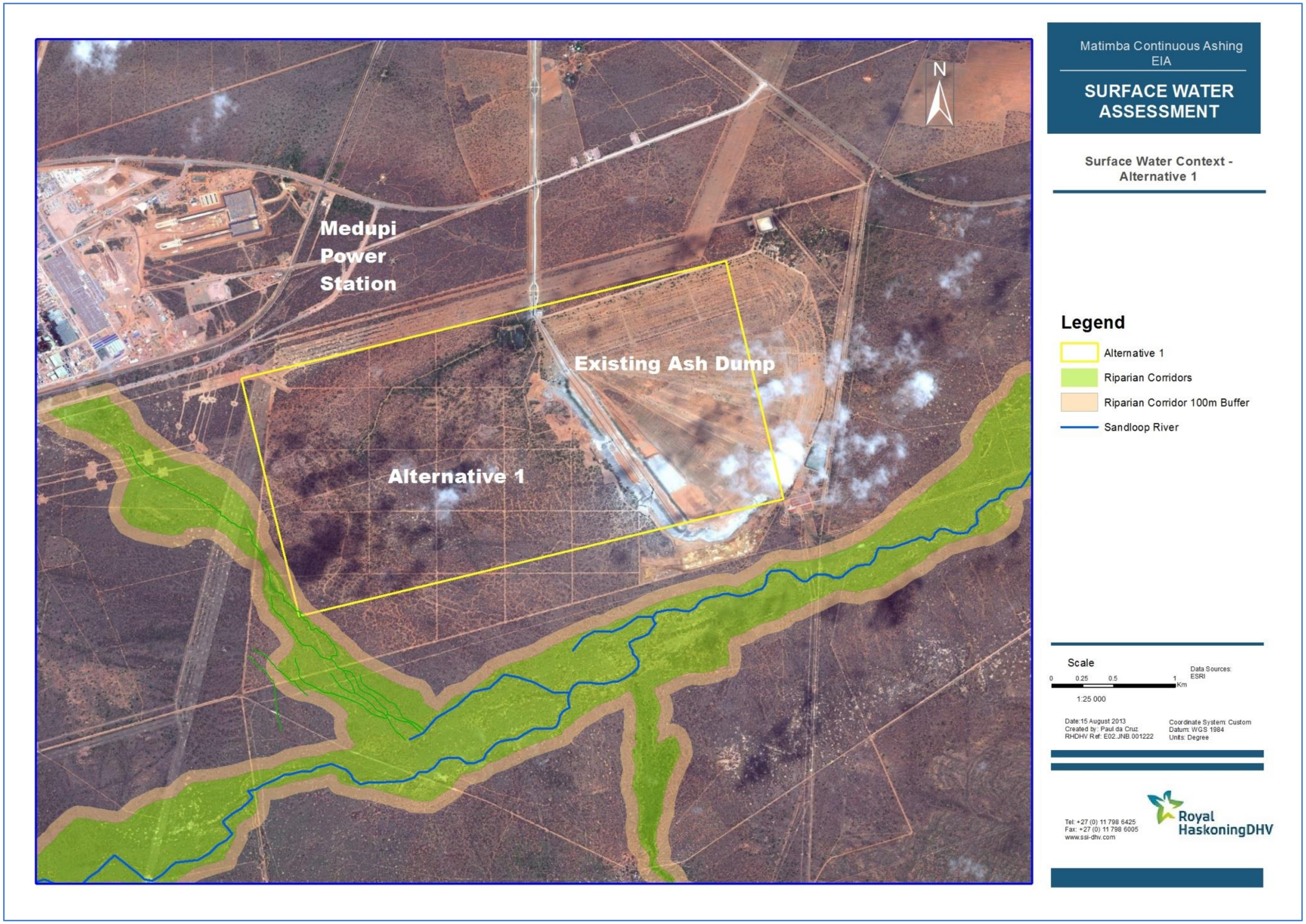

Figure 7 – Layout of Site Alternative 1 and riparian corridors and associated buffers

Figure 8 – Riparian Corridors and associated buffers on Alternative 1

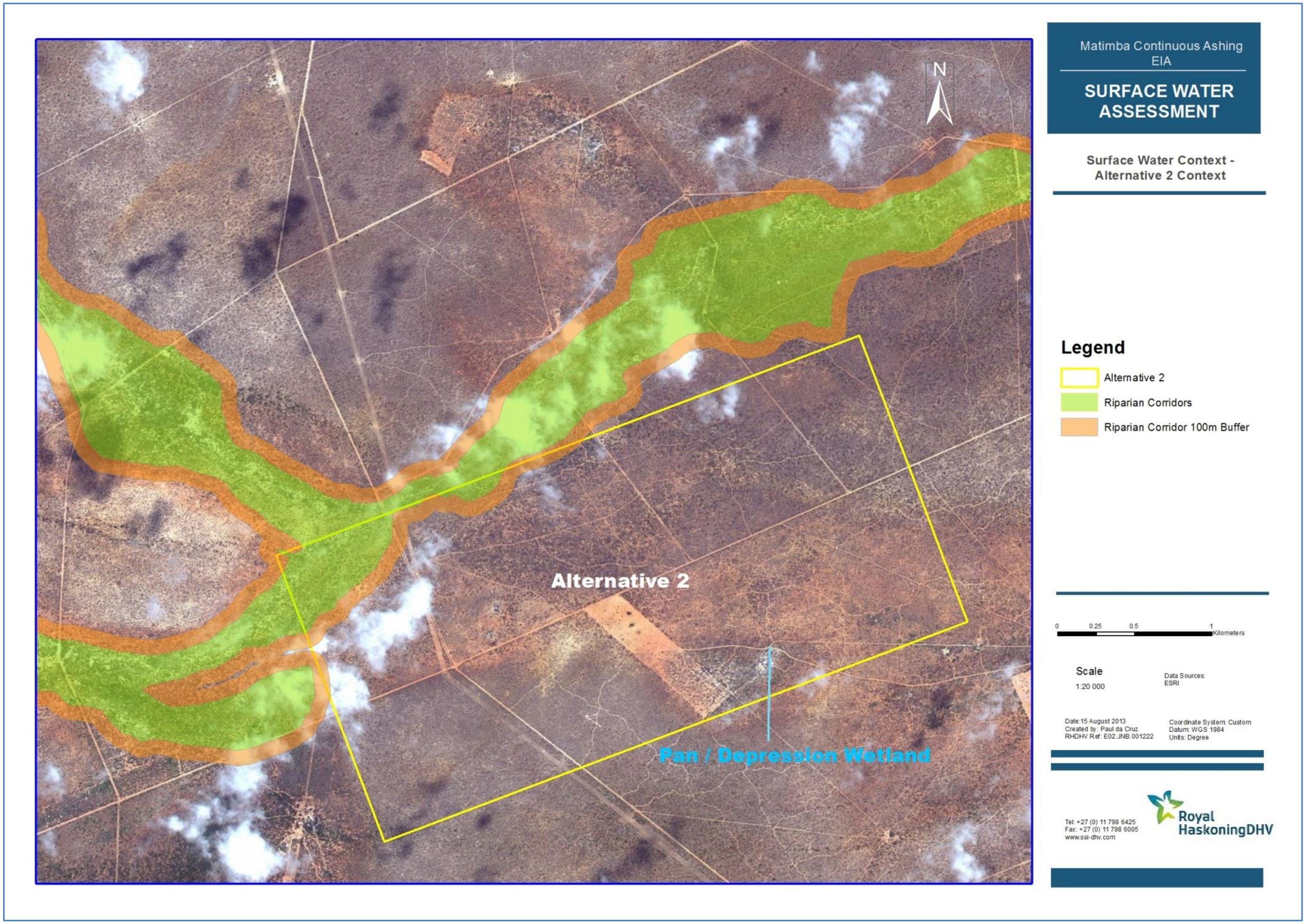

Figure 9 – Layout of Site Alternative 2 and riparian corridors and associated buffers

