ZITHOLELE CONSULTING

KUSILE POWER PLANT: ASH DISPOSAL FACILITY
GEOTECHNICAL STUDY
FEASIBILITY DESK STUDY REPORT

Report No.: JW006/13/D121 - Rev 1

April 2013

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SYNOPSIS

The Kusile Power Plant has an Ash Disposal Facility for the initial 10 year operational period but requires a new Disposal Facility for the life of the station of 60 years.

This report details the geotechnical feasibility desk study as part of the specialist studies required for the Integrated Regulatory Process.

The feasibility desk study included a detailed airphoto interpretation of the five preferred / proposed areas followed by a walk-over survey to inspect soil exposures at any road / river cuttings and old borrow areas.

For the baseline study, various parameters that have an influence on the ash disposal facility development from a geotechnical perspective were assessed and rated for each area. The impact of external factors such as the conveyors, road and river crossings on each area were then assessed and incorporated into the final ranking / selection process.

The geotechnical assessment of the sites has indicated that Area A is considered the most favourable area for the development.

Further to the above baseline study, a more detailed comparative impact assessment of the development for each area during Construction, Operation, Closure and Post-Closure phases was undertaken. During the construction and operational phases Area A and then Area B are rated as the preferred areas but during the closure and post-closure phases, the long term impacts of development of the ash disposal facility rated Area B as the least preferred area while Area A remained the preferred area.

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1. INTRODUCTION

1.1 Background

Kusile Power Plant is a coal fired power station that currently has an ash disposal facility (ADF) for an initial 10 year operational period. The estimated life of the plant is 60 years and consequently an ADF with a 60 year life is required within a 15km radius of the plant.

A pre-feasibility geotechnical ranking study[1] of eleven areas was undertaken in 2012 and after the screening phase, this number was reduced to five for further study.

A baseline feasibility study was required for these areas that included a detailed desk study followed by on-site "walk over" inspections. Following this baseline study, a more detailed comparative impact assessment for the development phases (e.g. construction, operation, closure and post-closure) of the facility was undertaken for each area.

This report details the findings of this feasibility desk study.

1.2 Scope and Purpose

The baseline feasibility desk study included a detailed airphoto interpretation of each of the five sites to identify:

- The general underlying geology.
- The representative terrain units.
- The soil profiles associated with the terrain units.
- Potential geotechnical constraints that would influence development of each site.

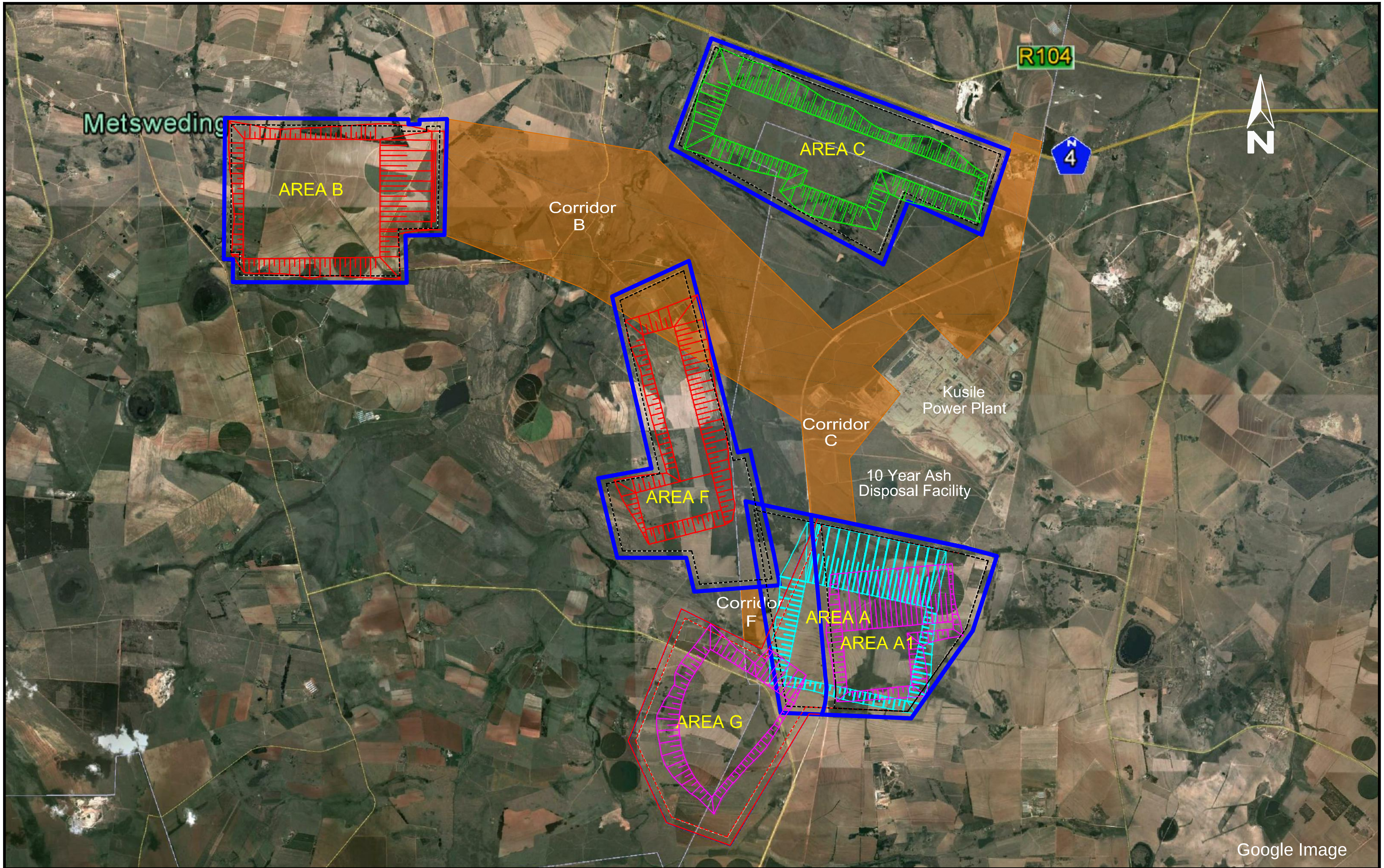
In addition to the five sites, the conveyor corridors to the study areas were assessed.

The locations of the five sites and the proposed conveyor corridors are shown on Figure 1.

1 Jones & Wagener (Pty) Ltd., May 2012. **Technical Site Selection for inclusion in Site Selection Report for Kusile 60 year ash facility EIA – Revision 2.** Technical Note.

On completion of the airphoto interpretation, a “walk over” survey was undertaken to inspect road and river cuttings, exposures, existing borrow pits, etc. to confirm the expected soil profile conditions.

This information was then used in the evaluation of the baseline geotechnical conditions that would have an influence on the location and design of an ADF. This was then followed by the comparative impact evaluation during the development phases of the facility.



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60 Year Ash Disposal Facility
Geotechnical Study

LOCALITY PLAN

Scale 1 : 100 000 (A4)
Coord System : WG29

Ø: D121-02

Figure 1

1.3 Report Structure

This report details the expected conditions at each of the five areas and the corridors. Each area is rated in isolation to external factors from a geotechnical perspective and then reviewed and re-rated against external impacts that conveyors, river and road crossings, etc. may have on the site.

A comparative assessment and rating of each area was then undertaken for the different phases of development (i.e. Construction, Operation, Closure and Post-Closure) of the facility.

The report concludes with the identification of the preferred site based on geotechnical conclusions.

2. METHOD OF INVESTIGATION

2.1 Desk Study

The desk study phase included a review of available geological data, geotechnical reports in the area and detailed airphoto interpretation.

2.2 Available Data

This included an assessment of available data provided in

- "*Geological Desk Study Report prepared for the EIA for the Proposed Witbank Power Station and Related Infrastructure*", prepared by Ninham Shand (Pty) Ltd., Report No. 4225/401281, October 2006.
- Council of Geoscience, 1:250 000 Geological Maps 2528 PRETORIA 1978.
- Topographic Sheet 2528DD BALMORAL, 1995.

2.3 Airphoto Interpretation (API)

Airphoto interpretation using 1:50 000 aerial photographs (Job 951 flown 25 May 1991 by the Government Printer) was undertaken for each area.

API is used to confirm general geological conditions and define terrain units and any linear features such as faults, dykes, etc.

A terrain unit defines specific land form within the broad area topography where similar geological conditions are present. Similar terrain units generally exhibit similar soil profiles and consequently geotechnical parameters.

Once the walk over survey was completed, the API was reviewed and modified to accommodate site observations.

2.4 Walk-over Survey

A site "walk over" was carried out where any cuttings, exposures, interesting features, etc. could be inspected.

No test pitting or laboratory testing was undertaken in this phase of the study.

3. GEOTECHNICAL CONSIDERATIONS

A review of each area and geotechnical aspects relevant to the construction of a tailings facility are provided below.

The parameters that have an influence on geotechnical conditions and thus the rating of an area include aspects such as geology, topography, terrain units, soil profile development, seepage, etc. These features were determined from the API and assessed on site during the walk-over survey. Following this, an assessment of the expected geotechnical conditions was made and compared to the end use with regard to construction requirements for an ADF.

The primary parameter assessed during the API is the general topography characterising each area. The macro topography can be subdivided into terrain units that could include broad convex crestal areas, convex / concave sideslopes and gullies and river zones. Each of these units will exhibit different typical soil profiles. The soil profile and horizon properties are largely dependent on the underlying geolgy.

The study area is characterised primarily by two geological sequences, namely, the Karoo Supergroup, primarily Dwyka Group tillites and Ecca Group shale and sandstones that are late Carboniferous to Early Permian in age (320 to 250 Ma) and the Transvaal Supergroup, Pretoria Group quartzites, slates and diabase that are late Archaean to early Proterozoic ranging from 2140Ma to 2350Ma in age.

The five sites are located in an area that is characterised by a humid climate where the Weinerts Climatic N value[2] is generally <5. In such areas chemical decomposition of the soil / rockmass predominates and consequently, depending on the rock mineralogy, residual soils tend to be more deeply weathered and clayey compared to areas affected by mechanical breakdown (N>5) of the rock fabric.

In the assessment of the potential suitability of site materials for construction use e.g. natural liner requirements, the texture of the soil provides a tangible indication of what the likely physical properties of the soils will be. These physical properties include parameters such as grading, plasticity index, liquid limit, etc, and combined with an on-site assessment and comparison against laboratory results of similar materials, a preliminary classification with regard to construction suitability can be made.

Once these soil types and expected parameters have been assigned to the terrain units, material and profile permeabilities, excavation characteristics, slope stabilities etc may be inferred.

Each of these parameters are weighted and then used in the rating and ranking of the geotechnical considerations for each area.

[2] Weinert, H.H. (1974) **A climatic index of weathering and its application in road construction**, Géotechnique, Vol. 24, No. 4, 475-488.

4. AREA GEOTECHNICAL EVALUATIONS

4.1 Area A

Area A is situated to the south of the Power Plant and could be defined by two potential configurations.

Area A, a single area that will provide for the requirements of a 60 year life but at the expense of having to divert the existing provincial road and pipeline and Area A1 a smaller area limited in the west by the existing provincial road. In order to satisfy a 60 year life, for Area A1, combing with either Area F or Area G may be required.

The latest design would suggest that Area A1 could accommodate the 60 year life requirement.

An option that could be considered if additional volume is required, would be to combine Area A1 with the existing 10 year facility particularly if a Wetland Offset Strategy is applicable.

4.1.1 Geology

Area A is underlain predominantly by tillite of the Dwyka Group (Figure 2). Sandstone and shales of the Ecca Group occur along the southern perimeter of the area. Shales of the Silverton Formation, Pretoria Group, are present along the northern perimeter. Diabase intrusives are present.

4.1.2 Topography & Terrain Units

Area A is characterised by an undulating topography. The main features causing the undulation are the two drainage streams that are present. The Holfonteinspruit that is situated in the middle of the site, drains in a northerly direction. Along the northern boundary, between the existing 10 year facility and Area A (as shown in Figure 3), the Klipfonteinspruit is encountered. The elevations on site range from 1500 metres above mean sea level (mamsl) in the upper crestal areas to 1440mamsl along the Holfonteinspruit.

The terrain units that are encountered in Area A are the Crestal Unit, the Sideslope Unit and the Alluvial/Gully Unit (Figure 3).

The crestal units are located along the western and eastern zones of the area. These are gently convex and typically have a gradient of 1:50 to 1:60.

The sideslope units are gently sloping generally in a northerly direction. The gradients of the sideslopes generally range from 1:25 to 1:30.

The alluvial/gully units are concave with the flood plain unit being in the order of 50m to 100m wide.

4.1.3 Soil Profile

The soil profile expected over the area underlain by the tillites will comprise a transported silty to clayey fine sand overlying a silty clay to clayey silt residual tillite. A basal gravel layer (pebble marker) is expected below the transported horizon varying from 0,3m to about 0,5m thick. The underlying residual tillite may extend to depth of 3,5m to 5,0m.

Locally diabase may be encountered and where present, the transported materials will be of a similar thickness and the underlying residual diabase, to depths of approximately 2,5m, will comprise a silty clay. Below this depth, a friable, residual silty sandy diabase with diabase cobbles/gravels is expected.

In the north, where the Silverton shales are encountered, the transported horizon will vary from 0,3m to 0,6m thick and will overlie a residual shale gravel. Below a depth of approximately 1m, soft rock shale can be expected.

4.1.4 Seepage & Profile Permeability

Based on the above expected profiles, the in-situ permeability of the soil profile is expected to be low to very low within the tillite profile. Where the diabase is present below a depth of approximately 2,5m, a low to moderate permeability can be expected. The diabase permeability will not play a significant role in the assessment as the diabase is intrusive and profile permeability will be determined primarily by the host rock i.e. tillite.

The Silverton shales will exhibit a low to very low primary permeability but due to secondary features such as jointing, the overall rockmass permeability is expected to be low. Where the diabase is present, below a depth of approximately 2,5m, a low to moderate permeability can be expected.

Seepage zones were noted in the sideslope unit and these zones are considered to be in areas where diabase is expected.

4.1.5 Materials

The transported horizon and the residual tillite and residual iabase horizons are expected to satisfy the requirements for natural liners as these materials are generally clayey fine sands to silty clays. When compacted (i.e. >98% Proctor at Optimum or up to 3% wet of optimum moisture content), permeabilities are expected to be low to very low[3] in the order of 1×10^{-7} cm/sec.

4.1.6 Excavation

Soft excavation is expected down to depths of at least 3m over most of the site. Over the Silverton shales, the depth of soft rock may only extend to about 1m and below this intermediate to hard excavation characteristics are likely.

4.1.7 Wetlands

The Holfonteinspruit and the Klipfonteinspruit are present. The headwater zones of these drainage features are located within the proposed opencast area of New Largo to the east and consequently contamination of these wetlands from mining operations can be expected.

The Klipfonteinspruit is already contaminated by decant from the old New Largo underground workings.

4.1.8 Site Summary

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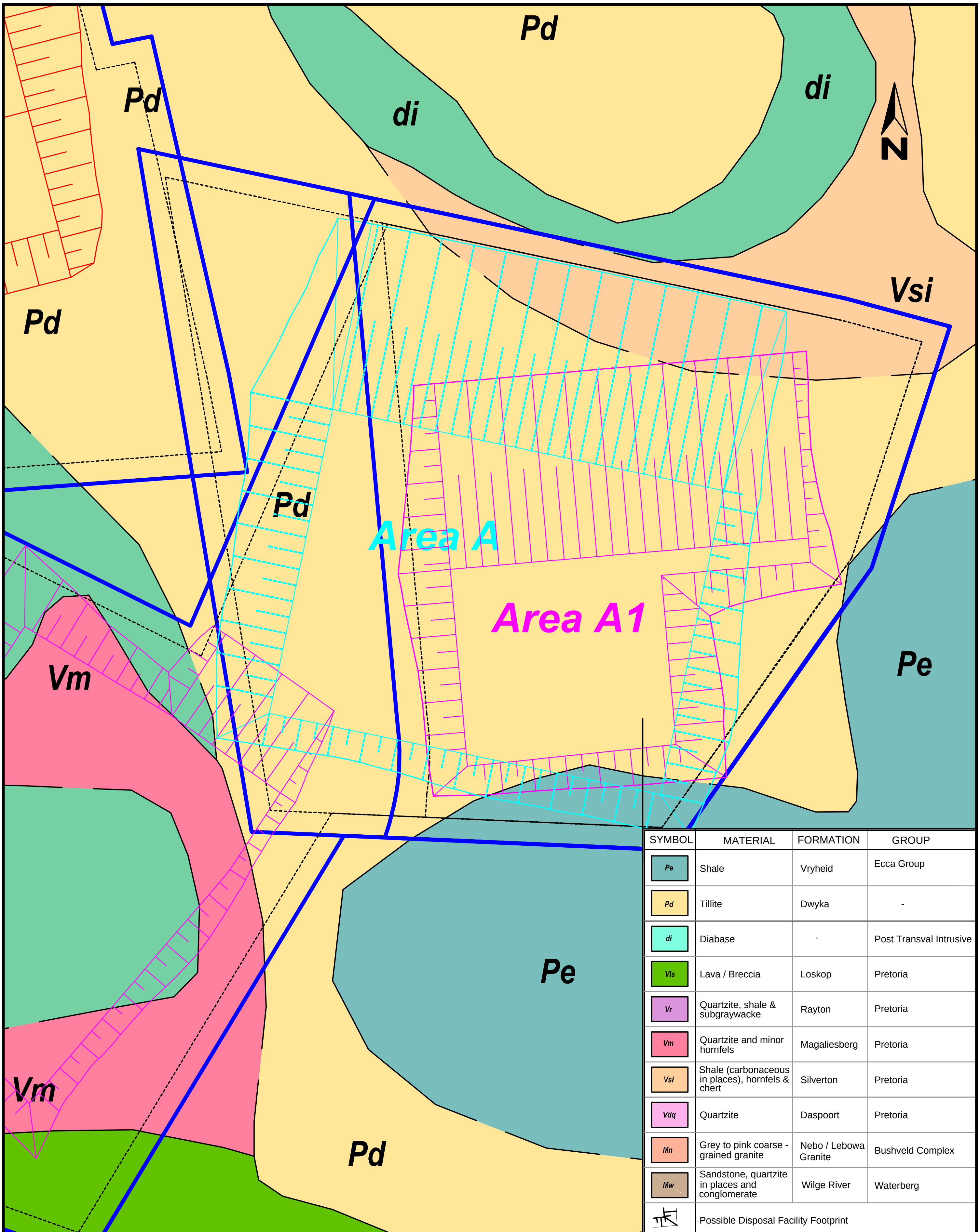
3 Pervious less than 1×10^{-4} cm/sec, low permeability (semi-pervious) 1×10^{-4} - 1×10^{-6} cm/sec, very low (practically impervious) >1×10^{-6} cm/sec. Earth and earth rock dams – Sherard et al 1967.

