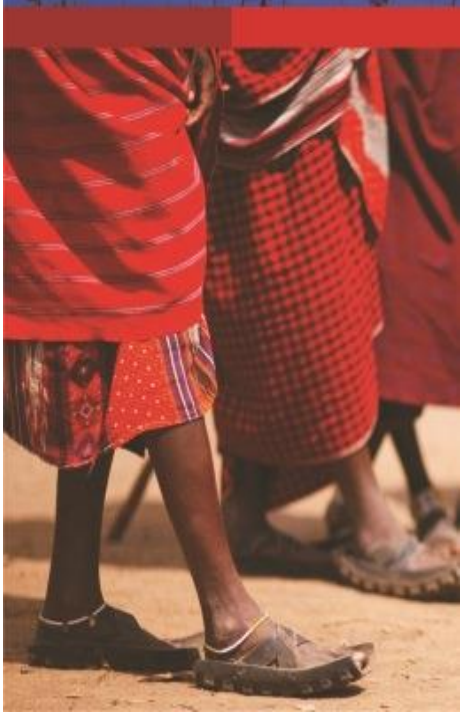

DIGBY WELLS
ENVIRONMENTAL

Environmental Authorisation and Integrated Water Use Licence Applications for the Proposed Active Water Treatment Plant at the Klipspruit Colliery, Mpumalanga Province

Soil and Land Capability Assessment Report

Project Number:

SOU5014

Prepared for:

South32 SA Coal Holdings (Pty) Ltd

August 2018

Digby Wells and Associates (South Africa) (Pty) Ltd
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This document has been prepared by Digby Wells Environmental.

Report Type:	**Soil and Land Capability Assessment Report**
Project Name:	**Environmental Authorisation and Integrated Water Use Licence Applications for the Proposed Active Water Treatment Plant at the Klipspruit Colliery, Mpumalanga Province**
Project Code:	**SOU5014**

Name	Responsibility	Signature	Date
Siphamandla Madikizela Pr.Sci.Nat	Report writer		July and August 2018
Leon Ellis	Technical review		July 2018
Danie Otto Pr.Sci.Nat	EXCO review		August 2018

DECLARATION OF INDEPENDENCE

I, **Siphamandla Madikizela**, in my capacity as a specialist consultant, hereby declare that:

- I act as an independent specialist and I will comply with the Act, regulations and all other applicable legislation;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998);
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act 1998 (Act 107 of 1998);
- I undertake to disclose to the client and the competent authority all material information in my possession that reasonably has or may have the potential of influencing – any decision to be taken with respect to the application by the competent authority and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I undertake to have my work peer reviewed on regular basis by a competent specialist in the field of study for which I am registered;
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity; and
- Based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement.

Full name:	Siphamandla Madikizela
Title/ Position:	Soil Scientist
Qualification(s):	MSc in Soil Science
Experience (years):	5
Registration(s):	SACNASP (*Prof. Nat. Sci. 400154/17*)
Signature:	

EXECUTIVE SUMMARY

Introduction

South32 SA Coal Holdings (Pty) Ltd (hereafter South32) intends to construct a modular Water Treatment Plant (WTP) for treating mine affected water at its Klipspruit Colliery (KPS) located near Ogies in the Mpumalanga Province (the project). Feedwater for the WTP will originate from the Balancing Dam on KPS which currently accommodates mine affected water from the KPS operation.

The proposed KPS Colliery WTP is located approximately 3km west of Ogies in Mpumalanga Province. The WTP is to be established in the south-eastern corner of the KPS Colliery, close to the KPS project offices, within the operational area of Klipspruit Colliery.

Digby Wells Environmental (hereinafter Digby Wells) has been appointed by South32 to undertake a soil and land capability assessment as part of the Environmental Impact Assessment (EIA) of the proposed KPS Colliery active WTP. Various other specialist studies were also undertaken by Digby Wells and this report should be read in collaboration with these.

To identify soils accurately, it is necessary to undertake a soil survey. The aim was to provide an accurate record of the soil resources of an area. Land capability, land use and agricultural potential are then determined from these results. This report presents the findings of a specialist soils and land capability assessment that forms part of the Environmental Authorisation and Integrated Water Use Licence Applications reports. The relevant project components include the following:

- The description of the soil types found in the proposed project area (infrastructure);
- Determining the existing land capability;
- Determining the current land use;
- Soil chemical and physical properties; and
- Impact assessment associated with the proposed WTP on soils.

This specialist soil and land capability report has been compiled in terms of Appendix 6 of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) EIA Regulations, 2014, (as amended in 2017) in terms of the Scoping and EIA process, which is being followed in applying for Environmental Authorisation.

Methodology

As part of the desktop assessment, baseline soil information was obtained from South African land type data published with maps at a scale of 1:250 000 by the Institute for Soil, Climate and Water (ISCW) of the Agricultural Research Council (ARC). A detailed study of the soils within the project expansion area was conducted during field visits on the 23rd of May, 2018.