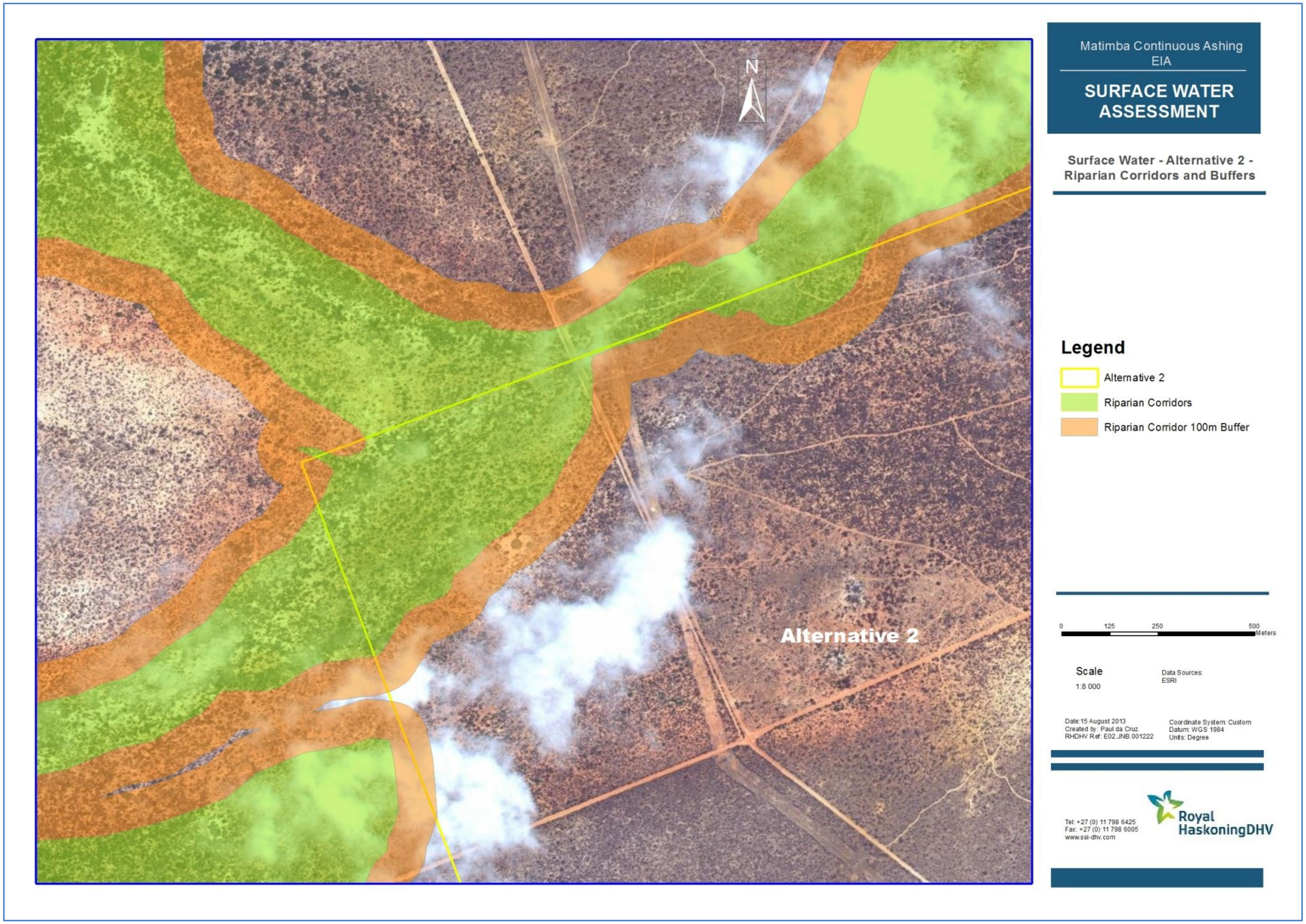

Figure 10 - Riparian Corridors and associated buffers on Site Alternative 2

4.3.4.2 Alternative 2

Surface water drainage on the Alternative 2 Site takes the form two ephemeral drainage lines that converge to form a single eastward-flowing drainage line the north-western corner of the site; one that drains from the Vooruit property to the west, and another that drains from the north in the vicinity of the Manketti Nature Reserve Office on the Gelykebult property. These 2 ephemeral drainage lines converge in the north-western part of the site, flowing north-eastwards off the site and parallel to it in a north-easterly direction towards the Sandloop River.

The part of the site on which the drainage lines are located is characterised by very gentle slopes. The ground slopes up very gently to the north, with the drainage lines being located in very wide and extremely shallow valley bottoms. Like the drainage lines on the Alternative 1 Site, there are no distinctly incised channels, and surface water drainage occurs over a wider area. The drainage line emanating from the north displays evidence of a very shallow 'channel' for a short stretch where the slope steepens slightly, but this is not more than a very shallow depression within the context of the wider open area. Other than this area there is no evidence of channelled flow on the site. The presence of riparian vegetation of a different structure to that of the surrounding bushveld, however, indicates the presence of greater moisture availability, and it is thus likely that a large part of the hydrological regime within these two ephemeral drainage lines is comprised of groundwater flow at very shallow depths along the drainage lines. Overland flow does occur within these two systems, albeit diffuse flow across a wider area. Evidence of the presence of episodic flow within the system is provided by pan-like depressions located within both of the drainage lines that are not only likely to be fed by rainwater but by overland flow within the wider area. At the time of the field assessment (early autumn), these were noted to be water-filled and are likely to be filled by overland flow emanating from the upstream portion of the drainage line.

In terms of the hydromorphology and riparian zone classification of these two drainage systems, it is difficult to assign a marginal zone within them, other than within the two pan-like depressions encountered, in which typical marginal vegetation (see below) was noted to occur. Thus apart from the localised area of the two depressions, the riparian area is likely to be comprised mostly of what can be termed the upper zone due to an ephemeral degree of hydrological activation, with a narrow lower zone occurring along more distinct flow lines and within parts of the western drainage line in which taller vegetation and a more luxuriant grassy understorey is present.

The riparian areas differed in vegetation composition across the site. At the point on the site where the two drainage lines converge, riparian vegetation was noted to comprise mainly of shrubs including *Euclea divinorum, Acacia melifera, Dichrostachys cinerea, Combretum hereroense, Grewia monticola,* and a few *Combretum imberbe* tree specimens. The riparian corridor within this area was characterised by a partial woody cover with a grassy substrate. In places the shrubs were noted to be taller, reflecting increased moisture availability. In areas of white bleached soils (showing affinities with sodic areas – see below), the tree / shrub species *Boscia foetida ss. Rehmaniana, Acacia nilotica* and some *Acacia robusta* were noted, with the dominant species being *Acacia mellifera.* Coverage of vegetation varied across these sodic areas with a relatively dense coverage of *Acacia mellifera* close to the pan-like depression within the northern drainage line, contrasting with a very sparse vegetation cover in the area to the north of the pan. *Acacia karoo* was noted in the transitional area between the riparian corridor (including the sodic areas) and non-riparian areas.