Site A is closest to the Kusile Power Plant and the current 10 year ADF and exhibits geotechnical conditions that generally are good for the development of an ADF.

The Holfonteinspruit and Kleinfonteinspruit have a significant impact on the area but these are likely to be under threat by the New Largo Mine. The Klipfonteinspruit is already impacted by the New Largo Colliery.

By applying the Wetlands Offset Strategy and using cut-off drains and diversion canals at the headwater zones, clean water could be intercepted and discharged into the Klipspruit in the north west corner of Area A.



SYMBOL	MATERIAL	FORMATION	GROUP
Pe	Shale	Vryheid	Ecca Group
Pd	Tillite	Dwyka	-
di	Diabase	-	Post Transval Intrusive
Vls	Lava / Breccia	Loskop	Pretoria
Vr	Quartzite, shale & subgraywacke	Rayton	Pretoria
Vm	Quartzite and minor hornfels	Magaliesberg	Pretoria
Vsi	Shale (carbonaceous in places), hornfels & chert	Silverton	Pretoria
Vdq	Quartzite	Daspoort	Pretoria
Mn	Grey to pink coarse - grained granite	Nebo / Lebowa Granite	Bushveld Complex
Mw	Sandstone, quartzite in places and conglomerate	Wilge River	Waterberg
	Possible Disposal Facility Footprint		

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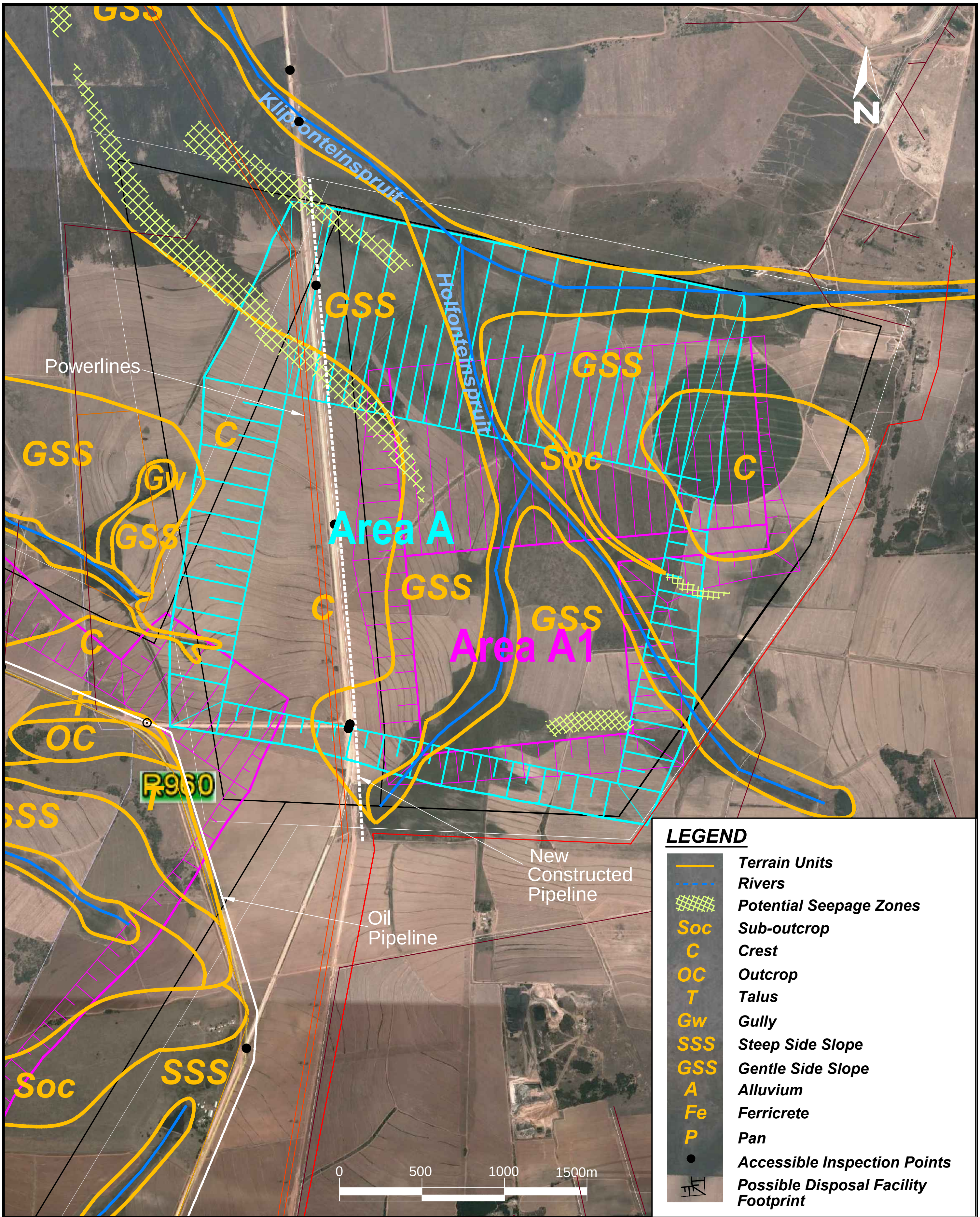
GEOLOGY - AREA A & A1

Ø: D121-02

Figure 2



Google Image

Scale 1 : 25 000 (A4)

Coord System : WG29

Jones & Wagener Consulting Civil Engineers 59 Bevan Road PO Box 1434 Rivonia 2128 South Africa Tel: (011) 519-0200 Fax: (011) 519-0201 Email: post@jaws.co.za	60 Year Ash Disposal Facility Geotechnical Study **TERRAIN UNITS - AREA A & A1**	Ø: D121-02 **Figure 3**

4.2 Area B

4.2.1 Geology

This area is underlain predominantly by Vryheid Formation, Ecca Group sediments and Dwyka Group sediments. The potential of any coal seams or other potential economic materials (e.g. fire clay) within the Ecca Group has not been assessed. The Ecca Group is present as a tongue within the northwestern section of the area (Figure 4 summarises the geology).

Within the extreme northwest corner and southeast corner, diabase and quartzite of the Transvaal Supergroup are present.

Two potential north east / south west trending lineaments are present in the eastern section of the area.

4.2.2 Topography and Terrain Units

The topography is characterised by a broad convex crestal area. Elevation in the central portion of the crest is approximately 1524mamsl and gentle sideslopes radiate from this area to approximately 1500mamsl around the site perimeter.

The general gradient away from the central area is in the order of 1:32 to 1:50.

Along the northern and western boundaries, north flowing tributaries (gully) of the Bronkhorstspruit are present while along the southern and eastern boundaries, east draining tributaries (gully) of the Wilge River are present.

The identified terrain units are shown in Figure 5.

4.2.3 Soil Profile

Over the crestal section, hillwash generally 1,2m to 3,0m can be expected. The hillwash is typically a fine grained silty to slightly clayey fine sand. This material overlies either a residual sandstone comprising silty to clayey medium grained sand or silty clay derived from the in-situ weathering of Ecca sandstone and siltstone respectively.

The soil profile over the tillite section (predominantly the eastern 2/3 of the area) will be characterised by a hillwash horizon that will vary in thickness from 0,6m to 1,7m. The hillwash comprises a silty fine sand with gravel. The underlying residual tillite comprises a firm, fissured clayey silt to silty clay with weathering generally occurring to depths of approximately 4m. Below this depth, highly weathered soft rock tillite can be expected.

Within the extreme northwestern portion of the area, quartzites and diabase are present. Thin sandy soils on hard rock bedrock are likely.

4.2.4 Seepage

Within the south-east section of the site, near surface seepage, possibly at the interface of a ferruginised hillwash and residual tillite horizon was noted. No defined gullies or streams are present.

4.2.5 Materials

The soil horizons to a depth of 2,5m are expected to classify as fine grained soils and the physical properties (e.g. gradings and Atterberg Limits) are expected to satisfy requirements where a permeability of 1×10^{-6} cm/sec to 1×10^{-7} cm/sec is achievable.

When reworked and recompacted the permeability is expected to be in the order of 1 x 10^{-7} cm/sec.

The in-situ permeability of the residual soils and the tillite bedrock is dependent on the degree of weathering and jointing. The profile is expected to be relatively impermeable but more permeable where a friable, sandy residual “sugar” diabase and quartzite is present in the northwest.

4.2.6 Excavatability

The soil profile to a depth of 3,0m is expected to classify as soft excavation.

4.2.7 Site Summary

When viewed in isolation to other factors, this site would be a suitable site for a disposal facility.

However, consideration will have to be given in the final screening to the impact of the conveyor route (refer Section 5) along the eastern boundary and the fact that two drainage catchments could be influenced.

4.3 Area C

4.3.1 Geology

This site is underlain primarily by rocks of the Transvaal Supergroup, Pretoria Group (Figure 6) that comprise shales of the Silverton Formation and quartzites of the Daspoort Formation.

Within the south west segment of the site, tillite of the Dwyka Group, Karoo Supergroup is present.

A defined linear structure trending northwest – southeast, located within the Silverton Shales, is evident on aerial photos but not evident on site. This could represent either a fault / fracture or a thin intrusive diabase dyke.

4.3.2 Topography and Terrain Units

This site has a general south westerly fall ranging from an elevation of approximately 1555mamsl in the north east to 1440mamsl in the south west. The area comprises sideslope and gully terrain units (Figure 7).

A well defined, narrow concave drainage channel (gully unit Gw) is present in the eastern section of the area that drains south westerly into a westerly draining branch of a tributary to the Wilge River that is present along the western boundary of the area.

The sideslope unit is generally characterised by a gentle south westerly dipping (gradient 1:33). In the north eastern corner a slightly steeper talus slope and outcrop zone are present.

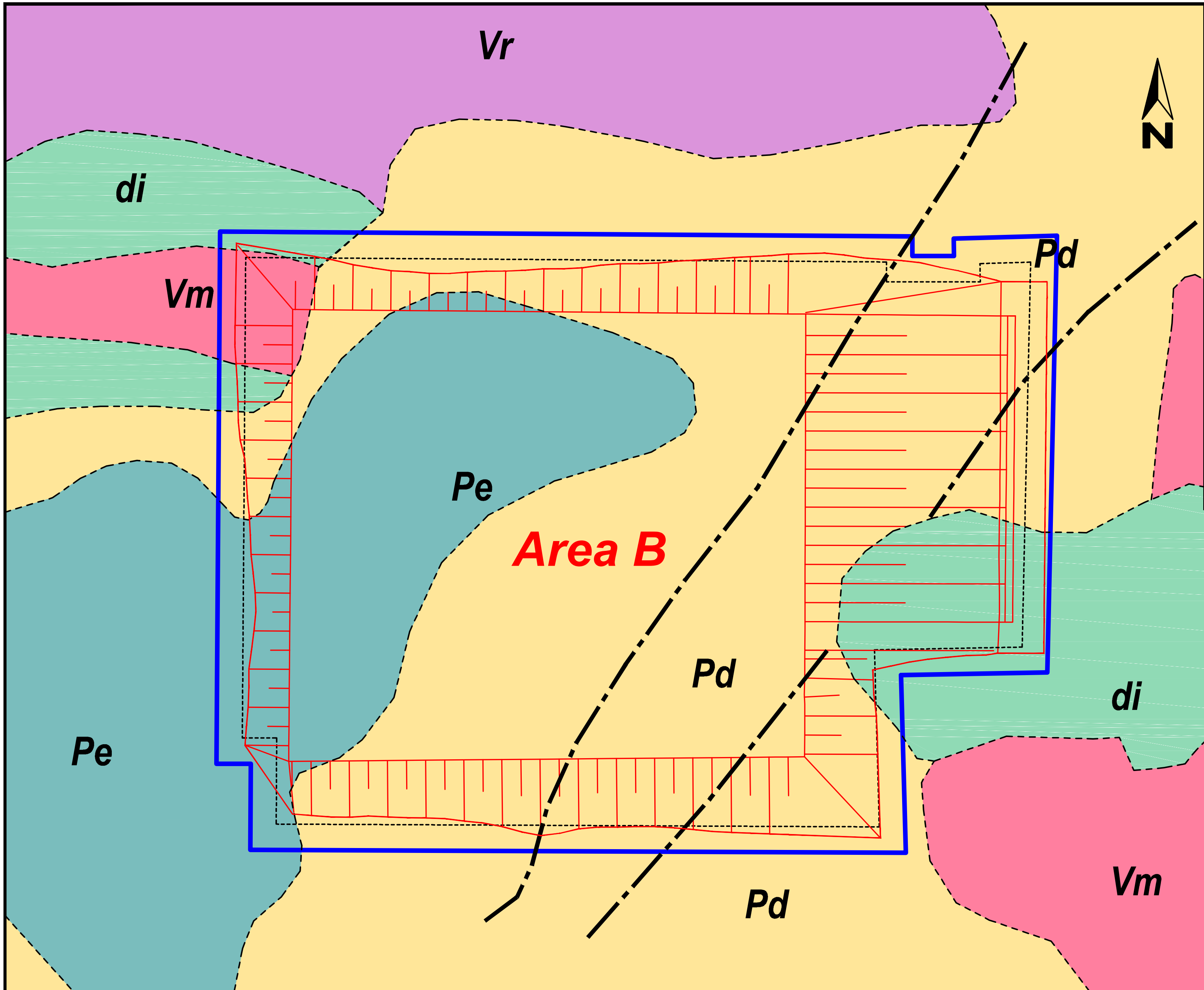
A small area characterised by a convex crestal zone is present in the centre of the site.

4.3.3 Soil Profile

The Crestal and Sideslope terrain units are encountered mainly over the Daspoort quartzites and the Silverton shales. In these units the thickness of the overlying transported horizon, although variable, is unlikely to exceed 0,5m. The transported material will comprise a silty fine sand with scattered gravels. The underlying soil profile comprises residual soils of clayey silts where shales are encountered or silty fine to coarse sands on the quartzites. The thickness of residual soil development will be very irregular and very limited, probably no thicker than 0,1m to 0,3m.

Shallow bedrock comprising a jointed, soft rock, shale and/or quartzite is expected at depths from about 0,3m.

Within the southwestern corner, the sideslope unit is underlain by the tillites of the Dwyka Group. A localised outcrop zone is also present in this area. Outside of the outcrop zone the thickness of transported and residual soils is expected to be slightly thicker than elsewhere on the site.



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Mn	Grey to pink coarse - grained granite	Nebo / Lebowa Granite	Bushveld Complex
Mw	Sandstone, quartzite in places and conglomerate	Wilge River	Waterberg
	Lineament		
	Possible Disposal Facility Footprint		

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GEOLOGY - AREA B

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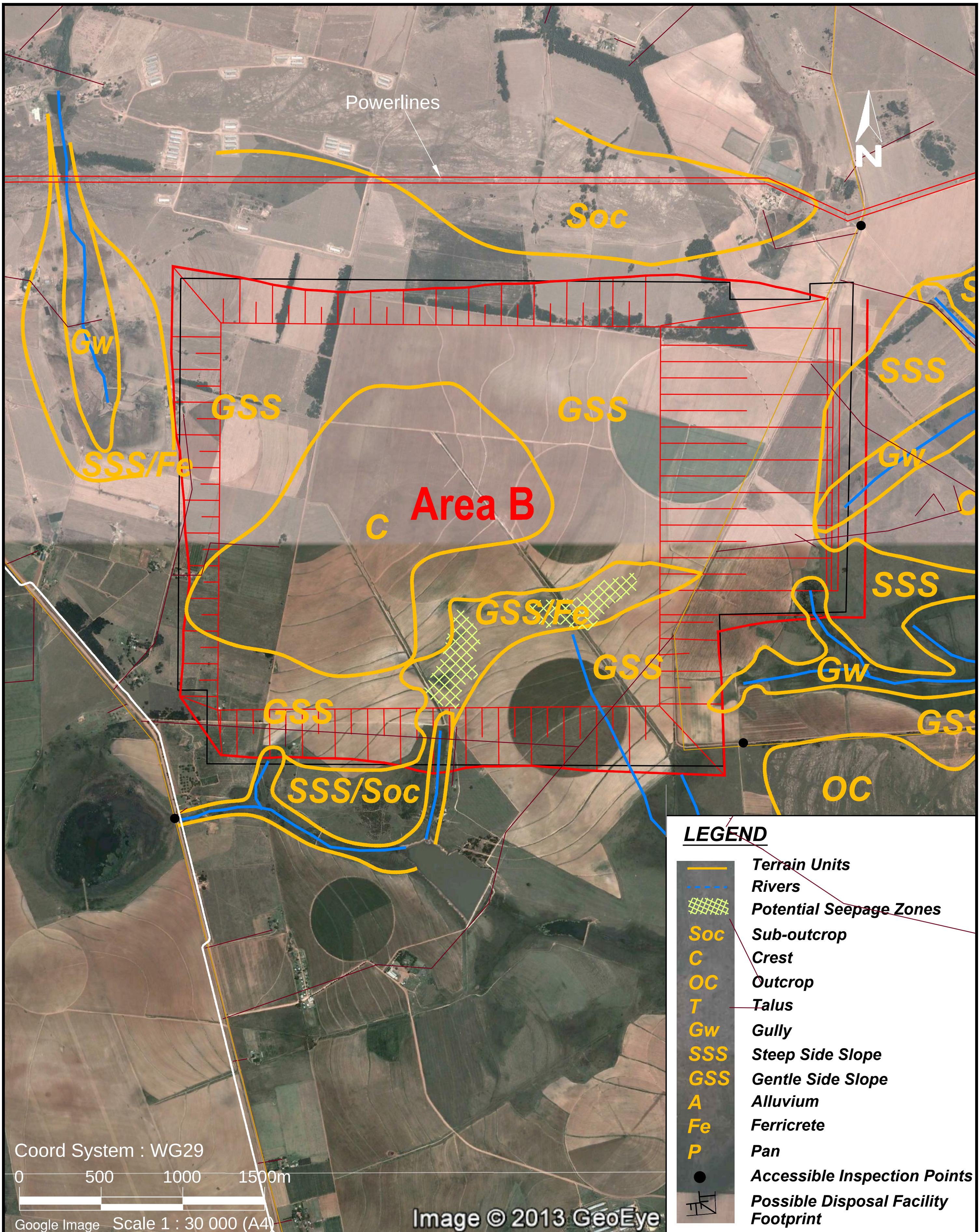
Figure 4



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TERRAIN UNITS - AREA B

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Figure 5

4.3.4 Seepage

No surface seepage zones were observed and the only drainage channel is a secondary gully tributary that drains in a southerly direction into a primary tributary of the Wilge River.