A free survey method was used where it starts with a detailed physiographic aerial imagery interpretation and the surveyor actually walks most of the landscape, usually in traverses "across the grain", concentrating on the proposed infrastructure areas. The surveyor chooses sample points in order to systematically confirm a mental model of the soil-landscape relationships, draw boundaries and determine map unit composition. Soils were investigated by augering to a maximum depth of 1.2 metre or to the depth of refusal. Soil survey positions were recorded as waypoints using a handheld Global Positioning System (GPS).

At each observation point, the South African Taxonomic Soil Classification System was used to describe and classify the soils. Land capability was determined by assessing a combination of soil, terrain and climate features. Land capability is defined by the most intensive long term sustainable use of land under rain-fed conditions. Land use was determined by aerial imagery and ground-truthed during the site visit.

Findings

The proposed WTP, laydown area and pipeline route are within land type Ba4 and noted soil form was Glencoe soil form on the WTP, pipeline and laydown area. The land capability is dominated by the Class IV (Moderate grazing) and the land use within the proposed area is mining. The fertility status of the soils is generally considered moderate. The area has low soil pH and lime such as dolomitic lime ($CaCO_3$+$MgCO_3$) is required to counteract acidity and to increase plant growth performance.

All of the soil samples collected on the site showed the profile of Ca>Mg>K>Na concentrations as expected. Calcium, magnesium and potassium levels were adequate. Phosphorus concentrations were low and these levels would require fertilisation, should the soils have been used for agricultural purposes. The soil can be described as sandy clay loam on the WTP. The soil organic carbon content of the soils on the proposed area ranged from 0 to 0.06 % and would have required an external nutrient input source, should the soils have been used for agricultural purposes.

Impact Assessment

The impacts associated with the proposed WTP (1.5 ha) and associated infrastructures are the disturbance of the natural occurring vegetation and limited soil profile consisting of soil horizons for foundations and pipeline plinths. The clearing of vegetation and topsoil removal during construction will have an impact on soils. The impacts on soils associated with the proposed WTP can be divided into the following:

- Loss of topsoil during clearing of construction;
- The removal of vegetation may lead to soil erosion by wind and water movement;
- Compaction of soils due to construction vehicles; and
- Chemical soil pollution as a result of oil and fuel spills.

Impact Rating

Construction phase:

- It is anticipated that the impact of WTP on dust will be of low negative significance; and
- It is anticipated that the impact of construction of WTP on erosion and compaction will be of low to moderate negative significance.

Operational phase:

- It is anticipated that the impact of WTP on soils will be of low negative significance.

Decommissioning phase:

- It is anticipated that the impact will be of low to moderate negative significance.

Recommendations

The main aspects that will have to be managed on site during construction and operation include the following:

- Runoff must be controlled and managed by use of proper storm water management facilities;
- Soils should be ameliorated and seeded as soon as possible during construction;
- Fuel and oil spills are common, remediate using commercially available emergency clean up kits; and
- Clearing and removal of soils should be done during dry months (May to September) to reduce erosion and compaction on soils.

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1 Introduction

South32 SA Coal Holdings (Pty) Ltd (hereafter South32) intends to construct a modular Water Treatment Plant (WTP) for treating mine affected water at its Klipspruit Colliery (KPS) located near Ogies in the Mpumalanga Province (the project). Feedwater for the WTP will originate from the Balancing Dam on KPS which currently accommodates mine affected water from the KPS operation. Treatment waste (brine) will be removed to a relevant waste site.

Digby Wells Environmental (hereinafter Digby Wells) has been appointed by South32 to undertake a soil and land capability assessment as part of the Environmental Impact Assessment (EIA) of the proposed KPS Colliery active WTP.

Activities that are listed in terms of the Environmental Impact Assessment (EIA) Regulations, dated 2014 (as amended in 2017) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) require environmental authorisation prior to commencing. The proposed activities at KPS constitute Listed Activities in terms of GN R 983 (Listing Notice 1) and GN R 984 (Listing Notice 2) of the EIA Regulations, 2014 (as amended).

This specialist soil and land capability report has been compiled in terms of Appendix 6 of the NEMA EIA Regulations, 2014, (as amended) in terms of the Scoping and EIA process, which is being followed in applying for Environmental Authorisation.

2 Project Background and Location

South32 owns the Klipspruit Colliery (KPS), near Ogies in the Mpumalanga Province (refer to Figure 2-1 for the locality plan). Contaminated water that is being generated at KPS by mining activities exceeds the re-use capacity within the operations, whilst the storage capacity in mined out areas has reached its limits. The result of this is the risk of spillages or discharges to the natural environment. Effective management of this risk is essential to continued operations at KPS ensuring access to coal resources as well as securing and maintaining the requisite environmental licences and authorisations to operate and expand. Water treatment is thus required and South32 proposes to construct a modular WTP and ancillary infrastructure to treat mine-affected water (the Project).

The WTP is to be established within the operational area of the mine in the south-eastern corner of the Mining Right boundary, adjacent to KPS project offices. The proposed WTP will be modular in design and constructed in three phases, starting at a capacity of 2Ml/day, upgradeable to 3.3 Ml/day and then increments of 3.3Ml/day to 10Ml/day. Contaminated water will be abstracted from the Balancing Dam at KPS and pumped to the WTP. After treatment, clean water that complies with the Resource Water Quality Objectives (RWQO) for the Wilge River catchment is proposed to be discharged into the Saalklapspruit at the northern boundary of the KPS operation adjacent to the N12 national highway.