Figure 11 – Lush growth within the understorey of the riparian corridor

Figure 12 – Water-filled depression and flanking thicket vegetation along the western drainage line

Vegetatively the main difference between the two drainage lines was that tall trees were only encountered along a stretch of the western drainage line. In this part of the site, the riparian corridor was very distinct and differed markedly from the surrounding non-riparian woodland. Along the western drainage line close to the western boundary of the site, a linear arrangement of tall indigenous trees species was noted. These species included large specimens of *Combretum imberbe* as well as *Ziziphus mucronata, Combretum hereroense, Acacia erubescens* and *Peltophorum africanum*. The understorey of this area comprised of shrubs and a luxuriant grass cover (comprising mainly of the species *Panicum maximum*) indicating a high degree of moisture availability. A small water-filled depression was located within this stretch. The width of this riparian corridor is approximately 30-40m in width. Coverage by woody vegetation was not complete, being about 50% as viewed aerially. Interestingly the taller trees did not extend along the entire reach of the western drainage line assessed on the site, and this distinct riparian corridor 'dissipated' downstream (closer to the confluence within the northern drainage line). Analysis of the riparian aerial photography (see **Figure 15**) reveals a widened riparian zone (as characterised by the presence of larger trees) in the areas where the two drainage lines meet, reflecting a wider area of increased moisture availability.

The northern drainage line did not display any such linear growths of distinctively larger trees, rather a more shrub-dominated woody component dominated by *Acacia mellifera*. Nonetheless *Combretum imberbe* and *Ziziphus mucronata* trees, as well as *Carissa bispinosa, Euclea crispa and Gymnosporia senegalensis* shrubs were found to occur around the larger pan-like depression. This drainage line displayed larger areas of sodic soils which were noted to display a very sparse coverage of both woody vegetation and the lower substrate as described above. Analysis of colour aerial photographs indicates the presence of two linear zones of larger and denser shrubs across a wider riparian zone across the northern drainage line (refer to **Figure 15**). The intervening area was very sparsely vegetated with large patches of bleached soils (believed to be sodic in character as discussed below). In the overall context of the site, the vegetative reference state for these ephemeral drainage lines is *shrub-dominated,* with trees only occurring in certain parts and shrubs being the dominant growth form. Coverage varies as described above from a dense coverage along part of the western drainage line to a much sparser coverage. As with the Alternative 1 site no invasive alien vegetation was noted, thus reflecting a 100% abundance of indigenous vegetation.

There is a distinct change in vegetation away from the riparian corridor in terms of a number of factors:

- **vegetation composition** – in the area immediately outside of the riparian corridor only *Acacia melifera* and *Grewias* are encountered, while the sandy upland slopes were characterised by two dominant species – *Combretum apiculatum* and *Terminalia sericea,*
- **cover** – a much lower density of vegetation with *Acacia melifera* more sparsely distributed, with a very sparse grassy substrate, comprising mostly of *Aristida spp.* grass,
- and **structure** – woody vegetation comprising of shrubs rather than trees (reflecting the decreased availability of moisture).

It should be noted that this change in vegetation composition was used to delineate the riparian zone, as distinct from the surrounding woodland vegetation.

Figure 13 – Tall trees and shrubs within the riparian corridor along the western drainage line

As described above, 'typical' marginal vegetation only occurred in very limited parts of the riparian zone on the margins of the two pan-like depressions. This was comprised predominantly of the grass *Eragrostis inamoena* as well as the obligate wetland grass species *Arundinella nepalensis* in flooded areas. This species is listed as a facultative wetland species in the context of the eastern seaboard on South Africa (Kotze and Marneweck, 1999), but in this much more arid context is highly likely to be an obligate hydrophyte. The presence of this hydrophyte in these locations corresponds with the confirmed presence of hydric soils as discussed below.

Figure 14 – Pan-like depression on the northern drainage line with *Arundinella nepalensis* marginal vegetation

The riparian corridor was not noted to not contain excessive erosion, in spite of the presence of sodic areas (the presence of these may be a reflection of the former cattle ranching on this property through which artificial water points were placed within these riparian zones, thus arguably resulting in accelerated erosion). The riparian area is thus assessed to be in a natural state, a state which represents the reference state for this area and this type of riparian zone associated with an ephemeral drainage line. The potential impact of the proposed development in terms of potential transformation of the site would thus be significant in this context.

4.3.4.2.1 Soil characteristics on the Alternative 2 Site

Soils were noted to change within the riparian corridor, as opposed to the surrounding non-riparian woodland areas in terms of colour (hue) and physical characteristics. Soils within the surrounding woodland were noted to be highly sandy with a light orange hue. Conversely soils within the riparian corridor were noted to be more clayey in character and a dark grey to brown colouration[2], with alternating areas of more bleached white soils in places.

[2] The more clayey character of the soils in the valley bottom drainage lines accords with the soil survey undertaken for the site as part of the Soil, land use and agricultural capability survey in the EIR phase (van der Waals, 2013). The survey identified the predominant soil form in the north-western part of the site to be the Valsriver Soil Form (Orthic A → Pedocutanic B → Unconsolidated material without signs of wetness). The Pedocutanic B horizon is a secondary soil horizon (underlying the topsoil) that has become enriched in clay, presumably by illuviation (a pedogenic process which involves downward movement of fine materials and deposition to give a cutanic character). The presence of the Orthic A horizon overlying clayey B horizon accords with the description of duplex soils as typical of sodic (or sodic area development-prone) areas, with the pedocutanic B horizon being likely to be much more impermeable than the overlying topsoil horizon.

These areas of bleached white soils showed many affinities to classical sodic sites as commonly occur within the Lowveld of Limpopo and Mpumalanga, and were noted to have a structured (encrusted) upper layer. Sodic sites typically occur at the foot of the catena (the landscape setting in which they occur on the site), where colluvial processes ensure the accumulation of deflocculated clays as well as salts. Sodic areas typically occur at the interface of the footslopes with bottomlands in which riparian zones are located. The presence of sodium and the reaction between this sodium and clays in these areas accounts for the susceptibility of these areas to erosion and sodic site formation. Duplex soils typically occur in these areas; the distinctly layered profiles typically have highly impermeable B horizons that allow the formation of seasonally perched water tables at the A/B horizon interface (Chappell, 1992). Sodic sites are erosion features that represent the loss of the entire A horizon, thus exposing the underlying clayey B soils. Sodic areas take on a bleached white appearance, due to a thin veneer of coarse quartz clasts overlying the darker clays that represents the remnants of the now eroded topsoil (Chappell, 1992). These sodic areas typically occur roughly parallel to the course of drainage lines, with an intervening band of riparian vegetation. This pattern is present on the site, with a clear zone of bleached white soils occurring between the riparian zone of the western drainage line and the edge of the footslopes to the north. In conditions where no overgrazing has occurred, there is typically a dense grass cover, however the high level of accumulation of sodium within the leaves attracts certain grazing herbivores, to the extent to that they tend be highly overgrazed, destroying the grass cover and initiating sodic site formation. Shallow surface depressions over impervious clays tend to form wallows and attract many types of animals. Such depressions were found on the site, both in the form of shallow, dry depressions or the larger water-filled depressions.