4.3.5 Materials

The material overlying the quartzites will be of limited thickness and sandy to gravelly in nature. Some borrowing of sandy gravels has occurred. These soils are expected to classify as sandy gravels / gravelly sand and therefore will exhibit moderate to high permeability characteristics and will not satisfy natural liner construction requirements.

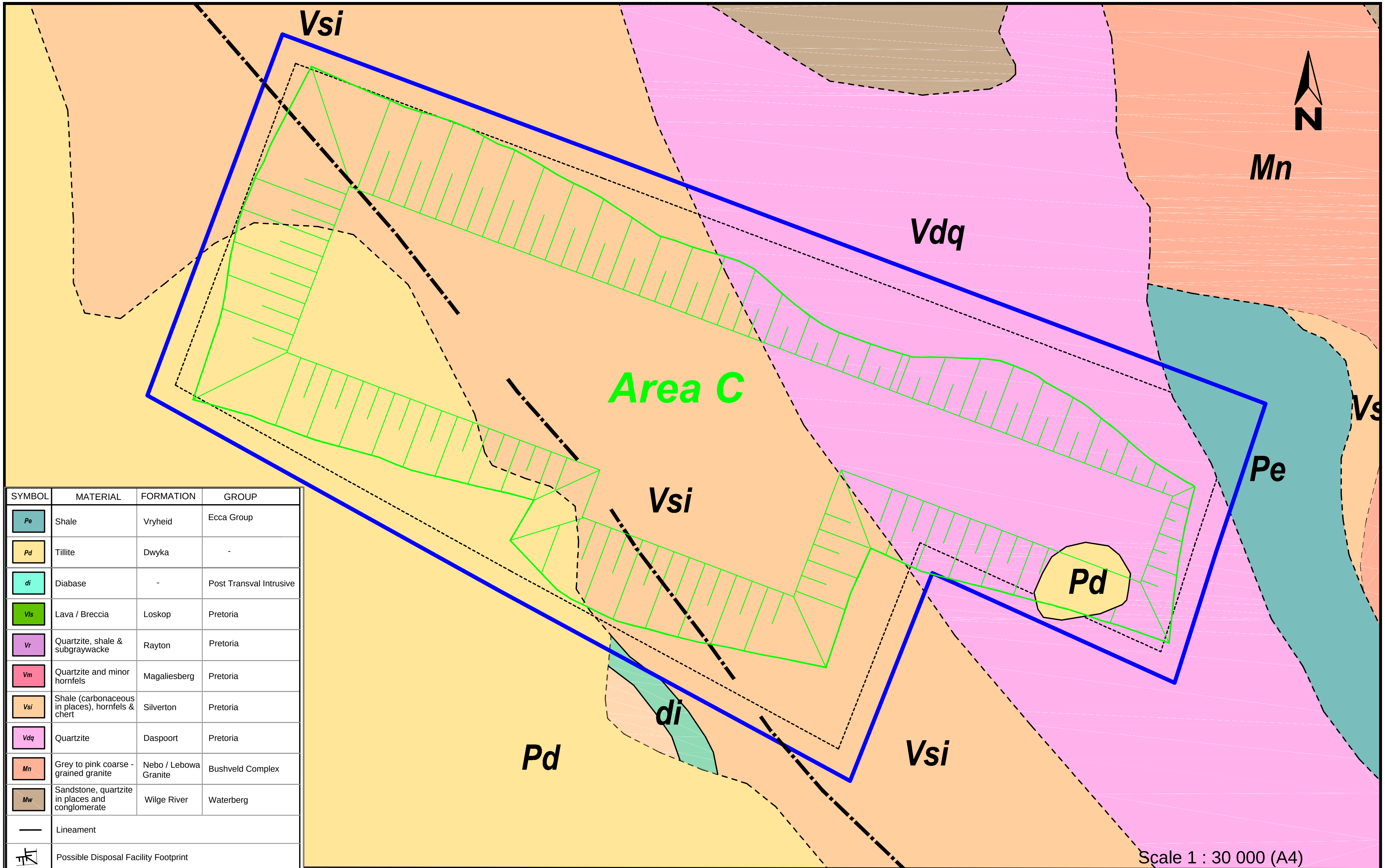
The physical properties of the residual soils and the jointing within the shallow bedrock are expected to result in moderately high in-situ permeabilities.

4.3.6 Excavation

The depth of soft excavation is likely to be limited to <1,0m over the whole site except possibly in the south west corner where tillites are expected. Depth of excavation in this area could be up to 3,0m.

4.3.7 Site Summary

Although the general topography and extent of the area is suitable for a disposal facility, the major disadvantage of this site is the poorly developed soil profile conditions. The lack of site materials for construction will require either establishing a suitable off-site borrow area or importing material.



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——	Lineament		
(hatched symbol)	Possible Disposal Facility Footprint		

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GEOLOGY - AREA C

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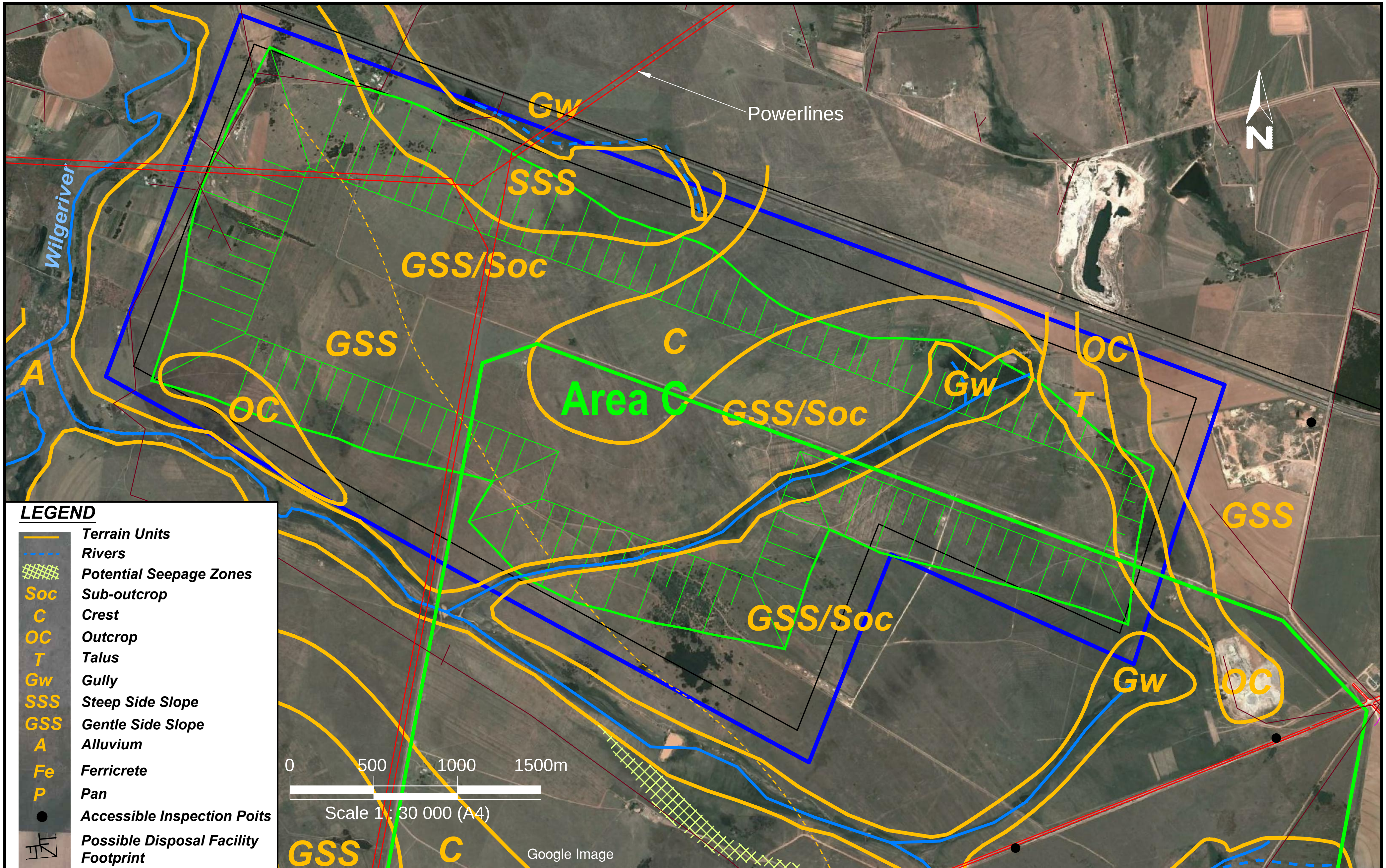
Figure 6



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TERRAIN UNITS - AREA C

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Figure 7

4.4 Area F

4.4.1 Geology

The proposed tailings area is underlain predominantly by rocks of the Dwyka Group, Karoo Supergroup. Within the south western and central west sections, diabase, quartzites and siltstone of the Pretoria Group, Transvaal Supergroup, are present (Figure 8).

Two northwest trending lineaments are evident within the central section of the study area and two north east trending lineaments are located on the northern and southern boundaries of the area.

4.4.2 Topography and Terrain Units

The site is characterised by a “whale back” topography with the dominant unit being a gentle convex crestal unit along the central area of the site. To the west and east of the crestal zone, gently sloping sideslopes are present. The western sideslope exhibits gradients in the order of 1:33 while the eastern sideslope is 1:50.

The terrain units and likely zones of seepage are shown on Figure 9.

Drainage / gully units are not well defined in Area F except in the south western area where a westerly draining gully is present. An indistinctly defined gullyhead is present in the central eastern section of the site.

Although no defined drainage channels are present on site, the area is bounded by the Wilge River and Klipfonteinspruit in the west and east respectively.

The south western limb of Area F is characterised by a gully zone with steep talus and sub-outcropping zones. The combination of these terrain units will have an influence on constructability.

4.4.3 Soil Profile

The soil profile within Area F will be characterised by a clayey fine sandy hillwash that is likely to range in thickness from 0,5m to 1,7m and be underlain by residual silty clays to clayey silts derived from the weathering of the tillites.

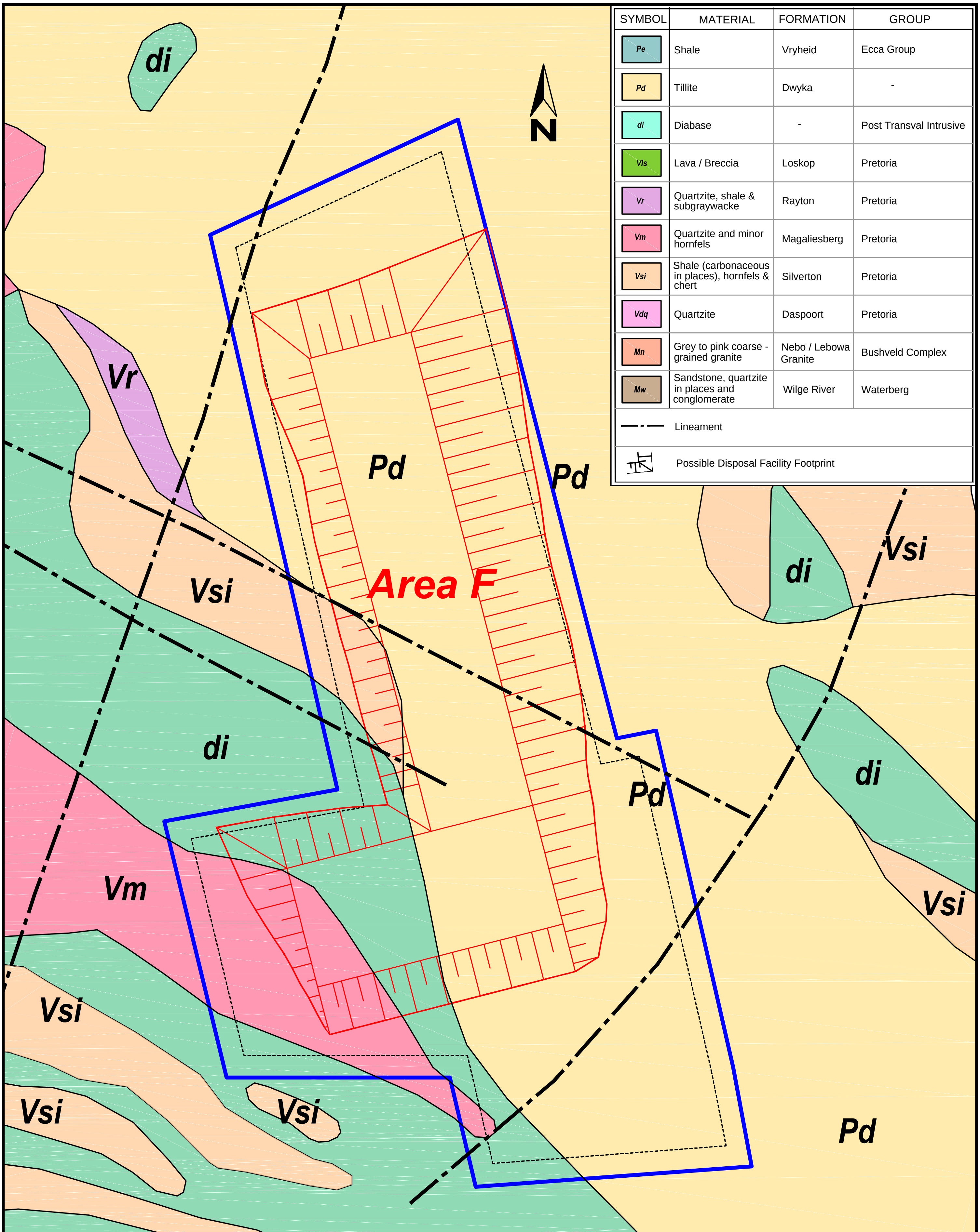
The western limb in the south west corner is underlain by quartzites and residual diabase soils. The thickness of soil will generally be thin over this section where the Pretoria Group rocks are encountered.

4.4.4 Seepage

Signs of perched water table development are evident along the flanks of the streams located along the western and eastern boundaries of the site.

Perched water tables are likely to develop on the contact of the hillwash and the residual soil profiles probably at depths in the order of 1,5m to 2,0m. The interface zone is characterised by ferruginisation and the development of ferricrete nodules and it is within this material that the seasonal perched water table will be evident.

A pan is located in the southern section of the proposed footprint.