The treatment process will be based on the use of membrane desalination with brine softening and will consist of the following steps:

- Pre-treatment of the feed water using pH adjustment and disinfection to remove organics from the system that can cause fouling and scaling of the membranes;
- Removal of the dissolved metals by chemical oxidation followed by the removal of precipitates and suspended solids using flocculation and coagulation unit processes;
- Ultrafiltration (UF) will be used to remove fine particles from the feed water to the Reverse Osmosis (RO) unit processes. This is necessary to prevent fouling and scaling of the RO membranes; and
- Product water conditioning is required to ensure the pH meets the discharge requirements.

This process will produce gypsum sludge and brine. The gypsum sludge will be dewatered at the WTP and then loaded onto trucks for off-site disposal at a licenced waste management facility designed for this type of material. The brine will be recycled back into the treatment process until the salinity requires that a portion be depleted from the system. This small volume of brine will be stored in tanks within the proposed WTP footprint from where it will be pumped into road tankers and transported to a third-party waste management site licenced to receive this waste.

The infrastructure layout of the project is depicted in Figure 2-2 and the key infrastructure components of the project scope are as follows:

- A Feed Water Line comprising of a pump station and 1.5km High Density Poly Ethylene (HDPE) pipeline from the Balancing Dam to the WTP site capable of pumping 10Ml/day;
- A return water system from the WTP to the Balancing Dam along the same route as the Feed Water Line for the management of treated water that does not comply with the requirements for release to the catchment;
- A WTP Area with a footprint of approximately 1.5ha for the establishment and operation of a modular WTP with a maximum throughput of 10Ml/day. This includes the development and use of facilities for the storage and handling of hazardous chemicals used in the treatment process;
- A Discharge Line comprising of a 4km HDPE pipeline along the eastern boundary of KPS to transfer the treated water for discharge to the Saalklapspruit. Two pipeline routes are required to accommodate advancing mining and rehabilitation activities along the proposed pipeline servitude, and will be implemented at different stages of the project; and

A dissipation structure at the proposed discharge point, alongside the N12 National Highway.