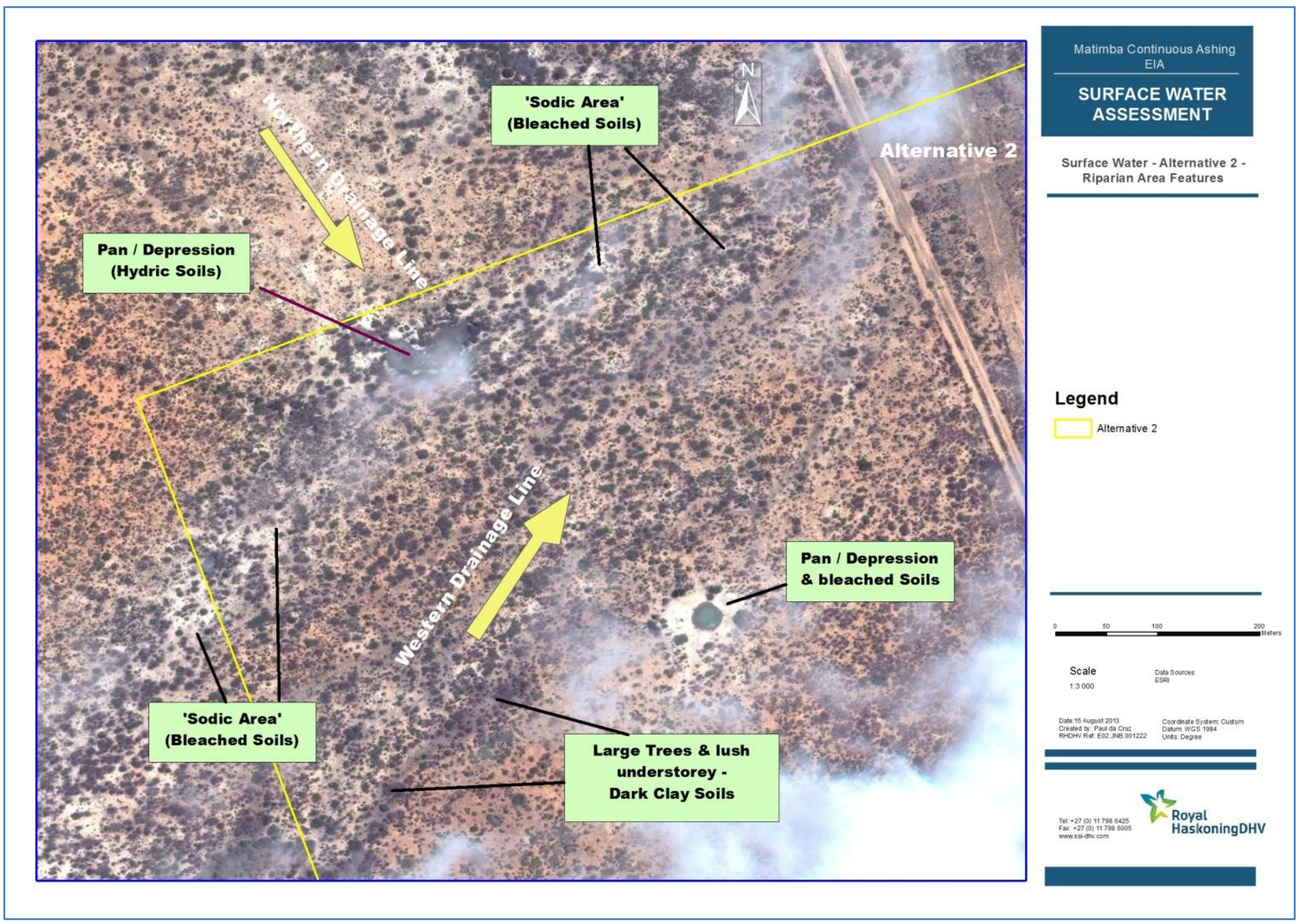

Figure 15 – Colour aerial image of Alternative Site 2 showing the location of riparian features

Soils in the larger pan-like depression were sampled to determine the presence of hydromorphy. The upper-most profile consisted of an Orthic A horizon to c40-50cm, being grey-brown at the surface grading down to a more gleyed interface with the B. Redoximorphic features in the form of iron mottles along with alternating patterns of redox depletions alongside iron mottles - a typical indication of repeated wetting and drying and associated development of anaerobic soil conditions and subsequent re-oxidation of the soils were present. The redoximorphic features only extended to c50cm below ground level, thus the zone of seasonal wetting and drying appears to only be associated with the presence of inundation by surface water inflows in the A horizon. Brown clays comprised the underlying B horizon. This vertical pattern is typical of the foot of the catena in areas prone to sodic area development as described above.

Figure 16 – Sodic area on the peripheries of the riparian corridor of the western drainage line

Figure 17 – Redox depletions within soils in the pan-like depression along the northern drainage line

The question of whether sodic areas on the site constitute part of the riparian zone can be posed. As described above these areas form typically occur at the interface between footslopes and the bottomlands (incorporating drainage lines) in which riparian corridors are located. In the context of the site the only marked drainage features are located within riparian zones, as well as the pan-like depressions around which much of the distinctive riparian vegetation occurs. Analysis of colour aerial photographs for the site reveals that these 'sodic' areas do tend to occur on the margins of the riparian corridor, but bands of sodic areas also occur intermittently between linear bands of denser and larger riparian vegetation (Refer to **Figure 15**). The spatial orientation of the sodic features is made more complex by the confluence of two drainage lines on this part of the site. Thus although strictly not part of the riparian zone in terms of the classical model of fluvial hydrological activation, their close interaction with the more distinct parts of the riparian zone and presence of surface water features within them has entailed that they have been included as part of the wider riparian corridor.

4.3.4.3 Watercourse north of Marapong

A tributary of the Sandloop rises to the north of the Marapong township relatively close to the proposed alignment of the conveyor belt to the Alternative 2 Site, and thus this watercourse was investigated to determine whether it extended to the alignment of the conveyor belt. The watercourse was noted to rise to the east of the conveyor belt alignment, and the surface water feature becomes visible at a low point in the otherwise flat or very gently sloping terrain. A small depression characterised by the presence of shallow standing water was located at the head of the watercourse. This depressional area was investigated for the presence of hydric soils, which were found to exist in the form of gleyed clays with the presence of extensive iron mottling. The vegetation in the depression consisted predominantly of the grass species *Echinochloa holubii* (a grass species typical of watercourses and naturally moist areas in the more arid parts of southern Africa) and a *Sesbania species* shrub within the depression. Downstream of this depression, the watercourse extended eastwards in the form of a poorly defined channel characterised by some bare patches of soil and stands of *Bothriochloa insculpta* grass (a species that can also occur in wet areas), and consisting of a series of similar downstream depressional areas. Upslope (west) of the uppermost depression, no visible surface water characteristics were present; although the area was characterised by grassy as opposed to shrub-dominated vegetation, there was no evidence of hydric soils (soils sampled were sandy, well drained in character) or any physical drainage features.

Figure 18 – The head of the watercourse north of Marapong

Interestingly this watercourse did not display a wooded riparian corridor as displayed by the other watercourses on and around the nearby sites, rather being characterised by grassy vegetation with a different species composition in the watercourse to the immediately adjacent areas that were characterised by the presence of grasses and low shrubs. Analysis of the site and of satellite imagery for the site reveals that a strip of trees runs parallel to the northern side of the watercourse in this area, but at a distance (approx. 50m) away from it. The site assessment revealed that gently sloping area moving north of and away from the watercourse graded from grass-dominated vegetation in the uppermost depression and ensuing channel to an area of low shrubs (mainly *Dichrostachys cinerea*) and to a belt of taller trees with the tree species being mainly *Acacia erioloba*. This belt of trees was too far removed from the watercourse to be riparian in nature, and appeared to be related more to the presence of sandy soils as opposed to the clayey soils in the watercourse.