SYMBOL	MATERIAL	FORMATION	GROUP
Pe	Shale	Vryheid	Ecca Group
Pd	Tillite	Dwyka	-
di	Diabase	-	Post Transval Intrusive
Vls	Lava / Breccia	Loskop	Pretoria
Vr	Quartzite, shale & subgraywacke	Rayton	Pretoria
Vm	Quartzite and minor hornfels	Magaliesberg	Pretoria
Vsi	Shale (carbonaceous in places), hornfels & chert	Silverton	Pretoria
Vdq	Quartzite	Daspoort	Pretoria
Mn	Grey to pink coarse - grained granite	Nebo / Lebowa Granite	Bushveld Complex
Mw	Sandstone, quartzite in places and conglomerate	Wilge River	Waterberg
—·—	Lineament		
	Possible Disposal Facility Footprint		

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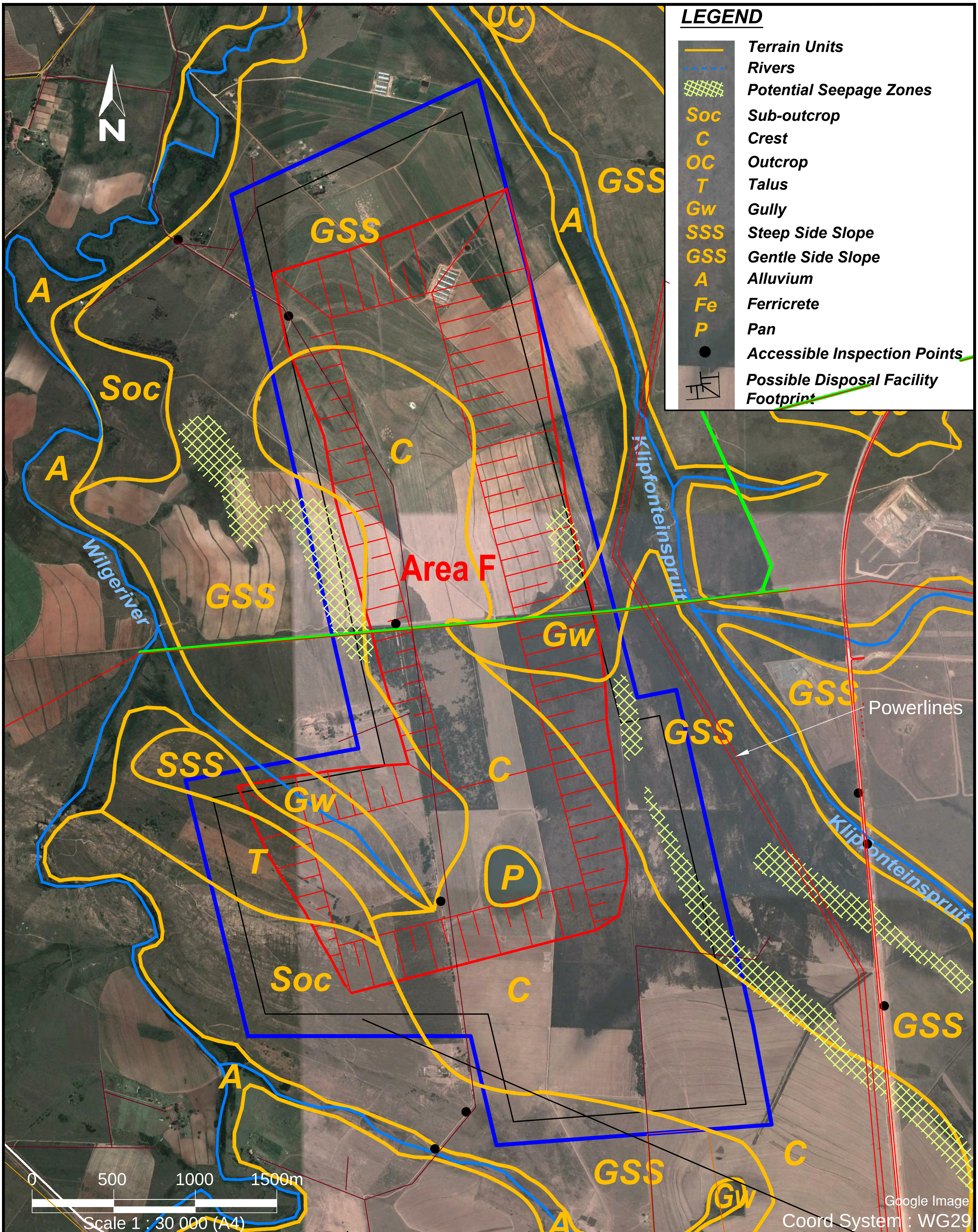
60 Year Ash Disposal Facility
Geotechnical Study

GEOLOGY - AREA F

Ø: D121-02

Figure 8



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60 Year Ash Disposal Facility
Geotechnical Study

TERRAIN UNITS - AREA F

Ø: D121-02

Figure 9

4.4.5 Materials

The transported and residual soils developed over the tillite profile are expected to be suitable for natural liner construction purposes. The permeability of these horizons when reworked and recompacted is expected to be in the order of 1 x 10^{-6} cm/sec to 1 x 10^{-7} cm/sec.

The residual soils and tillite bedrock are likely to exhibit a low degree of permeability. Over the quartzites, shales and diabase, moderate permeabilities can be expected. This will be influenced primarily by the jointing present within the rockmass.

4.4.6 Excavatability

Soft excavation, down to depths of 2m, is expected over the whole area except for the south west section where the quartzites and shales are encountered. Over this south-west section, soft excavation to depths ranging from 0,5m to 1m is likely while blasting below this depth can be expected.

4.4.7 Site Summary

Based purely on geotechnical conditions, the site is considered a moderate to good area for a discard facility. However, the area is bounded by two major streams and has a pan on the southern perimeter.

Consideration should be given to moving the western limb off the quartzites and shales and extending the site southwards. By doing this, the proposed facility will be located on a crestal to gentle sideslope area that would provide more favourable conditions than would be encountered over the quartzites.

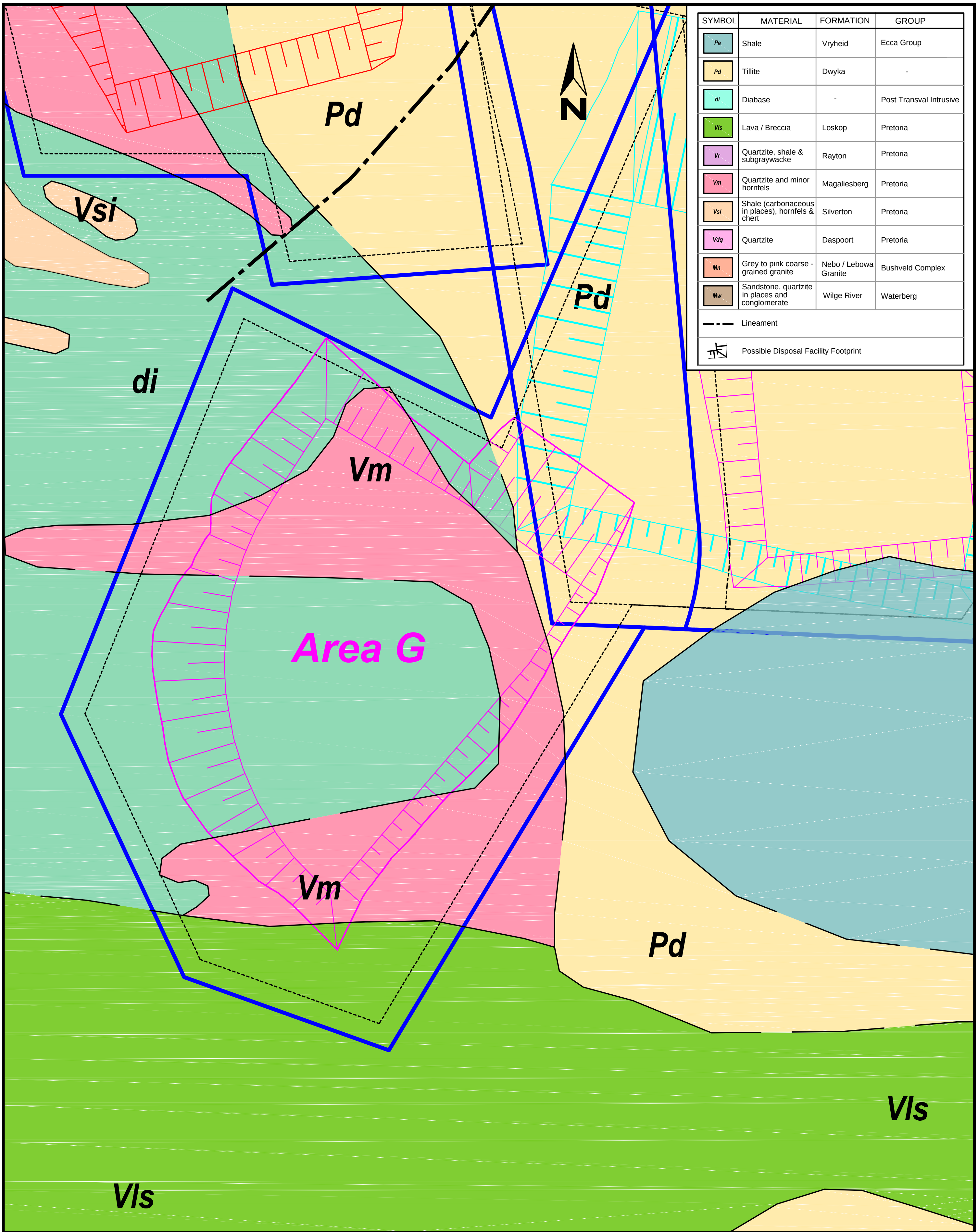
4.5 Area G

4.5.1 Geology

Area G is underlain primarily by quartzites of the Pretoria Group and diabase intrusives. The quartzite occurs as outcropping hard rock and is present as a horse-shoe within a diabase rockmass (Figure 10).

4.5.2 Topography & Terrain Units

Area G is dominated by a central depression area underlain by diabase that is rimmed by the sub-outcropping quartzite. The depression is drained in a westerly direction by a well defined gulley. The extreme northern area of the proposed disposal area is characterised by a gentle northerly dipping sideslope and crestal area while the remainder of the area is generally characterised by steep sideslope and the gullywash units. The sideslopes to the south of the quartzite outcrops are generally steep (1 in 10) while the slopes to the north of the quartzite are generally flatter (1 in 30). The terrain units are shown on Figure 11.



SYMBOL	MATERIAL	FORMATION	GROUP
Pe	Shale	Vryheid	Ecca Group
Pd	Tillite	Dwyka	-
di	Diabase	-	Post Transval Intrusive
Vls	Lava / Breccia	Loskop	Pretoria
Vr	Quartzite, shale & subgraywacke	Rayton	Pretoria
Vm	Quartzite and minor hornfels	Magaliesberg	Pretoria
Vsi	Shale (carbonaceous in places), hornfels & chert	Silverton	Pretoria
Vdq	Quartzite	Daspoort	Pretoria
Mn	Grey to pink coarse - grained granite	Nebo / Lebowa Granite	Bushveld Complex
Mw	Sandstone, quartzite in places and conglomerate	Wilge River	Waterberg
	Lineament		
	Possible Disposal Facility Footprint		

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GEOLOGY - AREA G

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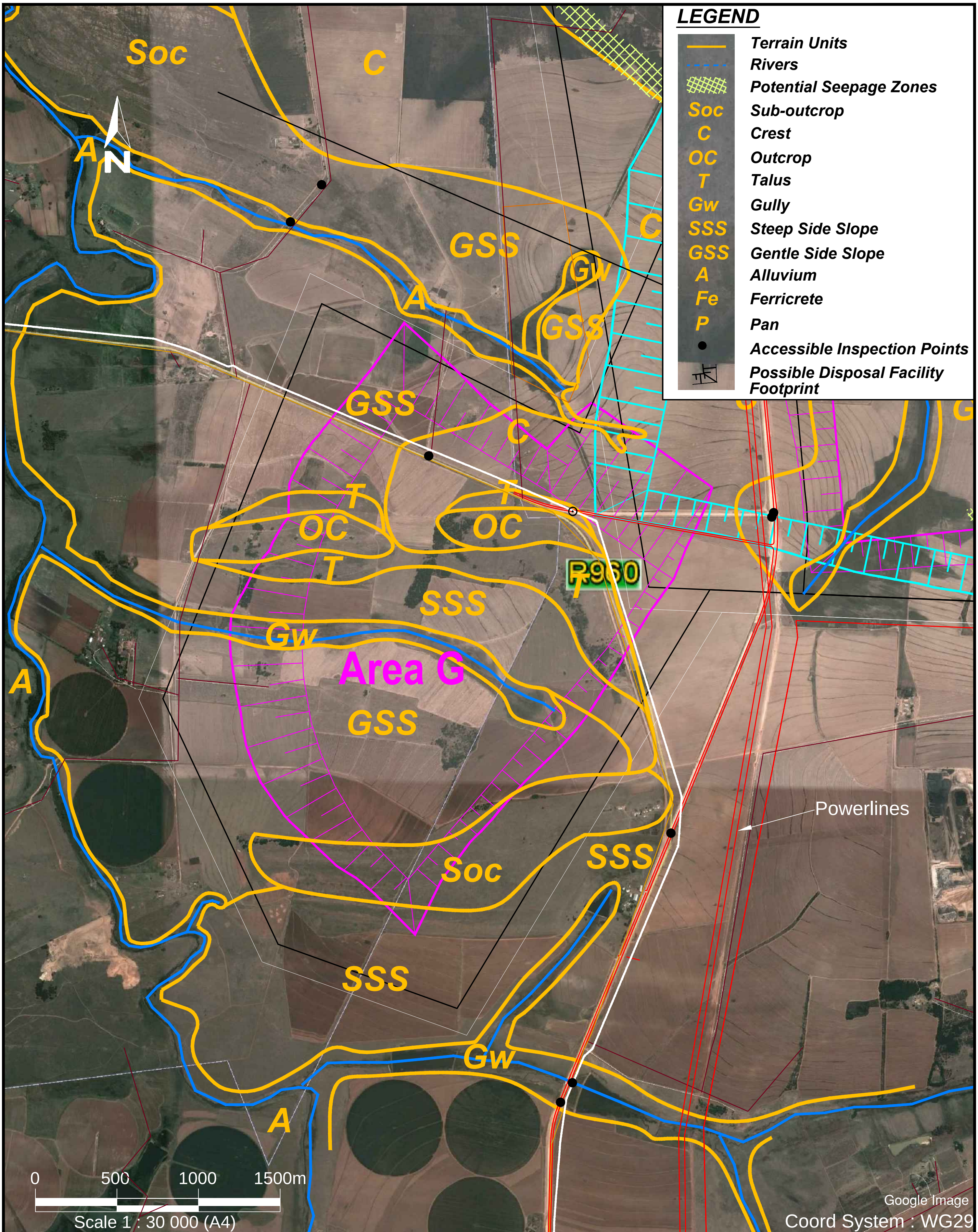
Figure 10



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60 Year Ash Disposal Facility
Geotechnical Study

TERRAIN UNITS - AREA G

Ø: D121-02

Figure 11

4.5.3 Soil Profile

The soil profile overlying the talus units and quartzite outcrop zones will comprise a thin to very thin sandy soil overlying a hard rock quartzite. Weathering within the quartzite may be possible that could result in residual soils approximately 0,5m thick. Over the diabase zones, transported clayey sands to a depth of about 1,5m overlying a friable sandy residual diabase can be expected.

4.5.4 Materials

The transported and residual soils developed over the diabase profile comprise clayey sands to sandy clays in the upper 1m to 2m and could be considered for natural liner construction. However, the underlying residual diabase is expected to be a friable silty sand, relatively permeable and not suitable for liner purposes.

The talus soils and the soil overlying the quartzite will be sandy and gravelly in nature, permeable and generally unsuitable as a natural liner.

The gullywash zone is expected to comprise 0,5m to 1,0m of grey brown sandy clay that will exhibit low permeability characteristics.

The in-situ permeability of the profile is expected to be fairly low (approximately 1×10^{-6} cm/sec) within the upper 1,5m in the diabase zone. Below this depth and within the quartzite, moderate permeabilities can be expected due to the sandy nature of the soils and relict jointing that will characterise the diabase and quartzites.

4.5.5 Excavatability

Over the diabase profile, excavation depths of at least 2m are expected, but over the quartzite excavation depths are likely to be limited to about 0,5m.

4.5.6 Seepage

No surface / perched water table conditions were noted. The only drainage / wetland feature is the gully in the centre of the area. Moderate to strong runoff of surface water can be expected over the quartzite zones.

4.5.7 Site Summary

The general basin topography and steep slopes of the site are likely to adversely influence the general deposition of tailings.

The soil profile conditions of this area result in the area having a reasonable rating. However, the steeper south facing sideslopes and general potential for localised instability and poorer topographic expression are considered negative factors that result in a down rating of this area relative to the pre-feasibility study. These aspects will have to be considered in the design and the method of deposition will have to take this into consideration.

The development of Area G would require relocation of an existing provincial gravel road and gas pipeline.

5. CORRIDORS

5.1 Corridor B

This is the corridor zone to the proposed disposal area – Area B. This corridor is located entirely on a greenfields zone.

This alignment traverses various terrain units ranging from crestal zones to alluvial zones. From the power plant westwards to the Wilge River, the dominant terrain units are the crestal, gentle sideslopes and alluvial units.

The soil profiles developed in these terrain units will generally result in fair to good founding conditions being present for the conveyor foundations.

Gantries or culverts could be considered over the smaller alluvial zones but over the Wilge River something more substantial i.e. bridge may have to be considered.

The soil profile along the section of conveyor from the Power Plant to the Wilge River will generally exhibit low permeability characteristics and consequently surface runoff of stormwater and any contaminants e.g. ash dust / fines generated by the conveyor is likely to discharge into the Klipfonteinspruit and Wilge River.

From the Wilge River to the approach to Area B, the gradient of the sideslopes locally vary from about 1:10 to 1:40 and are characterised by sub-outcropping zones. These areas exhibit numerous near-surface wet zones with high run off that will develop during the wet season. Any spillage or waste from the conveyor over this zone will run off and discharge into the Wilge River.

5.2 Corridor C

This corridor runs in a northerly direction to the proposed Area C disposal facility. Much of the corridor is located within property already influenced by the existing Kusile development. The geotechnical conditions along most of the route will be characterised by the soils overlying Silverton shales or Dwyka tillites. In general, good founding conditions will be encountered and one relatively small gully channel will need to be crossed. In situ profile permeabilities will generally be low.

5.3 Corridor F

This corridor to areas F and G is generally located on a crestal unit underlain by tillites. These conditions will provide fair to good foundations for the conveyor. The profile conditions are relatively impermeable and thus downward migration of any dirty water / contamination created by the conveyor is likely to be limited and surface runoff will predominate.

One provincial road, a pipeline and powerline will need to be crossed to access Areas F and G.

6. GEOTECHNICAL BASELINE RATING

The rating and ranking for each site has been based on the parameters discussed in the previous sections. The ratings based on these parameters and the detailed API and walk-over survey are shown on Table 1.