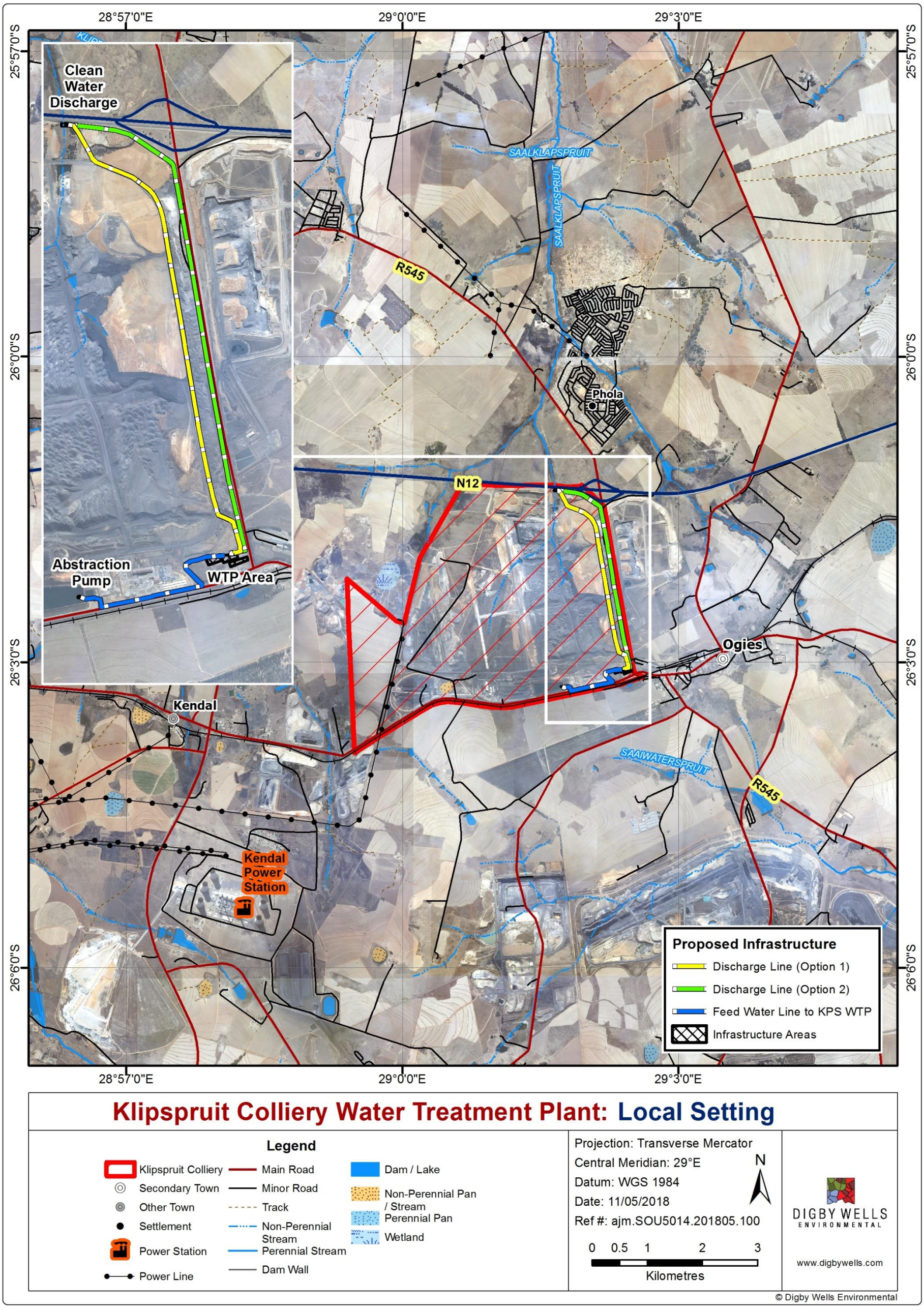

Figure 2-1: Local setting of Klipspruit Colliery Water Treatment Plant

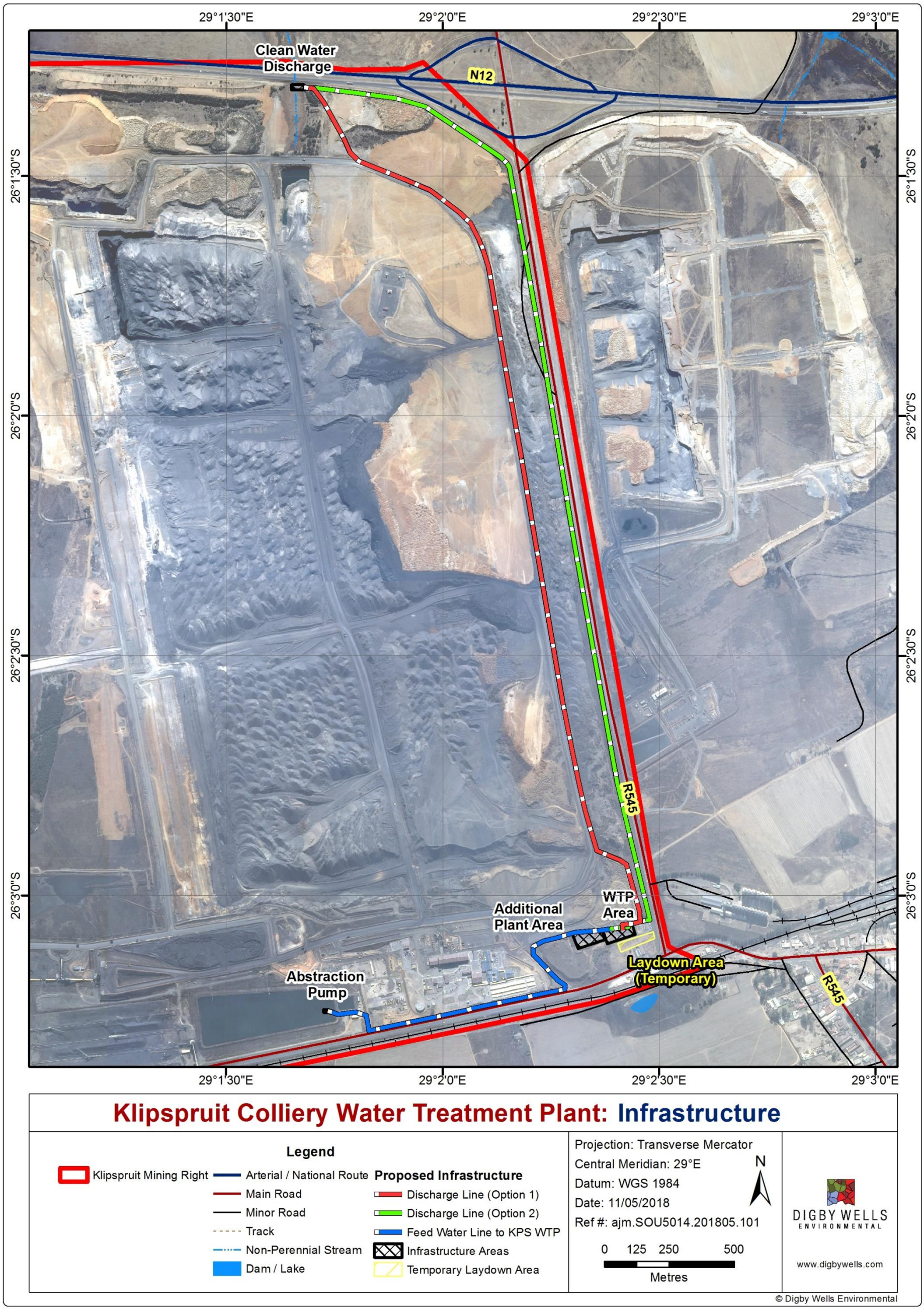

Figure 2-2: Infrastructure Layout for the KPS WTP

3 Scope and Purpose of this Report

The soils, land capability and land use assessment comprised of the following activities:

- Review of the existing soils information;
- Soil survey: the soils occupying the proposed WTP and associated infrastructure (pipelines, and laydown area) were surveyed during site visits. A hand soil auger was used to survey the soil types present and survey positions were recorded as waypoints;
- Description and categorisation of soils was identified using the South African Soil Classification Taxonomic System (Soil Classification Working Group, 1991);
- Land capability: was assessed from the soil classification for the proposed area and climate capability;
- Land use: present land use was mapped in conjunction with the soil survey which included current land uses/covers associated with the respective project components;
- Description of soils in terms of soil fertility: two soil samples were collected in the infrastructure areas (WTP and laydown area); and
- Identification and assessment of potential impacts on soils resulting from the proposed project using the prescribed impact rating methodology. Mitigation measures were recommended to minimise impacts associated with the proposed project.