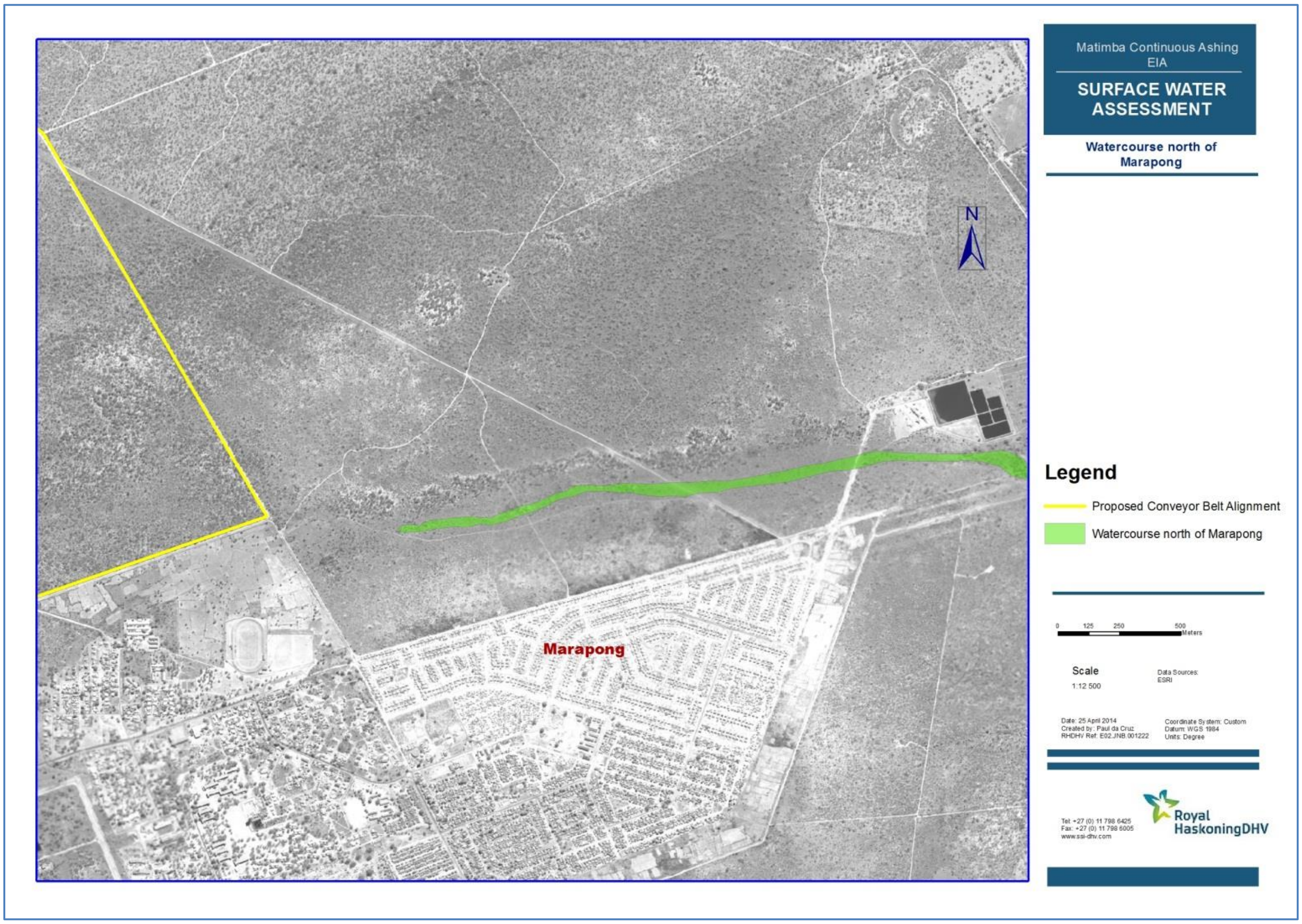

Figure 19 – Watercourse north of Marapong, in relation to the proposed conveyor belt alignment

4.3.4.4 Implications of surface water feature and riparian zone occurrence for the proposed development

As described above, surface water features occur on both sites, with ephemeral drainage lines and their associated riparian zones being the primary surface water –related feature. It should be noted that a small pan-like depression wetland very similar to the largest water-filled depression on Alternative Site 2 was encountered in the south-eastern part of the Alternative 2 site. This pan was not connected to any linear drainage feature and is believed to be fully endorheic. It was very small in spatial extent and like the larger depression on the northern drainage line displayed *Arundinella nepalensis* as the primary marginal vegetation species.

Figure 20 – Small pan-depression on the south-eastern part of the Alternative 2 Site

The total required area of the ash disposal facility at the end of its operational lifespan is not known and thus the degree to which the development would take up the entire site. However if the coverage of the site was complete, then these surface water drainage features on the sites would fall partially within the footprint of the development, thus being transformed. This would have a significant impact on the resource quality of the affected surface water features, and would drastically alter their hydrological state as well as biological composition. On both sites the surface water features are located on the periphery of the site, thus making it relatively easy to develop the majority of the site while at the same time avoiding physically impacting the surface water features. The potential impacts and implications for maintenance of buffer zones are described in the ensuing sections of this report.

The watercourse located to the north of Marapong is located relatively close to the alignment of the proposed conveyor belt linking the Matimba Power Station with the Alternative 2 Site, but the conveyor belt would not cross this feature, as the head of the watercourse is located to the east of the alignment of the conveyor belt route.

5 NATURE OF THE POTENTIAL IMPACTS ON SURFACE WATER FEATURES ASSOCIATED WITH THE PROPOSED DEVELOPMENT

5.1 Potential loss of Riparian and Wetland Habitat

It is not certain what the total maximum footprint of the ash dump expansion would be, and what portion of each alternative site is proposed to be covered by the expanded ash disposal area. This would have an important bearing on whether surface water features on each of the sites would be impacted or not, and the proximity of the ash disposal activities to the surface water features.

Under a worst case scenario, the entire area of each respective site would need to be developed. Under this scenario the surface water features on the site would be directly affected, and the reaches of the ephemeral drainage lines on the development site would be completely lost or transformed. A smaller area of riparian habitat would stand to be transformed in the case of the **Alternative 1** Site being developed in its totality as compared to Alternative 2 – only a small reach of the ephemeral drainage line bisects the site. As described above, two ephemeral drainage lines traverse the north-western part of **Alternative 2** Site, and comprise a much larger area of riparian habitat.

There would be a number of aspects to the impact associated with transformation of certain reaches of the drainage lines on each site. Firstly the development would cause the loss of riparian habitat in the affected reach, thus adversely affecting the resource quality of the affected surface water feature. All vegetation within the affected part of the riparian corridor(s) would be destroyed through removal prior to being covered in ash. This would result in the loss of habitat for fauna inhabiting these riparian zones. Thus the ecosystem services offered by the riparian zone in terms of providing habitat for fauna and by performing an ecological linkage between natural areas would be severely affected.

Importantly, in spite of the ephemeral nature of the hydrological regimes of the drainage lines, the hydrology of the drainage line(s) would be altered and adversely affected as it is likely that alternative flow conduits for surface water flow along the drainage systems would be engineered. Any functionality currently performed by the riparian zones relating to the retardation / pooling of water draining along the system would be lost, and the channelisation of flow into reaches of the drainage system downstream of the affected reach could introduce erosion and scouring which are not part of the natural hydrological regime of these drainage systems.

On an ecological level at the localised scale of the Manketti Nature Reserve (in the context of **Alternative 2** Site), important habitat (in terms of food sources and cover) and water sources for much of the fauna (including ecologically and economically important mega fauna) within the reserve would be lost. It is recognised that if such impacts were to occur, they would occur on a localised scale. Nonetheless they would constitute a direct impact on a water resource, which would need to be licensed under the National Water Act.

As described below, however, no physical alteration of any wetland area on the site should be allowed to occur, and if this key recommendation was adhered to the above impacts would be unlikely to materialise.