Table 1: Geotechnical Ratings and Rankings

Area	A	B	C	F	G
Geotechnical Aspects					
Geology	8	8	7	8	8
Soil Profile	9	9	3	8	6
Lineaments	9	9	2	5	9
Site Materials	9	9	1	8	7
Seepage/Drainage	2	6	8	5	6
Topography	5	7	8	8	4
Excavation up to 3m	9	8	3	8	6
Profile Permeability	9	9	5	8	8
Rating Total	60	65	42	58	54
Ranking*	2	1	5	3	4

Each site was rated and ranked on the geotechnical aspects and in isolation to any other outside factors such as distance from the site, influence of conveyors, etc. These factors were included when the external factors and risk impacts were considered.

The external factors that were considered to impact on the ranking of each site are discussed below.

7. GENERAL EXTERNAL FACTORS IMPACT REVIEW

7.1 Area A

Area A was consistently identified as a favourable site geotechnically for the development of an ADF. However, due to the existence of the provincial road and the pipeline on the western boundary, Area A may have to be reduced in size to Area A1. In order to achieve a 60 year life for the facility, a combination of Area A1 with either Area F or Area G will be required, or with the current 10year ADF.

The major factor influencing Area A is the presence of the two wetland areas of the Holfonteinspruit and the Klipfonteinspruit. The headwaters of these two rivers start within the area of the proposed New Largo open pit and consequently a deterioration of these wetlands will occur with or without Area A being developed.

Therefore, as Area A is consistently a good site, it may be expedient to contain the infrastructure development to the Eskom property but this would result in the loss of the wetlands of the Holfonteinspruit and Klipfonteinspruit in this area. As the Klipfonteinspruit is already contaminated by mine water discharge from the New Largo area, the application of the Wetland Offset Strategy may be considered. By constructing cut-off / collection drains in the headwater areas, these wetland areas could be replaced or relocated into the Klipfonteinspruit to the northwest of Area A.

If the road and pipeline in the western portion of Area A cannot be relocated, the combination of A1 with either Area F or G will have to be considered, but is not ideal. Alternatively, if a wetland offset is approved, combining A1 with the existing 10 year ADF could be considered.

7.2 Area F

Area F is characterised by good geotechnical parameters. The main disadvantage of this site is that it is bounded by the Wilge River and Holfonteinspruit in the west and east respectively and has a small pan in the south. The design of the facility and good management practices during construction and operation should minimise dirty water runoff into these river systems.

If this area is to be used in association with Area A, we would recommend that the western limb be excluded and replaced by a southwards extension. It is probable that sufficient space will be present for any infrastructure and a southward extension to accommodate the volume covered by the west limb even if a southwest extension is contemplated.

7.3 Area G

This area is only considered a reasonable area for development. The south facing slopes in this area are relatively steep 1:10 and this may result in localised instability depending on how the disposal of fine ash will occur. In addition a road diversion and relocation of a pipeline will be required.

7.4 Areas A, F and G Summary

Taking the above factors into consideration, a combination of A1 and F is preferred over A1 and G.

7.5 Area B

Area B has a good geotechnical ranking but the dominant external factors that will impact this site are:

- the distance from the power plant.
- A conveyor from the plant to Area B will traverse over a greenfield area.
- The conveyor will have to cross a provincial road and two river crossings.
- The steep, sub-outcropping approach to Area B from the Wilge River.

The conveyor approach to Area B is characterised by sub-outcropping quartzites and thin soil development. High runoff, easterly to the Wilge River, during wet seasons can be expected. If the conveyor is not enclosed over this section, it is likely that moderate to high levels of fine ash / ash dust could end up in the Wilge River.

The Wilge River floodplain is fairly extensive in this area and it is possible that a bridge rather than a gantry option may be required.

7.6 Area C

Area C ranks last from a geotechnical perspective primarily due to the lack of transported and residual soil development. Very limited site materials that would satisfy natural liner requirements are present and this would result in the use of an artificial liner or opening a borrow source to provide a sufficient quantity of clayey material suitable for liner requirements. The cost of importing material from a borrow source are not only likely to be high but a licence to open a borrow source will also be required. The borrow source would also have to be remediated on completion of removal of material.

The conveyor considered to Site C will generally be located within an area belonging to Eskom and already affected by development and consequently this impact is not considered significant.

7.7 Corridor Summary

The geotechnical and other conditions encountered along the different corridor routes that will have an impact on the final rankings are given in Table 2.

Table 2: Summary of Corridors

CORRIDORS		
B	C	F/G
Geotechnical Aspects:		
Good founding conditions.	Good founding conditions.	Good founding conditions.
Predominantly Karoo Supergroup rocks and good soil profile conditions.	Variable geological conditions. Variable soil profile permeabilities.	Predominantly underlain by tillite.
Predominantly a tillite profile but more complex geology from the Wilge River to eastern boundary on Area B.	Gently sloping sideslope to slightly undulating topography.	Generally flat crestal terrain units.
The eastern approach to Area B is characterised by steep topography, outcrop zones, seasonal perched water table. High runoff into Wilge River expected.	.	Moderately impermeable soil profile conditions.
Relatively impermeable soil profile conditions.		
Other:		
Two river crossings – bridge / gantries will be required.	One river and one gully crossing (Klipfonteinspruit) to Area A.	Gully crossing and no seepage problems.
	Within the existing Kusile property that is already affected by development.	This corridor only applicable if either Area F or G developed.
Road and pipeline crossings.	One road and pipeline crossing.	One road, pipeline and gasline crossings.
Greenfields area.	Generally a brownfields area.	

The above impacts of the conveyor routes on the geotechnical assessment of the areas have also been assessed relative to the Impact Risk Classification. The final combined ratings and rankings of the sites are summarised in Table 3.

Table 3: Final Geotechnical Ranking

Area	Geotechnical Rating	Geotechnical Ranking	Risk Impact Ranking		Final Rank	
			Value	Class	Rating	Ranking
A	60	2	1,6	2	37.5	1
B	68	1	2,4	3	28	4
C	42	5	1,8	2	23	5
F	58	3	1,8	2	32	2
G	54	4	1,8	2	30	3

The final rating value has taken the geotechnical parameters and external factors and risk impacts into consideration and dased on this review, Area A is the preferred site. If Area A as a single area is not feasible, then Area A1 combined with the existing 10 year ADF could be considered provided the Wetland Offset Strategy is applicable. Alternately, Area A1 with Area F would be the preferred selection, followed by A1+G, then B and finally C.

8. COMPARATIVE ASSESSMENT

The above evaluation and rating is for the baseline greenfields condition of each area. A further rating of each site was undertaken for the different phases of development of the facility using the matrix spreadsheet prepared by Zitholele Consulting. The geotechnical parameters and impacts that would affect the different phases of development (i.e. construction, operation, closure and post-closure) although similar to those identified for the initial baseline study, would have different impacts during the various development phases of the life of the disposal facility.

The detailed comparative assessments and ratings are provided in Appendix A.

The comparative assessment indicated that during the construction and operation phases of the facility, when the geotechnical influences such as material availability, foundation stability are the most critical, Area A is the preferred site followed by Area B then Areas A and F, A and G, F and G and finally Area C (Table 4).

Table 4: Ranking for Development Phases of Ash Disposal Facility

AREA	PHASES OF DEVELOPMENT			
	Construction	Operation	Closure	Post Closure
A	1	1	1	1
B	2	2	5	6
C	6	6	6	5
A & F	3	3	2	2
A & G	4	4	2	3
F & G	4	4	2	3

However, during the closure and post closure phases when the long term residual effects of geotechnical factors should be less influential but could still have an influence on drainage, localised stability etc., Area A was still the preferred site with Area B being the least preferred.

9. CONCLUSION

The geotechnical evaluation has assessed various parameters that will have an influence on the development of an ash disposal facility.

The baseline assessment looked at each area in isolation, i.e. as an individual closed unit within which only the geotechnical factors such as soil profile, geological conditions, potential founding conditions etc were evaluated. Subsequent to this, outside factors such as the influence of conveyor routes, seepage zones etc. were evaluated. Finally the geotechnical impacts of the facility during the different phases from construction to post closure were evaluated.

The geotechnical evaluation indicated that Area A is the preferred site under all the phases of the ash disposal facility.

Once a site or combination of sites has been selected, a detailed geotechnical investigation will be required to assess, in detail, the soil profile conditions and soil properties. This will require that test pits will have to be excavated (with a TLB) and site materials tested to assess the soil properties relative to liner requirement specifications.

In addition, test pits and probably boreholes will also be required for the conveyor to assess founding conditions. The boreholes will be required at road / river crossings.

BRYAN ANTROBUS
Project Manager

AUBREY DE BEER
Engineering Geologist

NICO VERMEULEN
Project Director
for Jones & Wagener

30 April 2013

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APPENDIX A

COMPARATIVE IMPACT RATINGS

Rated By: *Bryan Antrobus*
Reviewed By:

ALTERNATIVES:

Code	IMPACT DESCRIPTION	Weighting
Code	*Phase*	
	Post-Closure	5
Impact 1	Conveyor servitude and old foundations	5
Impact 2	Closure of any external borrow sources	3
Impact 3	Storm water runoff into Wilge River System	4
Impact 4		
Impact 5		
Impact 6		
Impact 7		
Impact 8		
Impact 9		
Impact 10		
COMBINED WEIGHTED RATING	**BEFORE MITIGATION**	
PROJECT IMPACT	**AFTER MITIGATION**	
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**	
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**	

Site A

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**		
Impact 1	Negative	Possible	1 VLOW	1 ISO	1 INCID	3 LIKE	**-0.7** **VLOW**	-1	-1
Impact 2	Negative	Possible	1 VLOW	1 ISO	1 INCID	2 UNLIKE	**-0.4** **VLOW**	-1	-1
Impact 3	Negative	Possible	1 VLOW	3 ADJ	1 INCID	3 LIKE	**-1.1** **LOW**	-1	-1
Impact 4									
Impact 5									
Impact 6									
Impact 7									
Impact 8									
Impact 9									
Impact 10									
COMBINED WEIGHTED RATING	Negative		-0.8 VLOW	-1.3 DEV	-0.8 INCID	2.2 COULD	**-0.5** **VLOW**		
PROJECT IMPACT	Negative	Possible	1 VLOW	2 DEV	1 INCID	2 UNLIKE	**-0.6** **VLOW**	-1	#REF!
STATUS QUO	Negative	Possible	2 LOW	2 DEV	2 SHORT	2 UNLIKE	**-0.9** **VLOW**	-1	#REF!
CUMULATIVE IMPACT	Negative	Possible	2 LOW	3 ADJ	2 SHORT	3 LIKE	**-1.5** **LOW**	-1	#REF!
RESIDUAL IMPACT	Positive	Possible	1 VLOW	2 DEV	1 INCID	3 LIKE	**0.9** **VLOW**	1	#REF!

SITE B

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**	-1
Impact 2	Negative	Possible	1 VLOW	3 ADJ	1 INCID	2 UNLIKE	**-0.7** **VLOW**	-1
Impact 3	Negative	Possible	3 MODL	5 DIS	1 INCID	3 LIKE	**-2** **LOW**	-1
Impact 4–10								
COMBINED WEIGHTED RATING	Negative		-2.3 MODL	-3.6 LOC	-1.1 SHORT	2.2 COULD	**-1.1** **LOW**	
PROJECT IMPACT	Negative	Possible	2 LOW	4 LOC	2 SHORT	2 UNLIKE	**-1.2** **LOW**	-1
STATUS QUO	Negative	Possible	4 MODH	5 DIS	3 MED	3 LIKE	**-2.7** **MODL**	-1
CUMULATIVE IMPACT	Negative	Possible	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**	-1
RESIDUAL IMPACT	Negative	Possible	3 MODL	5 DIS	1 INCID	3 LIKE	**-2** **LOW**	-1

SITE C

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	3 MODL	4 LOC	1 INCID	2 UNLIKE	**-1.2** **LOW**	-1
Impact 2	Negative	Probable	3 MODL	4 LOC	1 INCID	3 LIKE	**-1.8** **LOW**	-1
Impact 3	Negative	Possible	3 MODL	4 LOC	1 INCID	3 LIKE	**-1.8** **LOW**	-1
Impact 4–10								
COMBINED WEIGHTED RATING	Negative		-2.4 MODL	-3.2 LOC	-0.8 INCID	2.1 COULD	**-1** **VLOW**	
PROJECT IMPACT	Negative	Possible	2 LOW	3 ADJ	2 SHORT	2 UNLIKE	**-1** **VLOW**	-1
STATUS QUO	Negative	Possible	3 MODL	4 LOC	2 SHORT	3 LIKE	**-2** **LOW**	-1
CUMULATIVE IMPACT	Positive	Possible	3 MODL	4 LOC	2 SHORT	3 LIKE	**2** **LOW**	1
RESIDUAL IMPACT	Negative	Possible	3 MODL	3 ADJ	1 INCID	3 LIKE	**-1.5** **LOW**	-1

SITE A+F

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3** **LOW**	-1
Impact 2	Negative	Possible	2 LOW	3 ADJ	1 INCID	2 UNLIKE	**-0.9** **VLOW**	-1
Impact 3	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3** **LOW**	-1
Impact 4–10								
COMBINED WEIGHTED RATING	Negative		-1.6 LOW	-2.4 ADJ	-0.8 INCID	2.2 COULD	**-0.8** **VLOW**	
PROJECT IMPACT	Negative	Possible	1 VLOW	2 DEV	1 INCID	2 UNLIKE	**-0.6** **VLOW**	-1
STATUS QUO	Negative	Possible	2 LOW	3 ADJ	2 SHORT	3 LIKE	**-1.5** **LOW**	-1
CUMULATIVE IMPACT	Negative	Possible	2 LOW	2 DEV	1 INCID	3 LIKE	**-1.1** **LOW**	-1
RESIDUAL IMPACT	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3** **LOW**	-1

SITEA+G

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3** **LOW**	-1
Impact 2	Negative	Possible	2 LOW	3 ADJ	1 INCID	2 UNLIKE	**-0.9** **VLOW**	-1
Impact 3	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3** **LOW**	-1
Impact 4–10								
COMBINED WEIGHTED RATING	Negative		-1.6 LOW	-2.4 ADJ	-0.8 INCID	2.2 COULD	**-0.8** **VLOW**	
PROJECT IMPACT	Negative	Possible	1 VLOW	3 ADJ	1 INCID	2 UNLIKE	**-0.7** **VLOW**	-1
STATUS QUO	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8** **LOW**	-1
CUMULATIVE IMPACT	Negative	Possible	3 MODL	2 DEV	1 INCID	3 LIKE	**-1.3** **LOW**	-1
RESIDUAL IMPACT	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3** **LOW**	-1

SITE F+G

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	3 MODL	3 ADJ	1 INCID	3 LIKE	**-1.5** **LOW**	-1
Impact 2	Negative	Possible	2 LOW	4 LOC	1 INCID	3 LIKE	**-1.5** **LOW**	-1
Impact 3	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3** **LOW**	-1
Impact 4–10								
COMBINED WEIGHTED RATING	Negative		-1.9 LOW	-2.6 ADJ	-0.8 INCID	2.4 COULD	**-0.9** **VLOW**	
PROJECT IMPACT	Negative	Possible	1 VLOW	3 ADJ	1 INCID	2 UNLIKE	**-0.7** **VLOW**	-1
STATUS QUO	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8** **LOW**	-1
CUMULATIVE IMPACT	Negative	Possible	3 MODL	2 DEV	1 INCID	3 LIKE	**-1.3** **LOW**	-1
RESIDUAL IMPACT	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3** **LOW**	-1

NO-GO

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Probable						-1
Impact 2	Negative	Probable						-1
Impact 3	Negative	Definite						-1
Impact 4–10								
COMBINED WEIGHTED RATING								
PROJECT IMPACT								1
STATUS QUO								1
CUMULATIVE IMPACT								1
RESIDUAL IMPACT								1

MITIGATION MEASURES

GENERAL:	Site A – *SITE SPECIFIC:*	SITE B – *SITE SPECIFIC:*	SITE C – *SITE SPECIFIC:*	SITE A+F – *SITE SPECIFIC:*	SITEA+G – *SITE SPECIFIC:*	SITE F+G – *SITE SPECIFIC:*	NO-GO – *SITE SPECIFIC:*
Removal of fences and old foundations	Within Eskom property thus remediation likely to be nominal	Will traverse private property thus good remediation measures will be required	Will be located primarily within Eskom property.	Section of conveyor likely to be limited to development footprint thus nominal remediation measures probable	Section of conveyor likely to be limited to development footprint thus nominal remediation measures probable	Section of conveyor likely to be limited to development footprint thus moderate remediation measures probable	
All external borrow areas to be rehabilitated	External sources not expected	External sources not expected	Access should be limited to conveyor servitude and shopuld be within Eskom property.	External sources not expected	External sources not expected	External sources not expected	
Design to include cut-off drains							

Rated By: *Bryan Antrobus*
Reviewed By:

ALTERNATIVES:

Site A

Code	IMPACT DESCRIPTION	Weighting	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**		
Code	*Phase*										
	Operation Phase	5									
Impact 1	Foundation failure: failure of soil profile during different phases of deposition	5	Negative	Possible	2 LOW	1 ISO	1 INCID	2 UNLIKE	**-0.6 VLOW**	-1	-1
Impact 2	Access about site: influence on materials, dust	3	Negative	Probable	1 VLOW	3 ADJ	3 MED	3 LIKE	**-1.5 LOW**	-1	-1
Impact 3	No suitable borrow material on site	4	Negative	Possible	1 VLOW	2 DEV	1 INCID	1 IMPOS	**-0.3 VLOW**	-1	-1
Impact 4	Ground water contamination if local borrow or construction areas not sealed	5	Negative	Possible	3 MODL	3 ADJ	2 SHORT	2 UNLIKE	**-1.2 LOW**	-1	-1
Impact 5	Surface water runoff	3	Negative	Possible	3 MODL	2 DEV	1 INCID	3 LIKE	**-1.3 LOW**	-1	-1
Impact 6	Wet conditions during operation	2	Negative	Possible	2 LOW	2 DEV	1 INCID	3 LIKE	**-1.1 LOW**	-1	-1
Impact 7	Runoff impact on the Wilge River	5	Negative	Possible	3 MODL	1 ISO	1 INCID	2 UNLIKE	**-0.7 VLOW**	-1	#REF!
Impact 8	Conveyor route	4	Negative	Possible	1 VLOW	2 DEV	2 SHORT	2 UNLIKE	**-0.7 VLOW**	-1	#REF!
Impact 9											
Impact 10											
COMBINED WEIGHTED RATING	**BEFORE MITIGATION**		Negative		-1.6 LOW	-1.5 DEV	-1.2 SHORT	1.7 UNLIKE	**-0.5 VLOW**		
PROJECT IMPACT	**AFTER MITIGATION**		Negative	Possible	1 VLOW	2 DEV	3 MED	3 LIKE	**-1.3 LOW**	-1	#REF!
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT		Negative	Possible	2 LOW	2 DEV	2 SHORT	3 LIKE	**-1.3 LOW**	-1	#REF!
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**		Negative	Probable	3 MODL	3 ADJ	3 MED	3 LIKE	**-2 LOW**	-1	#REF!
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**		Negative	Probable	2 LOW	2 DEV	3 MED	3 LIKE	**-1.5 LOW**	-1	#REF!