4 Details of the Specialist

The following is a list of Digby Wells' staff who was involved in the compilation and review of the soil and land capability report for KPS:

Siphamandla Madikizela is a Soil Scientist, completed his MSc in Soil Science at University of KwaZulu-Natal and is a Professional Natural Scientist (Registration no. 400154/17) in the Republic of South Africa. Prior to his employment at Digby Wells Environmental, Siphamandla worked as an Assistant Plantation Manager at EcoPlanet Bamboo SA. He is the part of the Closure, Rehab and Soils Department at Digby Wells Environmental. His role involves conducting soil surveys; soil, land capability and land use environmental impact assessments; soil and agricultural potential studies; soil contamination assessments; interpreting results of soil samples; soil management plans and writing detailed scientific reports in accordance to local legislation and IFC standards and World Bank Guidelines. Siphamandla has worked in projects in South Africa, Democratic Republic of the Congo, Malawi and Mali. (Full CV available in Appendix A)

Leon Ellis; is the Divisional Manager of the Mine Closure and Rehabilitation Division at Digby Wells. Leon completed his BSc. (Hons) in Geography and Environmental Management at the University of Johannesburg (UJ) in 2009. He joined Digby Wells in

January 2013. When Leon joined Digby Wells, he was part of the Environmental Management Services (EMS) Department and since joined the Mine Closure Unit. He has eight years' experience in the environmental services sector with specialised focus on Environmental Liability Assessments, Mine Closure Plans, Performance Assessments and Risk Assessments, locally and internationally. He has also been involved in the undertaking of Environmental Impact Assessments (EIAs) and Environmental Management Programmes (EMPs). Leon also completed the Environmental Risk Assessment and Management course based on ISO 31000 at the Centre of Environmental Management (North West University) in 2016.

Danie Otto; is the Technical Director at Digby Wells. Danie holds an MSc in Environmental Management (Phytoremediation) with BSc Hons (Limnology, Geomorphology, GIS and Environmental Management) and BSc (Botany and Geography & Environmental Management). He is a bio-geomorphologist that specialises in ecology of wetlands and rehabilitation. He has been a registered Professional Natural Scientist since 2002. Danie has 20 years of experience in the mining industry in environmental and specialist assessments, management plans, audits, rehabilitation, and research.

5 Legal and Administrative Framework

The South African Environmental Legislation needs to be considered with the reference to the management of the soil. Soils and land capability are protected under the following:

- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA);
- The Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002 (MPRDA); and
- The National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEMWA).

6 Assumptions and Limitations

The following assumptions and limitations have been made:

- The information provided in this report is based on information gathered from the site visit undertaken in May 2018;
- Proposed pipeline routes were surveyed using aerial imagery and verified on site;
- A total of two soil samples were collected on the proposed infrastructure areas;
- The information contained in this report is based on auger points taken and observations on site; and
- The area surveyed was based on the preliminary layout presented by South32.

7 Methodology

This section provides the methodology used in the compilation of the soils report as indicated in Figure 7-1.

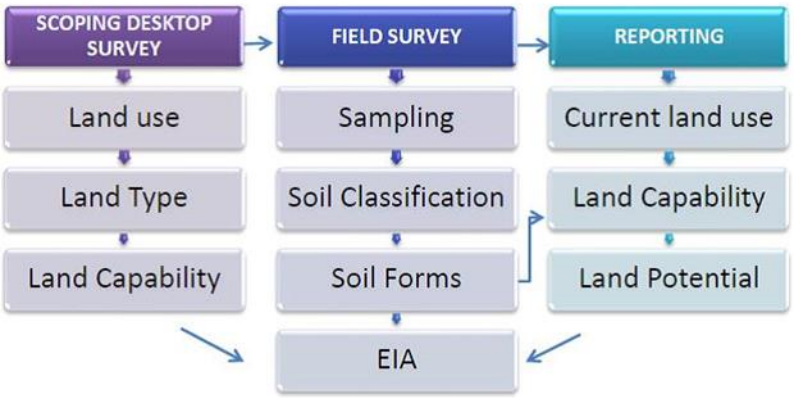

Figure 7-1: Soil and land capability assessment and report process

To complete the proposed scope of work, there were a number of tasks which needed to be completed and these tasks are explained separately below.

7.1 Desktop Assessment and Literature Review

7.1.1 Desktop Assessment

Existing Land Type data was used to obtain generalised soil patterns and terrain types for the KPS Colliery. Land Type data exists in the form of published 1:250 000 maps. These maps indicate delineated areas of relatively uniform terrain, soil pattern and climate (Land Type Survey Staff, 1972 - 2006). These maps and their accompanying reports provide a statistical estimate of the different soils that can be expected in the area.