5.2 Stormwater-related Impacts

The development could be associated with discharge of stormwater off the ash dump into the drainage lines on the respective sites. This could be an impact that materialises even if the riparian zones are not physically destroyed by the ash dump. Stormwater runoff will be generated off the ash dump and will need to be managed. Rainfall as well as water used for dust suppression would infiltrate the ash dump and 'daylight' as seepage at the edges of the dump, thus forming a discharge that would enter the surrounding environment, along with stormwater runoff off the surface of the dump. Depending on where this stormwater runoff is discharged and whether it is discharged into adjacent riparian areas is important in determining the potential impact of stormwater from the dump on the riparian corridors.

Increased volumes of surface water discharge into riparian areas could alter their hydrology. If the stormwater discharge is concentrated to one or a few point-specific discharges, this could result in channelisation of flow within the affected riparian area and the possible development of gulley erosion, particularly in the context of the occurrence of highly erosive duplex soils that were noted to occur on the **Alternative 2** Site (as indicated by the presence of sodic areas). This could in turn result in loss of riparian habitat, as the current hydrological regime of primarily diffuse overland flow into and within the riparian corridor could be altered to one of more channelled flow. This could have spin-off effects in changing the vegetative composition of the riparian zone through alteration of sub-surface moisture availability.

Stormwater discharge could also carry potential pollutants into the riparian corridor, as well as silt. These pollutants could equally adversely affect the resource quality of the surface water system. The nature of leachate from the ash dump is explored in section 5.3 below.

In the context of the above worst case scenario impacts, it should be noted that the existing ash dump has a stormwater drainage system that captures stormwater flow from the rehabilitated sections of the ash dump into drains at the foot of the ash dump that feed stormwater into lined stormwater retention ponds. The implementation of such measures would greatly reduce the risk of any stormwater impacts to nearby riparian corridors; however this would be contingent on there being no risk of overflow / emergency discharge of stormwater from the attenuation ponds into any riparian area. The management of stormwater on the active ash disposal face is less easy to control, and infiltration of stormwater into the ground at the ash disposal face may become a factor, as discussed below. For this reason, the maintenance of a buffer between the ash dump and any surface water feature has been recommended as a key mitigation factor.

5.3 Groundwater-related impacts

Although the scope of this report does not cover groundwater, groundwater cannot be completely excluded due to the potential hydrological linkages between groundwater and surface water on the site. As described above subterranean hydrological inputs are believed to be an important factor in the occurrence of riparian vegetation on the site. Surface water hydrology on the site is not clearly defined in hydromorphological terms and there is no evidence of a classical fluvial regime with water inputs to the riparian zone emanating from an active channel. Surface water flows take the form of diffuse overland flow. It appears likely that riparian vegetation on the site draws on subterranean water (shallow groundwater) to a significant degree. It should be noted however that no surface water discharges (springs or seeps) were noted, thus groundwater inputs do not contribute to surface water flow in the system.

In this context impacts of the proposed development on groundwater could adversely affect surface water features by potentially affecting the health of the riparian corridor. Experience relating to existing ash dump facilities and groundwater flows in south Africa indicates that shallow water tables will develop as a mound under the disposal site, driving the groundwater flow in the direction of streams or other discharge points (Brites, 2013);

this suggests that shallow groundwater may be forced towards the ephemeral drainage lines on / adjacent to the site. The geohydrological report has concluded that groundwater flow direction on **Alternative 1** is generally southwards / south-eastwards (mimicking the topography) towards the valley bottom of the Sandloop Spruit. In the context of the **Alternative 2** site, groundwater flow also roughly mimics topography, being eastward flowing in the direction of the Mokolo River valley bottom. In the context of the **Alternative 1** site, the drainage line just to the west of the site would thus theoretically not be down gradient of groundwater flows. In the context of the **Alternative 2** site, the drainage lines in the north-western corner of the site would not be down gradient of the ash dump, but the downstream reaches of the drainage line to the north of the site could be. Nonetheless the report lists the non-perennial rivers on and adjacent to both sites as sensitive receptors (Brites, 2013).

The most important water quality impact associated with the proposed ash disposal facility (as based on experience relating to existing ash dump facilities in South Africa) would be changes in the pH of water moving through the dump and becoming leachate, the increase in salt content and the concentration of potentially toxic trace elements (Brites, 2013). According to the geohydrological report water contained in the ash material during deposition can leach constituents from the ash storage facility and transport it to the surrounding environment. The water that migrates through the facility can be discharged at the edge of the ash storage facility and enter the surrounding environment as surface water, or migrate vertically to the bottom of the storage facility and enter the underlying soil from where it can recharge and contaminate the aquifers (Brites, 2013). If not mitigated (through lining of the facility), leachate could enter groundwater receptors, thereby polluting existing groundwater resources. The exact nature of interaction between riparian vegetation within the ephemeral drainage lines on the sites and groundwater is not known, however groundwater with decreased pH (increased acid content) could adversely affect riparian vegetation causing a die off of this vegetation. It is thus very important that the mitigation measures and alternative site selection preferences of the geohydrological study be implemented (**Alternative 1** is preferred as the current groundwater baseline in the area around Alternative 1 is already adversely affected by the existing ash dump, entailing that groundwater pollution associated with the expanded ash disposal facility would have less of an impact than the impact at **Alternative 2**, where the groundwater is less polluted).

5.4 Construction-related Impacts

The general construction of the expanded ash disposal facility and associated infrastructure could be associated with other generic construction-related impacts on the riparian zones on the respective sites that are detailed below. The most important of these potential impacts relate to:

- A lack of / poor stormwater controls being put in place on the construction site. This may result in the creation of runoff containing pollutants such as cement and oils being transported by stormwater runoff into the adjacent riparian corridors.
- The dumping of construction material, including fill or excavated material into, or close to surface water features that may then be washed into these features.
- Spills of hazardous materials, especially oils and other hydrocarbons that may be washed into, or infiltrate nearby surface water features.
- The conducting of certain construction-related activities (such as cement batching) too close to surface water features or without the implementation of certain controls that may lead to the direct or indirect pollution of the surface water feature.
- The lack of provision of ablutions that may lead to the conducting of 'informal ablutions' within or close to a surface water feature that may lead to its pollution by faecal contaminants.
- The interaction of untrained construction workers with wetlands and water resources, which could result in the washing if equipment in rivers, for example

Most of these and other potential construction-related impacts can be minimised or adequately mitigated by controlling construction activities on the basis of an appropriately designed Environmental Management Programme (EMPr).

5.5 Comparative Assessment of Site Alternatives

Two sites have been provided for comparative assessment, and a preferred site needs to be chosen from a surface water perspective. Both sites contain surface water features, however the drainage line on the **Alternative 1** Site traverses a much smaller part of the site than the two drainage lines that converge within the north-western corner of the **Alternative 2** Site. The drainage line on the **Alternative 1** Site is also much narrower and contains less pronounced riparian vegetation. Looking slightly further than the drainage lines traversing the sites, the upper catchment of the drainage line that traverses the **Alternative 1** site is located close to the western boundary of the site, and the Sandloop River is located to the south of the site, about 650-850m to the south. In the context of **Alternative 2** Site, the drainage line downstream of the confluence of the northern and western drainage lines in the north-western part of the site runs parallel to the northern part of the site, being located between 100m-500m away from the northern boundary. The distance of the Sandloop River away from the **Alternative 1** site is believed to be sufficient to ensure that the Sandloop would not be directly affected by surface water inflows from the site. In contrast the closer location of the **Alternative 2** Site to the downstream reach of the drainage line after it leaves the site entails that this downstream reach could be adversely affected through stormwater discharge or polluted groundwater inputs in spite of not being located on the actual development site.