SITE B

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	2 LOW	3 ADJ	1 INCID	2 UNLIKE	**-0.9 VLOW**	-1
Impact 2	Negative	Probable	3 MODL	4 LOC	3 MED	3 LIKE	**-2.2 MODL**	-1
Impact 3	Negative	Possible	1 VLOW	3 ADJ	3 MED	1 IMPOS	**-0.5 VLOW**	-1
Impact 4	Negative	Possible	4 MODH	5 DIS	2 SHORT	2 UNLIKE	**-1.6 LOW**	-1
Impact 5	Negative	Possible	3 MODL	5 DIS	1 INCID	3 LIKE	**-2 LOW**	-1
Impact 6	Negative	Possible	2 LOW	2 DEV	1 INCID	3 LIKE	**-1.1 LOW**	-1
Impact 7	Negative	Probable	4 MODH	3 ADJ	2 SHORT	3 LIKE	**-2 LOW**	-1
Impact 8	Negative	Probable	5 HIGH	5 DIS	4 LONG	5 OCCUR	**-5.2 VHIGH**	-1
Impact 9								
Impact 10								
COMBINED WEIGHTED RATING	Negative		-2.4 MODL	-3 ADJ	-1.7 SHORT	2.1 COULD	**-1.1 LOW**	
PROJECT IMPACT	Negative	Possible	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4 MODL**	-1
STATUS QUO	Negative	Possible	4 MODH	5 DIS	4 LONG	3 LIKE	**-2.9 MODL**	-1
CUMULATIVE IMPACT	Negative	Possible	4 MODH	4 LOC	4 LONG	3 LIKE	**-2.7 MODL**	-1
RESIDUAL IMPACT	Negative	Possible	4 MODH	3 ADJ	3 MED	3 LIKE	**-2.2 MODL**	-1

SITE C

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	1 VLOW	1 ISO	1 INCID	2 UNLIKE	**-0.4 VLOW**	-1
Impact 2	Negative	Probable	3 MODL	3 ADJ	3 MED	3 LIKE	**-2 LOW**	-1
Impact 3	Negative	Definite	6 VHIGH	5 DIS	3 MED	5 OCCUR	**-5.2 VHIGH**	-1
Impact 4	Negative	Probable	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4 MODL**	-1
Impact 5	Negative	Possible	4 MODH	3 ADJ	3 MED	4 VLIKE	**-2.9 MODL**	-1
Impact 6	Negative	Probable	2 LOW	2 DEV	1 INCID	3 LIKE	**-1.1 LOW**	-1
Impact 7	Negative	Probable	3 MODL	5 DIS	3 MED	3 LIKE	**-2.4 MODL**	-1
Impact 8	Negative	Probable	4 MODH	3 ADJ	3 MED	3 LIKE	**-2.2 MODL**	-1
Impact 9								
Impact 10								
COMBINED WEIGHTED RATING	Negative		-2.6 MODL	-2.7 ADJ	-1.9 SHORT	2.5 COULD	**-1.3 LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	4 LOC	1 INCID	3 LIKE	**-1.8 LOW**	-1
STATUS QUO	Negative	Possible	4 MODH	3 ADJ	3 MED	3 LIKE	**-2.2 MODL**	-1
CUMULATIVE IMPACT	Positive	Possible	4 MODH	3 ADJ	3 MED	3 LIKE	**2.2 MODL**	1
RESIDUAL IMPACT	Negative	Possible	4 MODH	2 DEV	2 SHORT	3 LIKE	**-1.8 LOW**	-1

SITE A+F

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	3 MODL	1 ISO	1 INCID	3 LIKE	**-1.1 LOW**	-1
Impact 2	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 3	Negative	Possible	3 MODL	4 LOC	1 INCID	1 IMPOS	**-0.6 VLOW**	-1
Impact 4	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8 LOW**	-1
Impact 5	Negative	Possible	3 MODL	3 ADJ	3 MED	2 UNLIKE	**-1.3 LOW**	-1
Impact 6	Negative	Probable	2 LOW	2 DEV	1 INCID	3 LIKE	**-1.1 LOW**	-1
Impact 7	Negative	Probable	4 MODH	5 DIS	3 MED	3 LIKE	**-2.7 MODL**	-1
Impact 8	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 9								
Impact 10								
COMBINED WEIGHTED RATING	Negative		-2.4 MODL	-2.6 ADJ	-1.7 SHORT	2.4 COULD	**-1.2 LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	4 LOC	2 SHORT	3 LIKE	**-2 LOW**	-1
STATUS QUO	Negative	Possible	3 MODL	4 LOC	3 MED	3 LIKE	**-2.2 MODL**	-1
CUMULATIVE IMPACT	Negative	Possible	3 MODL	4 LOC	3 MED	3 LIKE	**-2.2 MODL**	-1
RESIDUAL IMPACT	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8 LOW**	-1

SITEA+G

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	4 MODH	3 ADJ	1 INCID	3 LIKE	**-1.8 LOW**	-1
Impact 2	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 3	Negative	Possible	3 MODL	4 LOC	3 MED	2 UNLIKE	**-1.5 LOW**	-1
Impact 4	Negative	Possible	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2 MODL**	-1
Impact 5	Negative	Possible	3 MODL	3 ADJ	3 MED	2 UNLIKE	**-1.3 LOW**	-1
Impact 6	Negative	Probable	2 LOW	2 DEV	1 INCID	3 LIKE	**-1.1 LOW**	-1
Impact 7	Negative	Probable	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4 MODL**	-1
Impact 8	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 9								
Impact 10								
COMBINED WEIGHTED RATING	Negative		-2.7 MODL	-2.9 ADJ	-1.7 SHORT	2.5 COULD	**-1.3 LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	4 LOC	2 SHORT	3 LIKE	**-2 LOW**	-1
STATUS QUO	Negative	Possible	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2 MODL**	-1
CUMULATIVE IMPACT	Negative	Possible	4 MODH	4 LOC	3 MED	3 LIKE	**-2.4 MODL**	-1
RESIDUAL IMPACT	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8 LOW**	-1

SITE F+G

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	4 MODH	3 ADJ	1 INCID	3 LIKE	**-1.8 LOW**	-1
Impact 2	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 3	Negative	Possible	3 MODL	2 DEV	3 MED	2 UNLIKE	**-1.2 LOW**	-1
Impact 4	Negative	Possible	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2 MODL**	-1
Impact 5	Negative	Possible	3 MODL	3 ADJ	3 MED	2 UNLIKE	**-1.3 LOW**	-1
Impact 6	Negative	Probable	2 LOW	2 DEV	1 INCID	3 LIKE	**-1.1 LOW**	-1
Impact 7	Negative	Probable	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4 MODL**	-1
Impact 8	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 9								
Impact 10								
COMBINED WEIGHTED RATING	Negative		-2.7 MODL	-2.7 ADJ	-1.7 SHORT	2.5 COULD	**-1.3 LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	4 LOC	2 SHORT	3 LIKE	**-2 LOW**	-1
STATUS QUO	Negative	Possible	4 MODH	5 DIS	3 MED	3 LIKE	**-2.7 MODL**	-1
CUMULATIVE IMPACT	Negative	Possible	4 MODH	5 DIS	3 MED	3 LIKE	**-2.7 MODL**	-1
RESIDUAL IMPACT	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8 LOW**	-1

NO-GO

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Probable						-1
Impact 2	Negative	Probable						-1
Impact 3	Negative	Definite						-1
Impact 4	Negative	Definite						-1
Impact 5	Negative	Possible						-1
Impact 6	Negative	Probable						-1
Impact 7								1
Impact 8								1
Impact 9								1
Impact 10								1
COMBINED WEIGHTED RATING								
PROJECT IMPACT								1
STATUS QUO								1
CUMULATIVE IMPACT								1
RESIDUAL IMPACT								1

MITIGATION MEASURES

GENERAL:	Site A – *SITE SPECIFIC:*	SITE B – *SITE SPECIFIC:*	SITE C – *SITE SPECIFIC:*	SITE A+F – *SITE SPECIFIC:*	SITEA+G – *SITE SPECIFIC:*	SITE F+G – *SITE SPECIFIC:*	NO-GO – *SITE SPECIFIC:*
Uniform controlled disposal to be undertaken. Rapid and excessive loading to be avoided.			Shallow bedrock. Failure of founding soils unlikely		Potential unstable founding conditions in Area G	Potential unstable founding conditions in Area G	
Existing roads on site to be used where practical.	Access will be in Eskom boundaries	Access will probably be along the conveyor servitude. Bridge likely for the Wilge River Crossing	Access should be limited to conveyor servitude and shopuld be within Eskom property.	Access should be limited to the conveyor servitude route	Access should be limited to the conveyor servitude route	Access should be limited to the conveyor servitude route but two road crossings likely	
Site materials available on all sites except Site C. Suitable areas to be selected off-site when not available on site.E	Suitable material within footprint.	Suitable material within footprint.	Only very local limited source material expected. Primarily in the south west corner	Suitable material within footprint.	Suitable material within footprint.	Suitable material within footprint.	
Ensure drainage from open sources available . Alternately areas to be compacted to reduce the insitu permeability of the soil.			Jointed rockmass likely to cause dificulty in sealing and thus minimising seepage ingress into the profile				
Construct storm-water catch berms around the periphery of the footprint area under construction.							
Conveyor will restrict access and will divide areas.	Conveyor servitude impact will be slight as distance minimal and within Eskom property.	Conveyor servitude impact will be significant as large distance traversed and it could impact on the Holfonteinspruit wetland area and will influence the Wige River. Underpass/overpass will be required to cross the provincial road.	Conveyor servitude should be limited to Eskom Property. Crosses a gully wetland.	Conveyor servitide although limited in distancewill cross provincial road that will require an underpass or overpass.	Conveyor servitide although limited in distancewill cross provincial road that will require an underpass or overpass.	Two road crossings will be required.	

Rated By: *Bryan Antrobus*
Reviewed By:

ALTERNATIVES:

Site A

Code	IMPACT DESCRIPTION	Weighting	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**		
Code	*Phase*										
	Closure	5									
Impact 1	Availability of capping material on site	5	Negative	Possible	2 LOW	1 ISO	1 INCID	2 UNLIKE	**-0.6 VLOW**	-1	-1
Impact 2	Access to capping stockpile	3	Negative	Probable	1 VLOW	2 DEV	1 INCID	3 LIKE	**-0.9 VLOW**	-1	-1
Impact 3	Additional capping sources off- site	4	Negative	Possible	1 VLOW	3 ADJ	1 INCID	2 UNLIKE	**-0.7 VLOW**	-1	-1
Impact 4	Ground water contaminationat additional capping sources	5	Negative	Possible	3 MODL	3 ADJ	2 SHORT	2 UNLIKE	**-1.2 LOW**	-1	-1
Impact 5	Surface water runoff	3	Negative	Possible	3 MODL	2 DEV	1 INCID	3 LIKE	**-1.3 LOW**	-1	-1
Impact 6	Loss of material at stockpile over time	2	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3 LOW**	-1	-1
Impact 7	Runoff impact on the Wilge River	5	Negative	Possible	3 MODL	1 ISO	1 INCID	2 UNLIKE	**-0.7 VLOW**	-1	#REF!
Impact 8	Rehabilitation of conveyor route	4	Negative	Possible	1 VLOW	2 DEV	2 SHORT	5 OCCUR	**-1.8 LOW**	-1	#REF!
Impact 9										1	#REF!
Impact 10										1	#REF!
COMBINED WEIGHTED RATING	**BEFORE MITIGATION**		Negative		-1.6 LOW	-1.6 DEV	-1 INCID	2.1 COULD	**-0.6 VLOW**		
PROJECT IMPACT	**AFTER MITIGATION**		Negative	Possible	1 VLOW	2 DEV	1 INCID	2 UNLIKE	**-0.6 VLOW**	-1	#REF!
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT		Negative	Possible	2 LOW	3 ADJ	2 SHORT	3 LIKE	**-1.5 LOW**	-1	#REF!
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**		Negative	Possible	2 LOW	2 DEV	2 SHORT	2 UNLIKE	**-0.9 VLOW**	-1	#REF!
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**		Positive	Possible	1 VLOW	2 DEV	1 INCID	1 IMPOS	**0.3 VLOW**	1	#REF!

SITE B

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3 LOW**	-1
Impact 2	Negative	Probable	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8 LOW**	-1
Impact 3	Negative	Possible	4 MODH	4 LOC	1 INCID	1 IMPOS	**-0.7 VLOW**	-1
Impact 4	Negative	Possible	3 MODL	5 DIS	2 SHORT	3 LIKE	**-2.2 MODL**	-1
Impact 5	Negative	Possible	3 MODL	5 DIS	1 INCID	3 LIKE	**-2 LOW**	-1
Impact 6	Negative	Possible	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3 LOW**	-1
Impact 7	Negative	Probable	4 MODH	3 ADJ	2 SHORT	3 LIKE	**-2 LOW**	-1
Impact 8	Negative	Probable	5 HIGH	5 DIS	1 INCID	5 OCCUR	**-4.1 HIGH**	-1
Impact 9								1
Impact 10								1
COMBINED WEIGHTED RATING	Negative		-2.6 MODL	-3 ADJ	-1.1 SHORT	2.3 COULD	**-1.1 LOW**	
PROJECT IMPACT	Negative	Possible	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4 MODL**	-1
STATUS QUO	Negative	Possible	4 MODH	5 DIS	4 LONG	3 LIKE	**-2.9 MODL**	-1
CUMULATIVE IMPACT	Negative	Possible	4 MODH	4 LOC	4 LONG	3 LIKE	**-2.7 MODL**	-1
RESIDUAL IMPACT	Negative	Possible	4 MODH	3 ADJ	3 MED	3 LIKE	**-2.2 MODL**	-1

SITE C

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	4 MODH	4 LOC	1 INCID	2 UNLIKE	**-1.3 LOW**	-1
Impact 2	Negative	Probable	2 LOW	3 ADJ		3 LIKE	**-1.1 LOW**	-1
Impact 3	Negative	Definite	6 VHIGH	3 ADJ	1 INCID	5 OCCUR	**-3.7 MODH**	-1
Impact 4	Negative	Probable	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4 MODL**	-1
Impact 5	Negative	Possible	4 MODH	3 ADJ	3 MED	4 VLIKE	**-2.9 MODL**	-1
Impact 6	Negative	Probable	1 VLOW	2 DEV	1 INCID	2 UNLIKE	**-0.6 VLOW**	-1
Impact 7	Negative	Probable	3 MODL	5 DIS	3 MED	3 LIKE	**-2.4 MODL**	-1
Impact 8	Negative	Probable	4 MODH	4 LOC	1 INCID	4 VLIKE	**-2.7 MODL**	-1
Impact 9								1
Impact 10								1
COMBINED WEIGHTED RATING	Negative		-2.9 MODL	-3 ADJ	-1.2 SHORT	2.5 COULD	**-1.3 LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	4 LOC	1 INCID	3 LIKE	**-1.8 LOW**	-1
STATUS QUO	Negative	Possible	4 MODH	3 ADJ	3 MED	3 LIKE	**-2.2 MODL**	-1
CUMULATIVE IMPACT	Positive	Possible	4 MODH	3 ADJ	3 MED	3 LIKE	**2.2 MODL**	1
RESIDUAL IMPACT	Negative	Possible	4 MODH	2 DEV	2 SHORT	3 LIKE	**-1.8 LOW**	-1

SITE A+F

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	3 MODL	1 ISO	1 INCID	3 LIKE	**-1.1 LOW**	-1
Impact 2	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 3	Negative	Possible	3 MODL	4 LOC	1 INCID	1 IMPOS	**-0.6 VLOW**	-1
Impact 4	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8 LOW**	-1
Impact 5	Negative	Possible	3 MODL	3 ADJ	3 MED	2 UNLIKE	**-1.3 LOW**	-1
Impact 6	Negative	Probable	2 LOW	2 DEV	1 INCID	3 LIKE	**-1.1 LOW**	-1
Impact 7	Negative	Probable	4 MODH	5 DIS	3 MED	3 LIKE	**-2.7 MODL**	-1
Impact 8	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 9								1
Impact 10								1
COMBINED WEIGHTED RATING	Negative		-2.4 MODL	-2.6 ADJ	-1.7 SHORT	2.4 COULD	**-1.2 LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	4 LOC	2 SHORT	3 LIKE	**-2 LOW**	-1
STATUS QUO	Negative	Possible	3 MODL	4 LOC	3 MED	3 LIKE	**-2.2 MODL**	-1
CUMULATIVE IMPACT	Negative	Possible	3 MODL	4 LOC	3 MED	3 LIKE	**-2.2 MODL**	-1
RESIDUAL IMPACT			3 MODL	3 ADJ	2 SHORT	3 LIKE	**1.8 LOW**	1