7.1.2 Literature Review

Digby Wells conducted a desktop review of the baseline data and findings related to the soil surveys. The following sources of information were reviewed and utilised for the compilation of this report:

- BHP1591. Environmental Impact Assessment for Klipspruit South. Soil Survey Report. Digby Wells, November 2014;
- South32 Klipspruit Colliery. Soil Contamination Assessment Report. Strategic Environmental Focus (Pty) Ltd (2015); and
- BHP2690. Environmental Impact Assessment for KPSX: Weltevreden. Soil Survey Report. Digby Wells, January 2015.

7.2 Soil Classification

An assessment of the soils present on the proposed WTP and laydown areas was conducted during a field visit in May 2018. The site was traversed on foot and a hand soil auger was used to determine the soil type and depth. Soils were investigated using a bucket auger to a maximum depth of 1.2m or to the depth of refusal. Survey positions were recorded as waypoints using a handheld Global Positioning System (GPS). Other features such as existing open trenches were helpful to determine soil types and depth. The soil forms (types of soil) found was identified using the South African Soil Classification System (Soil Classification Working Group, 1991).

7.3 Soil Sampling and Analysis

Two soil samples (0 to 0.6 m) were collected from the proposed areas (Figure 7-2). The soil samples were stored in plastic bags and sent to Intertek Agricultural Laboratory in Bapsfontein for analysis (the laboratory certificate is attached as Appendix B). Samples were analysed for indicators of acidity, fertility and texture as follows:

- Soil pH;
- Exchangeable cations (Ca, Mg, K and Na) (Ammonium acetate extraction);
- Phosphorus (Bray No.1 extractant);
- Soil Organic carbon and
- Soil Texture (Clay, Sand and Silt).