The riparian corridors on the **Alternative 2** Site have been assessed to be in a very natural state and close to reference state, being surrounded by a catchment in natural condition (falling within a nature reserve and game farm to the east). While the drainage line that bisects a small area of the **Alternative 1** Site was assessed to be in a natural condition, with its immediate catchment comprising of natural woodland vegetation, the wider setting is important. The upper-most part of the catchment of this drainage line is currently undergoing development and thus transformation as part of the development of the Medupi Power Station. Accordingly it is possible that stormwater discharges off the Medupi Site may be channelled into this drainage line, potentially affecting its hydrology. Immediately upstream of the area assessed a number of power line servitudes traverse the riparian corridor and accordingly the riparian habitat has been transformed as part of the clearing of the servitudes. Perhaps most importantly, the **Alternative 1** Site is located immediately adjacent to the existing Matimba Ash Dump, and in the context of consolidating impacts the expansion of the ash disposal facility onto the remainder of the Zwartwater property (**Alternative 1**) would be preferable to the creation of impacts in area that is currently relatively un-impacted by industrial development (**Alternative 2** Site). The development of the **Alternative 1** Site would thus constitute the consolidation of impacts on the affected drainage line in the context of it being impacted by the Medupi Power Station and the existing power line servitudes.

For these reasons explored above, the Alternative 1 Site is strongly preferred over the Alternative 2 Site, and it is recommended that the Alternative Site not be developed. In summary, the primary reasons for this finding are:

- The much smaller area of riparian habitat that would stand to be transformed / impacted on Alternative 1 as opposed to Alternative 2
- The highly natural condition of the riparian corridors on the Alternative 2 site that represent a reference state
- The catchment context which entails that the surface water features on Alternative 2 have a much more natural and un-impacted catchment than Alternative 1 in which the upstream drainage line and its catchment are impacted by the Medupi Power Station and the power line servitudes
- The close proximity of the downstream reach of the drainage line to the northern boundary of Alternative 2 that entails that this downstream reach could also be affected

5.6 Mitigation Measures and Recommendations

5.6.1 Development of the Facility on the Preferred Site

As discussed above the **Alternative 1** Site is the preferred Site, for a number of reasons. The development of the ash disposal facility on that site would constitute a mitigation measure as it would be likely to be associated with a much lower degree of impact, for the reasons explored above.

5.6.2 Non-transformation of surface water features by the proposed development

It is strongly recommended that no surface water feature and associated riparian zone be destroyed / transformed or physically affected by the proposed extension of ash disposal facilities. Both of the alternative sites could to be sufficiently large to accommodate the ash disposal facility without needing to physically impact the respective drainage lines and their associated riparian zones, depending on the area of the ash dump as compared to the size of the site. This is facilitated by the location of the drainage lines on the respective sites, being located close to the boundary of each site, particularly in the case of the preferred site Alternative 1 where the drainage line only traverses a very small part of the south-western corner of the site. By ensuring that these drainage lines and their associated buffers are maintained as no-go areas for development the risk of impacting these surface water features would be greatly reduced.

5.6.3 Maintenance of a buffer between the development and surface water features

Irrespective of which alternative site is developed, it is very important that a buffer zone be maintained beyond the boundaries of the surface water features and riparian corridors on, and adjacent to the sites. The buffer around riparian zones (which are of high sensitivity in a surface water context) has been recommended in order to offer protection to these features in terms of providing a distance between proposed infrastructure and the riparian corridor. Buffers allow ecosystem linkages and processes between the riparian corridor and surrounding woodlands to be maintained, with the retention of a natural gradient (the ecotone) between the riparian corridor and its catchment being an important component of the ecological functionality of the riparian corridor. Many types of biota which inhabit riparian corridors utilise the surrounding areas for foraging, and are not spatially restricted to the riparian corridor. The buffering of the catchment from development in the context of the riparian corridors on the site is very important in the context of potential impacts that may emanate from the ash dump, in particular potential stormwater impacts. As such it is critical to maintain a buffer surrounding the riparian corridor in which no development should be allowed.

The following exclusions must apply to the buffer areas:

- No ash disposal activities should occur within the buffer area
- No construction activities should occur in the buffer zone; the construction footprint should not affect the buffer zone in any way
- No storage areas for any materials, in particular hazardous materials (such as fuel), parking areas for vehicles or any temporary toilets should be located within a 50m zone beyond the buffer.
- No associated or linear infrastructure should be placed within the buffer

A 100m-wide buffer has been specified, in line with buffer specifications for buffers around river and wetland Freshwater Ecosystem Support Areas (FEPAs) and Fish Support Areas (Driver *et al*, 2011). It is important to note that the riparian area as delineated in this report and the associated 100m buffer must be used as the exclusion area on the development site.

5.6.4 Stormwater-related mitigation measures

A fully functional stormwater system must be installed as part of the design of the ash disposal facility, to ensure that no stormwater enters any drainage line on, or adjacent to the development site. Stormwater must be discharged into lined retention ponds, with sufficient capacity to ensure that there is no discharge into the environment.

Stormwater management must be carefully controlled in the vicinity of the active ash disposal face. It is recognised that 'permanent' stormwater measures cannot be implemented on the active ash disposal face as this is continually shifting. Nonetheless measures to ensure that stormwater does not leave the active ash disposal area must be installed. This could entail the construction of temporary soil berms at the edge of the cleared area to ensure that no stormwater carrying any pollutants leaves the active ash disposal area.

Similar temporary stormwater control measures must be implemented for any construction-related activities in areas adjacent to the buffers surrounding drainage lines and their riparian corridors.

6 IMPACT RATING MATRIX

The Impact rating matrix for the project appears below.

Phase	Potential Aspect and or Impact	Significance rating of impacts before mitigation	Mitigation	Significance rating of impacts after mitigation
Construction	• Irresponsible construction practices could lead to the pollution of surface water features (e.g. faecal contamination, or pollution of surface water through hydrocarbons) • Poor stormwater management could lead to the siltation or pollution of surface water features • Temporary road accesses across riparian corridors could cause hydrological and morphological impacts (erosion, channel morphology changes, undercutting of riparian areas, etc) and degrade the resource quality of the riparian corridor	**Extent:** Local (-2) **Duration:** Medium-term (-2) **Intensity:** Moderate (-2) **Probability:** Possible (-2) **Significance: Medium (-8)**	• Construction to be guided by Eskom guidelines for construction • Construction to be monitored by an ECO according to the stipulations of the EMPr • No batching or chemical / fuel storage areas to be located within any surface water feature or associated buffer • A construction stormwater management plan to be devised to prevent silt and polluted water ingress into surface water features • No temporary construction accesses to be constructed through any surface water feature and no machinery to enter any surface water feature or buffer	**Extent:** Site (-1) **Duration:** Medium-term (-2) **Intensity:** Low (-1) **Probability:** Possible (-2) **Significance: Low (-6)**
Operations	• Transformation / clearing of riparian corridors as part of the ash disposal activities would have a significant impact on the hydrology, morphology and resource quality of the affected drainage lines.	**Extent:** Local (-2) **Duration:** Long term (-3) **Intensity:** High (-3) **Probability:** Possible (-2) **Significance: Medium (-10)**	• No riparian zones or associated buffer areas must form part of the footprint of the ash dump. • The presence of a buffer beyond the edge of the riparian zone will protect the riparian corridor from direct impacts	**No impact**
	• Stormwater from the ash disposal area could enter riparian areas and transport pollutants into the surface water features.	**Extent:** Local (-2) **Duration:** Long-term (-3) **Intensity:** Moderate (-2) **Probability:** Possible (-2)	• Stormwater control to be included in the design of the rehabilitated ash dump. • Temporary stormwater control must be incorporated into the active ash disposal area. • Buffers (100m beyond the edge of the riparian zone) around riparian corridors to be strictly enforced	**Extent:** Site (-1) **Duration:** Short-term (-1) **Intensity:** Moderate (-2) **Probability:** Improbable (-1)