SITEA+G

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	4 MODH	3 ADJ	1 INCID	3 LIKE	**-1.8 LOW**	-1
Impact 2	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 3	Negative	Possible	3 MODL	4 LOC	3 MED	2 UNLIKE	**-1.5 LOW**	-1
Impact 4	Negative	Possible	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2 MODL**	-1
Impact 5	Negative	Possible	3 MODL	3 ADJ	3 MED	2 UNLIKE	**-1.3 LOW**	-1
Impact 6	Negative	Probable	2 LOW	2 DEV	1 INCID	3 LIKE	**-1.1 LOW**	-1
Impact 7	Negative	Probable	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4 MODL**	-1
Impact 8	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 9								1
Impact 10								1
COMBINED WEIGHTED RATING	Negative		-2.7 MODL	-2.9 ADJ	-1.7 SHORT	2.5 COULD	**-1.3 LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	4 LOC	2 SHORT	3 LIKE	**-2 LOW**	-1
STATUS QUO	Negative	Probable	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2 MODL**	-1
CUMULATIVE IMPACT	Negative	Possible	4 MODH	4 LOC	3 MED	3 LIKE	**-2.4 MODL**	-1
RESIDUAL IMPACT	Negative	Probable	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8 LOW**	-1

SITE F+G

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	4 MODH	3 ADJ	1 INCID	3 LIKE	**-1.8 LOW**	-1
Impact 2	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7 MODH**	-1
Impact 3	Negative	Possible	3 MODL	2 DEV	3 MED	2 UNLIKE	**-1.2 LOW**	-1
Impact 4	Negative	Possible	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2 MODL**	-1
Impact 5	Negative	Possible	3 MODL	3 ADJ	3 MED	2 UNLIKE	**-1.3 LOW**	-1
Impact 6	Negative	Probable	2 LOW	2 DEV	1 INCID	3 LIKE	**-1.1 LOW**	-1
Impact 7	Negative	Probable	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4 MODL**	-1
Impact 8	Positive	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**3.7 MODH**	1
Impact 9								1
Impact 10								1
COMBINED WEIGHTED RATING	Negative		-2.1 MODL	-1.9 DEV	-1.1 SHORT	2.5 COULD	**-0.9 VLOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	4 LOC	2 SHORT	3 LIKE	**-2 LOW**	-1
STATUS QUO	Negative	Possible	4 MODH	5 DIS	3 MED	3 LIKE	**-2.7 MODL**	-1
CUMULATIVE IMPACT	Negative	Possible	4 MODH	5 DIS	3 MED	3 LIKE	**-2.7 MODL**	-1
RESIDUAL IMPACT	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8 LOW**	-1

NO-GO

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Probable						-1
Impact 2	Negative	Probable						-1
Impact 3	Negative	Definite						-1
Impact 4	Negative	Definite						-1
Impact 5	Negative	Possible						-1
Impact 6	Negative	Probable						-1
Impact 7								1
Impact 8								1
Impact 9								1
Impact 10								1
COMBINED WEIGHTED RATING								
PROJECT IMPACT								1
STATUS QUO								1
CUMULATIVE IMPACT								1
RESIDUAL IMPACT								1

MITIGATION MEASURES

GENERAL:	Site A *SITE SPECIFIC:*	Site B *SITE SPECIFIC:*	Site C *SITE SPECIFIC:*	Site A+F *SITE SPECIFIC:*	Site A+G *SITE SPECIFIC:*	Site F+G *SITE SPECIFIC:*	No-Go *SITE SPECIFIC:*
Capping: material should be stockpiled during construction and operation			Shallow bedrock. Failure of founding soils unlikely		Potential unstable founding conditions in Area G	Potential unstable founding conditions in Area G	
Suitable locations determined during construction phase.	Access will be in Eskom boundaries	Access will probably be along the conveyor servitude. Bridge likely for the Wilge River Crossing	Access should be limited to conveyor servitude and shopuld be within Eskom property.	Access should be limited to the conveyor servitude route	Access should be limited to the conveyor servitude route	Access should be limited to the conveyor servitude route but two road crossings likely	
Site materials available on all sites except Site C. Suitable areas to be selected off-site when not available on site.	Suitable material within footprint.	Suitable material within footprint.	Only very local limited source material expected. Primarily in the south west corner	Suitable material within footprint.	Suitable material within footprint.	Suitable material within footprint.	
Ensure drainage from open sources available . Alternately areas to be compacted to reduce the insitu permeability of the soil.			Jointed rockmass likely to cause dificulty in sealing and thus minimising seepage ingress into the profile				
Construct storm-water catch berms around the periphery of the footprint area under construction.							
Conveyor will restrict access and will divide areas.	Conveyor servitude impact will be slight as distance minimal and within Eskom property.	Conveyor servitude impact will be significant as large distance traversed and it could impact on the Holfonteinspruit wetland area and will influence the Wige River. Underpass/overpass will be required to cross the provincial road.	Conveyor servitude should be limited to Eskom Property. Crosses a gully wetland.	Conveyor servitide although limited in distancewill cross provincial road that will require an underpass or overpass.	Conveyor servitide although limited in distancewill cross provincial road that will require an underpass or overpass.	Two road crossings will be required.	

Rated By: *Bryan Antrobus*
Reviewed By:

ALTERNATIVES:

Site A

Code	IMPACT DESCRIPTION	Weighting	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**		
Code	*Phase*										
	CONSTRUCTION	5									
Impact 1	Foundation failure: failure of soil profile during deposition of ash	5	Negative	Possible	2 LOW	1 ISO	2 SHORT	2 UNLIKE	**-0.7** **VLOW**	-1	-1
Impact 2	Access to site: influence on materials, dust	3	Negative	Probable	1 VLOW	3 ADJ	3 MED	3 LIKE	**-1.5** **LOW**	-1	-1
Impact 3	No suitable borrow material on site	4	Negative	Possible	1 VLOW	2 DEV	1 INCID	1 IMPOS	**-0.3** **VLOW**	-1	-1
Impact 4	Ground water contamination if local borrow or construction areas not sealed	5	Negative	Possible	3 MODL	3 ADJ	2 SHORT	2 UNLIKE	**-1.2** **LOW**	-1	-1
Impact 5	External area for stockpile for closure	4	Negative	Possible	3 MODL	2 DEV	3 MED	2 UNLIKE	**-1.2** **LOW**	-1	-1
Impact 6	Surface water runoff	3	Negative	Possible	3 MODL	2 DEV	1 INCID	3 LIKE	**-1.3** **LOW**	-1	-1
Impact 7	Runoff impact on the Wilge River	5	Negative	Possible	3 MODL	2 DEV	2 SHORT	2 UNLIKE	**-1** **VLOW**	-1	#REF!
Impact 8	Conveyor route	4	Negative	Definite	1 VLOW	2 DEV	2 SHORT	2 UNLIKE	**-0.7** **VLOW**	-1	#REF!
Impact 9											
Impact 10											
COMBINED WEIGHTED RATING	**BEFORE MITIGATION**		Negative		-1.8 LOW	-1.7 DEV	-1.7 SHORT	1.7 UNLIKE	**-0.7** **VLOW**		
PROJECT IMPACT	**AFTER MITIGATION**		Negative	Possible	1 VLOW	2 DEV	3 MED	3 LIKE	**-1.3** **LOW**	-1	#REF!
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT		Negative	Possible	2 LOW	2 DEV	2 SHORT	3 LIKE	**-1.3** **LOW**	-1	#REF!
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **BEFORE MITIGATION**		Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8** **LOW**	-1	#REF!
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROM PROJECT, **AFTER MITIGATION**		Positive	Possible	2 LOW	2 DEV	2 SHORT	3 LIKE	**1.3** **LOW**	1	#REF!

SITE B

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	2 LOW	3 ADJ	2 SHORT	2 UNLIKE	**-1** **VLOW**	-1
Impact 2	Negative	Probable	6 VHIGH	5 DIS	3 MED	5 OCCUR	**-5.2** **VHIGH**	-1
Impact 3	Negative	Possible	3 MODL	3 ADJ	3 MED	1 IMPOS	**-0.7** **VLOW**	-1
Impact 4	Negative	Possible	4 MODH	5 DIS	2 SHORT	2 UNLIKE	**-1.6** **LOW**	-1
Impact 5	Negative	Possible	3 MODL	5 DIS	3 MED	2 UNLIKE	**-1.6** **LOW**	-1
Impact 6	Negative	Possible	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**	-1
Impact 7	Negative	Probable	4 MODH	5 DIS	3 MED	3 LIKE	**-2.7** **MODL**	-1
Impact 8	Negative	Definite	5 HIGH	5 DIS	4 LONG	5 OCCUR	**-5.2** **VHIGH**	-1
Impact 9								
Impact 10								
COMBINED WEIGHTED RATING	Negative		-3.1 MODH	-3.7 LOC	-2.3 MED	2.3 COULD	**-1.5** **LOW**	
PROJECT IMPACT	Negative	Possible	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**	-1
STATUS QUO	Negative	Possible	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**	-1
CUMULATIVE IMPACT	Negative	Possible	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**	-1
RESIDUAL IMPACT	Negative	Possible	3 MODL	4 LOC	2 SHORT	3 LIKE	**-2** **LOW**	-1

SITE C

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	1 VLOW	1 ISO	1 INCID	2 UNLIKE	**-0.4** **VLOW**	-1
Impact 2	Negative	Probable	3 MODL	4 LOC	3 MED	4 VLIKE	**-2.9** **MODL**	-1
Impact 3	Negative	Definite	6 VHIGH	5 DIS	3 MED	5 OCCUR	**-5.2** **VHIGH**	-1
Impact 4	Negative	Probable	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**	-1
Impact 5	Negative	Possible	5 HIGH	4 LOC	3 MED	5 OCCUR	**-4.4** **HIGH**	-1
Impact 6	Negative	Probable	4 MODH	5 DIS	3 MED	3 LIKE	**-2.7** **MODL**	-1
Impact 7	Negative	Probable	3 MODL	5 DIS	3 MED	3 LIKE	**-2.4** **MODL**	-1
Impact 8	Negative	Definite	4 MODH	3 ADJ	3 MED	3 LIKE	**-2.2** **MODL**	-1
Impact 9								
Impact 10								
COMBINED WEIGHTED RATING	Negative		-3 MODL	-3.3 LOC	-2.1 MED	2.8 COULD	**-1.7** **LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	4 LOC	3 MED	3 LIKE	**-2.2** **MODL**	-1
STATUS QUO	Negative	Possible	4 MODH	3 ADJ	2 SHORT	3 LIKE	**-2** **LOW**	-1
CUMULATIVE IMPACT	Positive	Possible	4 MODH	4 LOC	2 SHORT	3 LIKE	**2.2** **MODL**	1
RESIDUAL IMPACT	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8** **LOW**	-1

SITE A+F

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	3 MODL	2 DEV	2 SHORT	2 UNLIKE	**-1** **VLOW**	-1
Impact 2	Negative	Probable	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7** **MODH**	-1
Impact 3	Negative	Possible	1 VLOW	2 DEV	2 SHORT	1 IMPOS	**-0.4** **VLOW**	-1
Impact 4	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8** **LOW**	-1
Impact 5	Negative	Possible	3 MODL	3 ADJ	3 MED	2 UNLIKE	**-1.3** **LOW**	-1
Impact 6	Negative	Probable	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2** **MODL**	-1
Impact 7	Negative	Probable	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**	-1
Impact 8	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7** **MODH**	-1
Impact 9								
Impact 10								
COMBINED WEIGHTED RATING	Negative		-2.5 MODL	-2.8 ADJ	-1.9 SHORT	2.4 COULD	**-1.3** **LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	3 DEV	2 SHORT	3 LIKE	**-1.5** **LOW**	-1
STATUS QUO	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8** **LOW**	-1
CUMULATIVE IMPACT	Negative	Possible	3 MODL	4 LOC	2 SHORT	3 LIKE	**-2** **LOW**	-1
RESIDUAL IMPACT	Negative	Possible	2 LOW	2 DEV	2 SHORT	3 LIKE	**-1.3** **LOW**	-1

SITEA+G

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	4 MODH	2 DEV	2 SHORT	3 LIKE	**-1.8** **LOW**	-1
Impact 2	Negative	Probable	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7** **MODH**	-1
Impact 3	Negative	Possible	3 MODL	2 DEV	2 SHORT	2 UNLIKE	**-1** **VLOW**	-1
Impact 4	Negative	Possible	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2** **MODL**	-1
Impact 5	Negative	Possible	3 MODL	3 ADJ	3 MED	2 UNLIKE	**-1.3** **LOW**	-1
Impact 6	Negative	Probable	4 MODH	4 LOC	2 SHORT	4 VLIKE	**-2.9** **MODL**	-1
Impact 7	Negative	Probable	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**	-1
Impact 8	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7** **MODH**	-1
Impact 9								
Impact 10								
COMBINED WEIGHTED RATING	Negative		-2.9 MODL	-2.9 ADJ	-1.9 SHORT	2.7 COULD	**-1.5** **LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8** **LOW**	-1
STATUS QUO	Negative	Probable	4 MODH	3 ADJ	2 SHORT	3 LIKE	**-2** **LOW**	-1
CUMULATIVE IMPACT	Negative	Possible	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2** **MODL**	-1
RESIDUAL IMPACT	Negative	Probable	2 LOW	3 ADJ	2 SHORT	3 LIKE	**-1.5** **LOW**	-1

SITE F+G

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Possible	4 MODH	2 DEV	2 SHORT	3 LIKE	**-1.8** **LOW**	-1
Impact 2	Negative	Probable	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7** **MODH**	-1
Impact 3	Negative	Possible	3 MODL	2 DEV	2 SHORT	2 UNLIKE	**-1** **VLOW**	-1
Impact 4	Negative	Possible	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2** **MODL**	-1
Impact 5	Negative	Possible	3 MODL	3 ADJ	3 MED	2 UNLIKE	**-1.3** **LOW**	-1
Impact 6	Negative	Probable	4 MODH	4 LOC	2 SHORT	4 VLIKE	**-2.9** **MODL**	-1
Impact 7	Negative	Probable	4 MODH	5 DIS	2 SHORT	3 LIKE	**-2.4** **MODL**	-1
Impact 8	Negative	Definite	3 MODL	4 LOC	3 MED	5 OCCUR	**-3.7** **MODH**	-1
Impact 9								
Impact 10								
COMBINED WEIGHTED RATING	Negative		-2.9 MODL	-2.9 ADJ	-1.9 SHORT	2.7 COULD	**-1.5** **LOW**	
PROJECT IMPACT	Negative	Possible	3 MODL	3 ADJ	2 SHORT	3 LIKE	**-1.8** **LOW**	-1
STATUS QUO	Negative	Possible	4 MODH	3 ADJ	2 SHORT	3 LIKE	**-2** **LOW**	-1
CUMULATIVE IMPACT	Negative	Possible	4 MODH	4 LOC	2 SHORT	3 LIKE	**-2.2** **MODL**	-1
RESIDUAL IMPACT	Negative	Possible	2 LOW	3 ADJ	2 SHORT	3 LIKE	**-1.5** **LOW**	-1

NO-GO

Code	Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	**Impact Risk**	
Impact 1	Negative	Probable						-1
Impact 2	Negative	Probable						-1
Impact 3	Negative	Definite						-1
Impact 4	Negative	Definite						-1
Impact 5	Negative	Possible						-1
Impact 6	Negative	Probable						-1
Impact 7								1
Impact 8								1
Impact 9								1
Impact 10								1
COMBINED WEIGHTED RATING								
PROJECT IMPACT								1
STATUS QUO								1
CUMULATIVE IMPACT								1
RESIDUAL IMPACT								1

MITIGATION MEASURES

	GENERAL:	*SITE SPECIFIC:* Site A	*SITE SPECIFIC:* Site B	*SITE SPECIFIC:* Site C	*SITE SPECIFIC:* Site A+F	*SITE SPECIFIC:* Site A+G	*SITE SPECIFIC:* Site F+G	*SITE SPECIFIC:* NO-GO
	Uniform controlled disposal to be undertaken. Rapid and excessive loading to be avoided.			Shallow bedrock. Failure of founding soils unlikely		Potential unstable founding conditions in Area G	Potential unstable founding conditions in Area G	
	Existing roads to be used where practical. Roads not to be constructed over potential borrow sites.	Access will be in Eskom boundaries	Access will probably be along the conveyor servitude. Bridge likely for the Wilge River Crossing	Access should be limited to conveyor servitude and should be within Eskom property.	Access should be limited to the conveyor servitude route. One road crossing	Access should be limited to the conveyor servitude route. One road crossing	Access should be limited to the conveyor servitude route but two road crossings likely	
	Site materials available on all sites except Site C. Suitable areas to be selected off-site when not available on site.E	Suitable material within footprint.	Suitable material within footprint.	Only very local limited source material expected. Primarily in the south west corner	Suitable material within footprint.	Suitable material within footprint.	Suitable material within footprint.	
	Ensure drainage from open sources available. Alternately areas to be compacted to reduce the insitu permeability of the soil.			Jointed rockmass likely to cause dificulty in sealing and thus minimising seepage ingress into the profile				
	Construct storm-water catch berms around the periphery of the footprint area under construction.							
	Conveyor will restrict access and will divide areas.	Conveyor servitude impact will be slight as distance minimal and within Eskom property.	Conveyor servitude impact will be significant as large distance traversed and it could impact on the Klipfonteinspruit and the Wilge River wetland areas. Underpass/overpass will be required to cross the provincial road.	Conveyor servitude should be limited to Eskom Property. Crosses a gully wetland and provincial road.	Conveyor servitide although limited in distance will cross provincial road that will require an underpass or overpass.	Conveyor servitide although limited in distance will cross provincial road that will require an underpass or overpass.	Two road crossings will be required.	