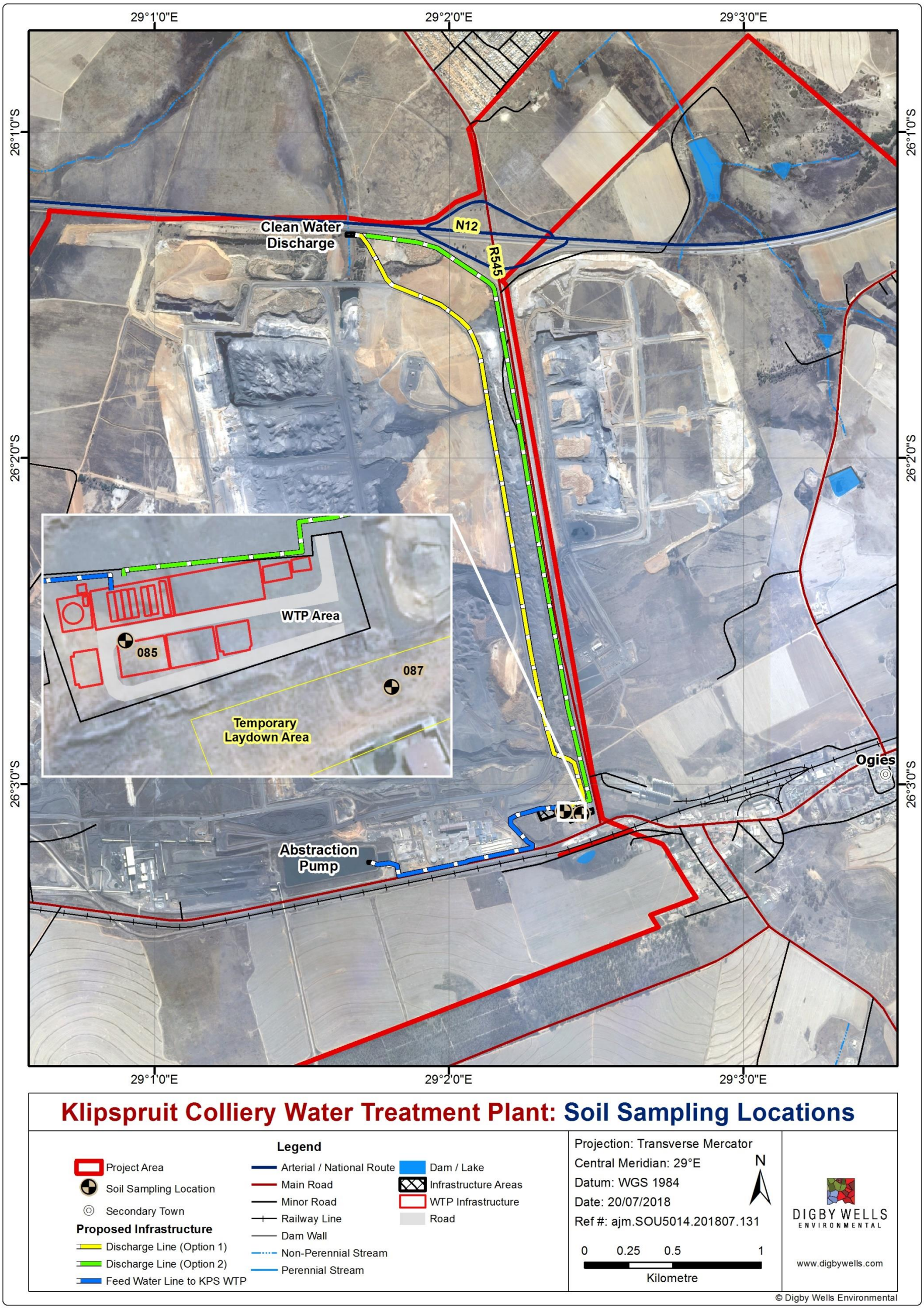

Figure 7-2: Soil sampling locations for the KPS WTP

Soil texture is defined as the relative proportion of sand, silt and clay particles found in the soil. The relative proportions of these three fractions (clay, sand and silt) as illustrated by the red arrows in Figure 7-3, determines one of 12 soil texture classes, for example sandy loam, loam, sand, sandy clay loam, etc. The different texture class zones are demarcated by the thick black line in the diagram. The green zone can be used as a guideline for moderate to high agricultural potential, but need to be evaluated together with other soil properties.

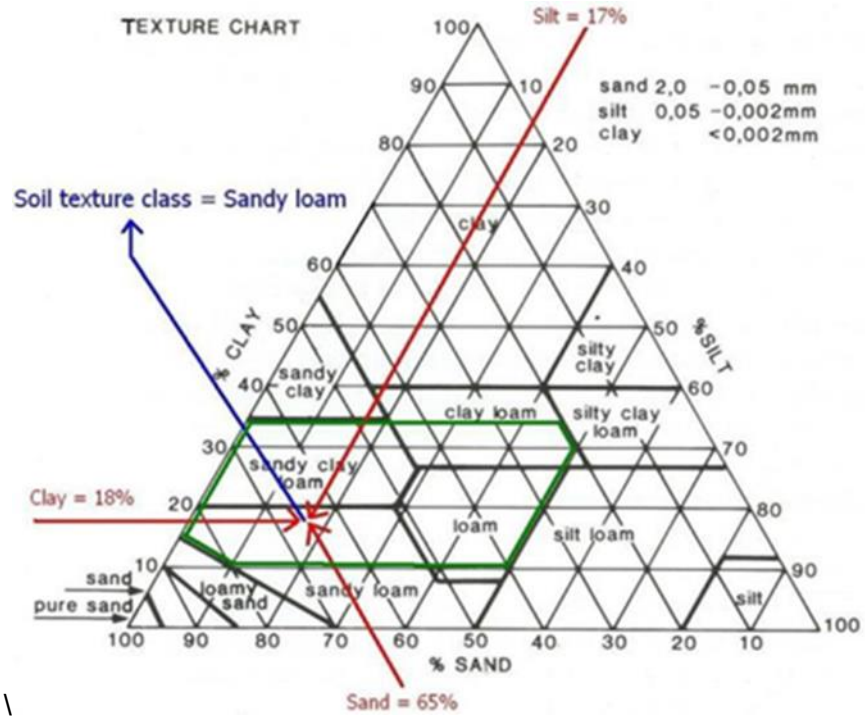

Figure 7-3: Soil textural triangle (SASA, 1999)

7.4 Land Capability

Land capability was determined by assessing a combination of soil, terrain and climate features. Land capability is defined by the most suitable land use under rain-fed conditions. The approach by Schoeman *et al* (2000) was used to assess the land capability. The defined land capability shows the most intensive long-term use of land for rain-fed agriculture and at the same time indicates the permanent limitations associated with different land use classes. The classification system is made up of land capability classes and land capability groups (Table 7-1).

Table 7-1: Land capability classes

Land Capability Class	Increased Intensity of Use									Land Capability Groups
I	W	F	LG	MG	IG	LC	MC	IC	VIC	**Arable Land**
II	W	F	LG	MG	IG	LC	MC	IC		
III	W	F	LG	MG	IG	LC	MC			
IV	W	F	LG	MG	IG	LC				
V	W		LG	MG						**Grazing Land**
VI	W	F	LG	MG						
VII	W	F	LG							
VIII	W									**Wildlife**

W- Wildlife **MG- Moderate Grazing** **MC- Moderate Cultivation**

F- Forestry **IG- Intensive Grazing** **IC- Intensive Cultivation**

LG-Light Grazing **LC- Light Cultivation** **VIC- Very Intensive Cultivation**

7.5 Land Use

The current land use was identified by aerial imagery during the desktop assessment and by on-site inspection. The land use is classified as follows:

- Plantations;
- Mines;
- Natural;
- Waterbodies;
- Urban built-up; and
- Cultivated.