Phase	Potential Aspect and or Impact	Significance rating of impacts before mitigation	Mitigation	Significance rating of impacts after mitigation
		Significance: Medium (-8)		**Significance: Low (-5)**
Decom-missioning	• Improper rehabilitation of the ash dump could result in erosion of the deposited ash and its transport through stormwater into adjacent riparian zones, thus causing pollution	**Extent:** Local (-2) **Duration:** Medium-term (-2) **Intensity:** Moderate (-2) **Probability:** Possible (-2) **Significance: Medium (-8)**	• Decommissioning to be guided by Eskom guidelines for construction / decommissioning • Final rehabilitation of the ash dump to be monitored by an ECO according to the stipulations of the EMPr • No temporary accesses to be constructed through any surface water feature and no machinery to enter any riparian corridor	
Cumulative	• Cumulative loss of riparian habitat due to transformation of the riparian areas could result in a cumulative impact on the wider surface water feature. This is particularly relevant in the case of the drainage line on the Alternative 1 Site where there are a number of existing impacts on the drainage line and associated riparian corridor.		• Refer to activity / phase specific mitigation measures above	

7 CONCLUSIONS

Two alternative sites have been proposed for the expansion of the Matimba Ash Disposal Facility. The surface water context of the study area in which these two alternative sites are located is of an area with a relatively low drainage density and the presence of ephemeral drainage lines. Both sites are traversed by such drainage lines, although these do not traverse significant portions of the respective sites. In spite of the ephemeral nature of these drainage lines, they contain riparian zones that are distinct from the surrounding woodland vegetation in terms of vegetation structure and species composition. These riparian zones are ecologically very important, and play an important role in terms of the morphological state and state of health of the watercourses. The drainage lines on the site are not typical fluvial systems in terms of the presence of an active channel and hydrological activation of the riparian corridor by spate flows originating in the channel. Rather these drainage lines are characterised by diffuse surface water flows covering a wide area with no distinct central channel In addition the presence of shallow groundwater in the valley bottoms is expected to provide a significant amount of the hydrological input to the riparian vegetation on the sites.

The proposed ash disposal facility expansion could result in a number of potential impacts on the identified surface water features on, and adjacent to the site chosen for development. The most significant potential impact would materialise if riparian corridors were physically transformed by becoming part of the footprint of the ash dump. This would result in a loss of resource quality of the affected surface water feature, as well as impacts on the hydrology and hydromorphology of the affected surface water feature. For this reason no surface water feature and associated riparian corridor should be physically affected by the proposed development.

Other potential impacts relate to stormwater ingress from the ash dump into riparian corridors that could carry polluted water into the surface water environment. Riparian areas could also be adversely affected by pollution of groundwater originating from the ash dump. The maintenance of a buffer beyond the riparian corridors as stipulated in this report, the installation of stormwater control measures, and the implementation of groundwater pollution-related mitigation measures are critical mitigation measures that must be implemented in order to prevent the above potential impacts from occurring.

From a surface water perspective, the Alternative 1 site is strongly preferred for a number of reasons, most important of which are the smaller size of the riparian area potentially affected on Alternative 1, and the more impacted state of the wider drainage line and its catchment on the Alternative 1 Site as compared to the Alternative 2 Site.

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8.1 Web pages referred to in the text:

South Africa Rainfall Atlas: http://134.76.173.220/rainfall/index.html

Peer Review

Scientific Aquatic Services

Applying science to the real world

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Attention: Ms P Reddy

RE: SPECIALIST EXTERNAL REVIEW OF THE SURFACE WATER IMPACT STUDY FOR THE PROPOSED CONTINUOUS ASH DISPOSAL FACILITY FOR THE MATIMBA POWER STATION, LIMPOPO PROVINCE

Scientific Aquatic Services was requested to undertake a specialist external review of the Surface Water Specialist Study for the proposed continues ash disposal facility at the Matimba Power Station by Royal Haskoning DHV (RHDHV) on the report with reference E02. JNB 0001222 undertaken by Mr. P da Cruz as reviewed and approved by Mrs. B. Griffiths *Pr Sci Nat* (Reg No.400169/11) and Dated July 2014. The objective of the review was focused on the following aspects:

- To ensure the work meets current requirements/best practice;
- To ensure the work meets the requirements of the specialist information in support of the mandatory supplementary information required for Section 21 c & i licenses Form *DW781 suppl;*
- To ensure that the work has adequately assessed the impacts of the proposed development; and
- To provide an independent opinion of the report, its findings and conclusion as it relates to the assessment of the impacts associated with the proposed project.

Less attention was paid to formatting and grammatical issues as these have no bearing on the scientific validity and independency of the work done. Notes were however made on the document on selected identified issues during the review process and forwarded to the project manager.

The following points highlight the key findings of the review:

1. The inclusion of an executive summary will be useful.
2. First use needs to be checked throughout the report, acronyms list needs to be updated with those used within the report.
3. Figure 8 and 9 would be better presented under the section describing alternative 2.
4. The description of terrestrial vegetation (section 4.2.4.2) would be informative if done for alternative 1 as well. In accordance with the DWA (2005) delineation guidelines using vegetation as indictor.

5. It would be easier to relate the results presented in Sections 4.2.4.3 to 4.2.4.5 to alternative 2, if these were subheadings of Section 4.2.4.2. A clarification regarding why these sections were not considered important to include for alternative 1 at the end of Section 4.2.4.1, would be useful.
6. Scientific writing must be independent and free of emotional words such as ‘luckily”.
7. Although the report gives a lot of detailed attention to riparian vegetation and associated soils, it lacks a function and service assessment, Present Ecological State determination as well as an overall Ecological Importance and Sensitivity component. It should be noted that these aspects are mandatory supplementary information required for the Section 21 c & i licenses Form *DW781 suppl* as part of Water Use License Applications. These assessments should be done according to the most recent best practice methodology such as Kleynhans *et al*. 2009, DWA, 2007 and Macfarlane *et al*., 2009.
8. The drainage line characterisation was also done according to the VEGRAI method (Kleynhans *et al.,* 2007), however as indicated within the report the VEGRAI was not completely applicable to the features on site. The more recent Ollis *et al.,* 2013 method of characterisation might have proven useful with the determination of Hydrogeomorphic (HGM) Units. It should be noted that the subdivision of features into HGM units will be required in order to accurately access features according to the methods presented in point 7.
9. Taking the above into consideration it is deemed possible that the impact assessment could have been informed by scientifically sound methods instead of the specialist gut feel. Furthermore, focus could have been placed on more specific social and ecological services and functions that could potentially be impacted upon.
10. It is said that the preferred alternative will have a lower impact so clarification should be provided why the impact ratings of the two alternatives are so similar.
11. No reference is made of General Notice 1199 as published in the Government Gazette 32805 of 2009 as it relates to the NWA and the implications of the 500m trigger on development.
12. No national or regional desktop information is provided as available on the National Freshwater Ecosystems Database or the recently released Limpopo Conservation Plan. This information is considered important to ensure that the project takes into consideration national and regional ecological conservation targets.

Based on the findings of this review it is the opinion of the independent reviewer that the information presented in this report is largely accurate but that there are some gaps in the technical information presented with specific mention of the function and service assessment, Present Ecological State determination as well as an overall Ecological Importance and Sensitivity according to current best practice methodologies. It is therefore recommended that the gaps highlighted in this review either be justified or filled prior to the report being used for interpretation and preparation of the Environmental Impact Assessment and Environmental Management Programme development.

We trust we have interpreted your requirements correctly. Please do not hesitate to contact us if there are aspects of our comments that you would like to discuss further.

Yours Faithfully,

Digital Documentation Not Signed For Security Purposes

Stephen van Staden