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31 May, 2013

Our Ref: **D121-02**
Your Ref:
D121-02_let_01_ba.docx

Attention: **Dr. M. Vosloo** mathysv@zitholele.co.za
Cc: **Mr. W. Kok** warren@zitholele.co.za

Dear Sir

GEOTECHNICAL ENVIRONMENTAL IMPACT STATEMENT

1. INTRODUCTION

A specialist geotechnical study[1] of various sites for the proposed 60 year Ash Disposal Facility (ADF) has been completed and Area A has been provisionally selected as the preferred site.

This report documents the geotechnical input as part of the Environment Impact Statement (EIS).

The geotechnical assessment evaluated site conditions with regard to foundations and availability of material for construction requirements. The impact of these considerations is pertinent to design procedures and construction/operation phases of the proposed development. As Area A was a preferred site from the geotechnical selection criteria, the geotechnical impacts therefore will be restricted to below the footprint of the facility, will have limited environmental influence and will only be of short term (5 year operation time period).

2. STATUS QUO

Area A is characterised by a gently undulating topography with three well defined drainage channels that include the Klipfonteinspruit (perennial) and the Holfonteinspruit (seasonal) and Holfonteinspruit tributary.

The area currently is under crops and grazing and thus the current impacts relate to agricultural practices and land use capability.

[1] Jones & Wagener April 2013: Kusile Power Plant: Ash Disposal Facility: Geotechnical Study: Feasibility Desk Study Report. Report JW006/13/D121-Rev1 prepared for Zitholele Consulting.

3. PROJECT IMPACT (UNMITIGATED)

The project includes the development of an ash disposal facility. The geotechnical assessment provides information that is used in the design of the facility such as the founding conditions and availability of site materials for construction and consequently the impacts of the disposal facility rather than the geotechnical parameters have greater relevance.

However, the short and long term impacts driven by the geotechnical conditions could include, for example:

- Borrow pits outside the project footprint.
- The loss of future construction materials
- Concentration of surface water infiltration
- Settlement below the facility
- Changes to the groundwater regime
- Disposal Facility foundation stability and potential for debri flow.
- Dust during construction

During the construction and operation of the disposal facility, materials will be required for use as a natural clay liner. Stockpiling of material for cover requirements for the final 5 year operation phase at Closure will also take place. During the various 5 year construction and operation phases, the in-situ material within each 5 year development zone will be stripped and reworked for the liner requirements i.e. no off-site borrow areas are required. Consequently, the impact of the geotechnical element on the environment will be limited to within the footprint of the development.

The short term impacts on the geotechnical conditions during construction and operation phases would be due to the excavations that may result in localised depressions within which ponding of surface runoff could occur as well as localised erosion channels developing and loss of material. This could result in localised soft wet zones, difficult working conditions that would only be of short duration and would only be limited to the "work" area.

Any ponding of construction water or operational tailings water could penetrate the ground water if liner material is ineffective. The environmental impact thus would be a ground water impact that would be assessed by the ground water specialist.

The soil profile conditions provide suitable founding conditions for the disposal facility. However, if rapid and excessive disposal does occur that results in localised foundation failure, an ash debris flow could occur.

The geotechnical impact of this would be that the availability of site materials may be affected. Other environmental impacts would be related to loss of land capability, groundwater contamination, etc.

However, due to the proposed method of disposal, failure of foundation horizons is unlikely.

The additional project impact (without mitigation) will increase the significance of the baseline impact and the unmitigated cumulative impact will definitely be of a MODERATE-LOW negative significance. The impact will be limited to the *development footprint*, is *going to happen* and will be permanent.

4. CUMULATIVE IMPACT

4.1 General

The area proposed for development comprises four different terrain units namely a crest, sideslope, alluvial floodplain and gully. The geotechnical significance of the soils is that they typically supply natural materials that are often used for construction requirements when an area is developed.

In the current project, these soils will be used to provide a source of natural clay for liner requirements and topsoil for final rehabilitation/cover purposes and the material will be sourced from within the project footprint. Consequently, the environmental impact on/from the use of these materials will be limited to the *development footprint* and although the development *will/is going to happen* and will be permanent, the impact risk class prior to any mitigation measures is **Moderate - Low.**

Mitigation measures that will have to be considered during and after the project life will have to focus on minimising the impacts of soil erosion, surface runoff etc for each development phase in and around the perimeter of the disposal facility. These are design impact considerations.

4.2 Mitigation Measures

Design measures that could influence geotechnical aspects that will be pertinent to the facility and that will require mitigation measures could include:

- Erosion of soils along the diversion canals. Mitigation measures should be related to design parameters and should include reduced gradients, the use of silt traps and rock to reduce velocity, excavation of the diversion canal into a suitable horizon to ensure minimal loss through downward percolation.
- Use of material for construction: soil profile to be assessed in advance of each 5 year operational phase. Topsoil and natural liner material to be stockpiled in suitably selected areas for use during the operation phase and final rehabilitation phase. Topsoil to be stockpiled separately for rehabilitation and capping phases.
- Washout of soil from stockpiles: stockpiles to be kept as suitable gradients to ensure infiltration of rainwater dominates rather than wash-off and erosion. Gentle stockpile gradients will also facilitate vegetation growth that will also assist in reducing washout and erosion of stockpiles.
- During the preparation of the liner for each phase, ponding of water must be prevented and runoff from investigated zones limited to minimise erosion.

- Infiltration of surface runoff or tailings water into the ground-water regime: To mitigate against this, the liner material will have to satisfy minimum requirements and be engineered according to design specifications.

- Potential foundation settlement and tailings slope failure: any unexpected foundation conditions to be reported to the design engineer during construction/operation phases and correct management during tailings disposal.

5. RESIDUAL IMPACT (CUMULATIVE IMPACT AFTER MITIGATION)

The residual impact on the geotechnical aspects of the project will only be the loss of potential construction materials and within the overall project environmental impact, the significance of this is very low.

The impact of the ash disposal facility will be permanent and will result in the loss of the Klipfontein- and Holfontein- spruits wetland areas within the footprint area. However, with the construction of the clean water diversion canals around the footprint within these headland areas, clean water drainage into the Klipfonteinspruit wetland to the northwest of the facility will be maintained.

The use of Area A also ensures that the impact of the whole Kusile Project is restricted to one area, namely the footprint of the disposal facility locally and within the whole Kusile Power Plant footprint.

The construction of the disposal facility will have a permanent impact on the geotechnical factors and will be limited to the Kusile *development footprint*. The impact *is going to happen,* will be permanent but the impact risk will be **Moderate - Low**.

The risk impact matrix is given in Table 1.

TABLE 1: Geotechnical Risk Impact

Rated By: B Antrobus				Site A				
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	1 VLOW	2 DEV	2 SHORT	4 VLIKE	**-1.5** **LOW**
Project Impact 1	Excavation and replacement of construction material	Negative	**Definite**	3 MODL	2 DEV	2 SHORT	5 OCCUR	**-2.6** **MODL**
Project Impact 2	Excavation and stockpile of construction material	Negative	**Definite**	2 LOW	3 ADJ	2 SHORT	5 OCCUR	**-2.6** **MODL**
Project Impact 3	Seepage from clean water stream diversion	Negative	**Possible**	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3** **LOW**
Project Impact 4	Loss of construction materials for future use	Negative	**Definite**	1 VLOW	2 DEV	5 PERM	5 OCCUR	**-2.9** **MODL**
Project Impact 5	Foundation stability	Negative	**Possible**	4 MODH	3 ADJ	2 SHORT	2 UNLIKE	**-1.3** **LOW**
Project Impact 6								
Project Impact 7								
Project Impact 8								
Project Impact 9								
Project Impact 10								
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROMPROJECT, **BEFORE MITIGATION**	Negative	**Definite**	3 MODL	2 DEV	3 MED	5 OCCUR	**-2.9** **MODL**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROMPROJECT, **AFTER MITIGATION**	Negative	**Definite**	2 LOW	2 DEV	3 MED	5 OCCUR	**-2.6** **MODL**

6. MANAGEMENT PLANNING

The management of the soil during the construction phase will be dependent on the different phases of construction and will need to be assessed by the design engineer and construction manager.

Geotechnical aspects that will need to be assessed / addressed during the phases of development are provided in Table 2.

Table 2: Geotechnical Environmental Management Plan

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Foundation stability			
Implementation	**Responsibility**	**Resources**	**Monitoring / Reporting**
Ensure layer works properly engineered	Construction manager	Regular Direct field and Lab tests	All test measurements
Regularly monitor excavations for liner materials within each five year phase	Construction manager	Visual inspection	After heavy rainfall periods
Monitor the stockpile area and vegetate to minimise erosion.	Environmental Manager	Visual inspection	Monthly and after heavy rain fall periods
Foundation layer works to be engineered according to specification	Design engineer	Visual inspection and site testing	To be determined by design engineer
Recommended management plans / procedures:			
Regular visual inspections of stockpiles and excavation/construction procedures.			

Yours faithfully

BRYAN ANTROBUS
for Jones & Wagener

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31 May, 2013

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Attention: **Dr. M. Vosloo** mathysv@zitholele.co.za
Cc: **Mr. W. Kok** warren@zitholele.co.za

Dear Sir

GEOTECHNICAL ENVIRONMENTAL IMPACT STATEMENT

1. INTRODUCTION

A specialist geotechnical study[1] of various sites for the proposed 60 year Ash Disposal Facility (ADF) has been completed and Area A has been provisionally selected as the preferred site.

This report documents the geotechnical input as part of the Environment Impact Statement (EIS).

The geotechnical assessment evaluated site conditions with regard to foundations and availability of material for construction requirements. The impact of these considerations is pertinent to design procedures and construction/operation phases of the proposed development. As Area A was a preferred site from the geotechnical selection criteria, the geotechnical impacts therefore will be restricted to below the footprint of the facility, will have limited environmental influence and will only be of short term (5 year operation time period).

2. STATUS QUO

Area A is characterised by a gently undulating topography with three well defined drainage channels that include the Klipfonteinspruit (perennial) and the Holfonteinspruit (seasonal) and Holfonteinspruit tributary.

The area currently is under crops and grazing and thus the current impacts relate to agricultural practices and land use capability.

[1] Jones & Wagener April 2013: Kusile Power Plant: Ash Disposal Facility: Geotechnical Study: Feasibility Desk Study Report. Report JW006/13/D121-Rev1 prepared for Zitholele Consulting.

3. PROJECT IMPACT (UNMITIGATED)

The project includes the development of an ash disposal facility. The geotechnical assessment provides information that is used in the design of the facility such as the founding conditions and availability of site materials for construction and consequently the impacts of the disposal facility rather than the geotechnical parameters have greater relevance.

However, the short and long term impacts driven by the geotechnical conditions could include, for example:

- Borrow pits outside the project footprint.
- The loss of future construction materials
- Concentration of surface water infiltration
- Settlement below the facility
- Changes to the groundwater regime
- Disposal Facility foundation stability and potential for debri flow.
- Dust during construction

During the construction and operation of the disposal facility, materials will be required for use as a natural clay liner. Stockpiling of material for cover requirements for the final 5 year operation phase at Closure will also take place. During the various 5 year construction and operation phases, the in-situ material within each 5 year development zone will be stripped and reworked for the liner requirements i.e. no off-site borrow areas are required. Consequently, the impact of the geotechnical element on the environment will be limited to within the footprint of the development.

The short term impacts on the geotechnical conditions during construction and operation phases would be due to the excavations that may result in localised depressions within which ponding of surface runoff could occur as well as localised erosion channels developing and loss of material. This could result in localised soft wet zones, difficult working conditions that would only be of short duration and would only be limited to the "work" area.

Any ponding of construction water or operational tailings water could penetrate the ground water if liner material is ineffective. The environmental impact thus would be a ground water impact that would be assessed by the ground water specialist.

The soil profile conditions provide suitable founding conditions for the disposal facility. However, if rapid and excessive disposal does occur that results in localised foundation failure, an ash debris flow could occur.

The geotechnical impact of this would be that the availability of site materials may be affected. Other environmental impacts would be related to loss of land capability, groundwater contamination, etc.

However, due to the proposed method of disposal, failure of foundation horizons is unlikely.

The additional project impact (without mitigation) will increase the significance of the baseline impact and the unmitigated cumulative impact will definitely be of a MODERATE-LOW negative significance. The impact will be limited to the *development footprint*, is *going to happen* and will be permanent.

4. CUMULATIVE IMPACT

4.1 General

The area proposed for development comprises four different terrain units namely a crest, sideslope, alluvial floodplain and gully. The geotechnical significance of the soils is that they typically supply natural materials that are often used for construction requirements when an area is developed.

In the current project, these soils will be used to provide a source of natural clay for liner requirements and topsoil for final rehabilitation/cover purposes and the material will be sourced from within the project footprint. Consequently, the environmental impact on/from the use of these materials will be limited to the *development footprint* and although the development *will/is going to happen* and will be permanent, the impact risk class prior to any mitigation measures is **Moderate - Low.**

Mitigation measures that will have to be considered during and after the project life will have to focus on minimising the impacts of soil erosion, surface runoff etc for each development phase in and around the perimeter of the disposal facility. These are design impact considerations.

4.2 Mitigation Measures

Design measures that could influence geotechnical aspects that will be pertinent to the facility and that will require mitigation measures could include:

- Erosion of soils along the diversion canals. Mitigation measures should be related to design parameters and should include reduced gradients, the use of silt traps and rock to reduce velocity, excavation of the diversion canal into a suitable horizon to ensure minimal loss through downward percolation.

- Use of material for construction: soil profile to be assessed in advance of each 5 year operational phase. Topsoil and natural liner material to be stockpiled in suitably selected areas for use during the operation phase and final rehabilitation phase. Topsoil to be stockpiled separately for rehabilitation and capping phases.

- Washout of soil from stockpiles: stockpiles to be kept as suitable gradients to ensure infiltration of rainwater dominates rather than wash-off and erosion. Gentle stockpile gradients will also facilitate vegetation growth that will also assist in reducing washout and erosion of stockpiles.

- During the preparation of the liner for each phase, ponding of water must be prevented and runoff from investigated zones limited to minimise erosion.

- Infiltration of surface runoff or tailings water into the ground-water regime: To mitigate against this, the liner material will have to satisfy minimum requirements and be engineered according to design specifications.

- Potential foundation settlement and tailings slope failure: any unexpected foundation conditions to be reported to the design engineer during construction/operation phases and correct management during tailings disposal.

5. RESIDUAL IMPACT (CUMULATIVE IMPACT AFTER MITIGATION)

The residual impact on the geotechnical aspects of the project will only be the loss of potential construction materials and within the overall project environmental impact, the significance of this is very low.

The impact of the ash disposal facility will be permanent and will result in the loss of the Klipfontein- and Holfontein- spruits wetland areas within the footprint area. However, with the construction of the clean water diversion canals around the footprint within these headland areas, clean water drainage into the Klipfonteinspruit wetland to the northwest of the facility will be maintained.

The use of Area A also ensures that the impact of the whole Kusile Project is restricted to one area, namely the footprint of the disposal facility locally and within the whole Kusile Power Plant footprint.

The construction of the disposal facility will have a permanent impact on the geotechnical factors and will be limited to the Kusile *development footprint*. The impact *is going to happen,* will be permanent but the impact risk will be **Moderate - Low**.

The risk impact matrix is given in Table 1.

TABLE 1: Geotechnical Risk Impact

Rated By: B Antrobus		Site A						
IMPACT DESCRIPTION		Direction of Impact	Degree of Certainty	Magnatude	Spatial	Temporal	Probability	Impact Risk
Code	*Phase*							
	CONSTRUCTION							
STATUS QUO	INITIAL BASELINE IMPACTS TO ENVIRONMENT	Negative	**Definite**	1 VLOW	2 DEV	2 SHORT	4 VLIKE	**-1.5 LOW**
Project Impact 1	Excavation and replacement of construction material	Negative	**Definite**	3 MODL	2 DEV	2 SHORT	5 OCCUR	**-2.6 MODL**
Project Impact 2	Excavation and stockpile of construction material	Negative	**Definite**	2 LOW	3 ADJ	2 SHORT	5 OCCUR	**-2.6 MODL**
Project Impact 3	Seepage from clean water stream diversion	Negative	**Possible**	2 LOW	3 ADJ	1 INCID	3 LIKE	**-1.3 LOW**
Project Impact 4	Loss of construction materials for future use	Negative	**Definite**	1 VLOW	2 DEV	5 PERM	5 OCCUR	**-2.9 MODL**
Project Impact 5	Foundation stability	Negative	**Possible**	4 MODH	3 ADJ	2 SHORT	2 UNLIKE	**-1.3 LOW**
Project Impact 6								
Project Impact 7								
Project Impact 8								
Project Impact 9								
Project Impact 10								
CUMULATIVE IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROMPROJECT, **BEFORE MITIGATION**	Negative	**Definite**	3 MODL	2 DEV	3 MED	5 OCCUR	**-2.9 MODL**
RESIDUAL IMPACT	INITIAL IMPACTS TO ENVIRONMENT + ADDITIONAL IMPACTS FROMPROJECT, **AFTER MITIGATION**	Negative	**Definite**	2 LOW	2 DEV	3 MED	5 OCCUR	**-2.6 MODL**

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