8 Findings

Information related to the soils within the project area is discussed in this section. The dominant land types covering the proposed WTP area, laydown area and pipeline routes were Ba4 (Figure 8-1). The laboratory analyses and results are also presented. Further information related to the soil covering the proposed project area is discussed in Section 8.1

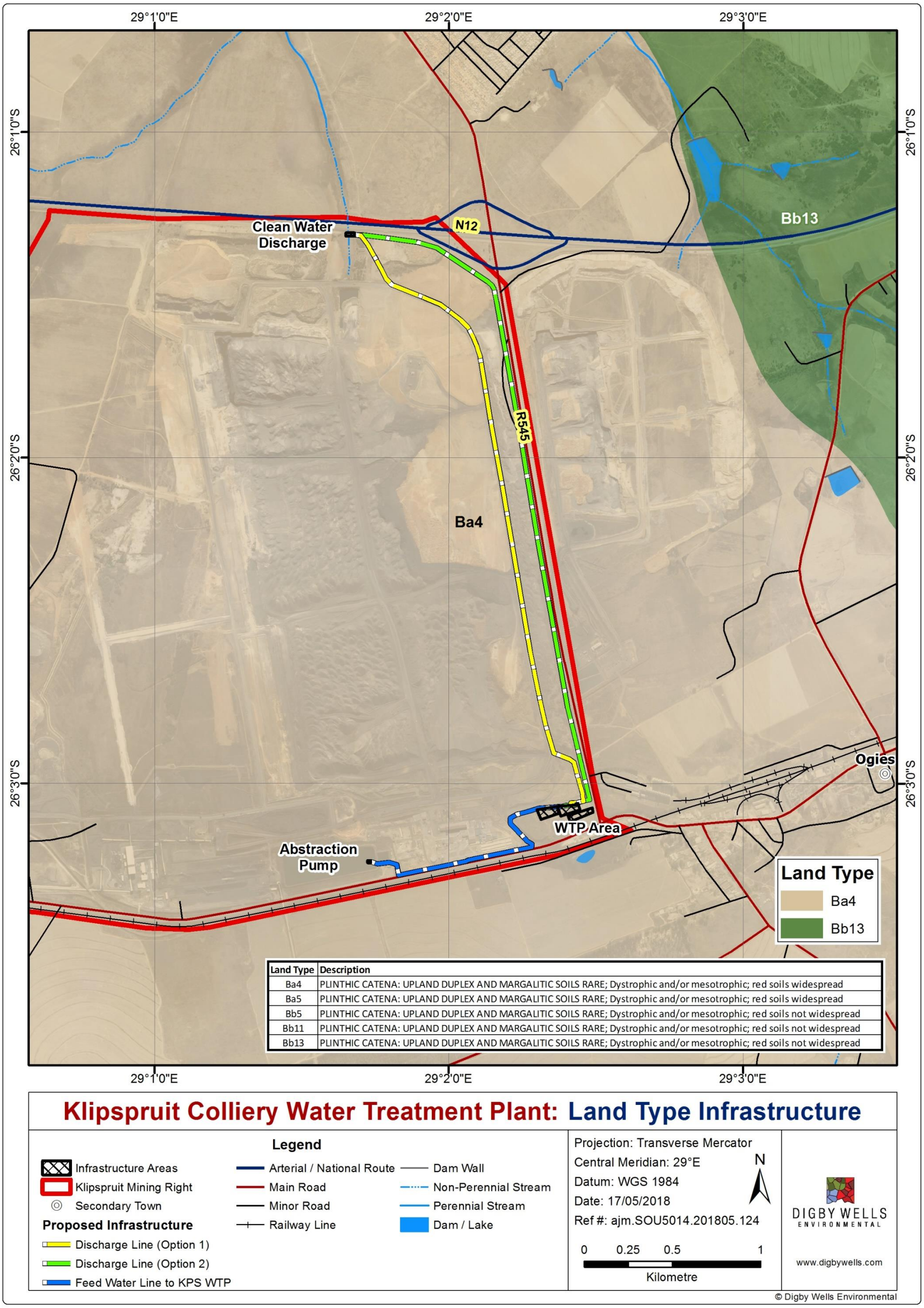

Figure 8-1: Land type at KPS Colliery

8.1 Land Type Data and Soil Forms

Table 8-1 shows dominant land type and soil forms found on the site with visual representation depicted Figure 8-2

Table 8-1: Dominant land type and soil forms

Land Type	Soil Forms	Geology
Ba4	Hutton, Avalon, Glencoe	Underlying geology consists of shale and sandstone of the Ecca Group, Karoo Sequence

8.1.1 Glencoe Form

The Glencoe soil form consists of an orthic A and yellow brown apedal over hard plinthic (Figure 8-2). Glencoe soil form is characterised by a hard plinthic layer and hard plinthic is formed when a soft plinthic horizon has hardened irreversibly into ferricrete.

Figure 8-2: Glencoe soil form

8.2 Land Capability

Land capability is determined by assessing a combination of soil, terrain and climate features. The dominant land capability class in the project area is Class IV (Moderate grazing), as depicted in Figure 8-3.

8.2.1 Class IV: Moderate grazing

Land in Class IV has very severe limitations that restrict the choice of plants that can be grown and may require special conservation practices. Land may be used for cultivated crops, but has more restrictions than Class III and careful management is required. Limitations restrict, individually or in combination, the amount of clean cultivation, time of planting, tillage, harvesting and choice of crops. Conservation practices are more difficult to

apply and maintain. Soils in class IV may be used for pasture, wildlife and food. Use for cultivated crops is limited as a result of the effects of one or more permanent features such as:

- Severe susceptibility to water or wind erosion;
- Severe effects of past erosion; and
- Low moisture holding capacity.

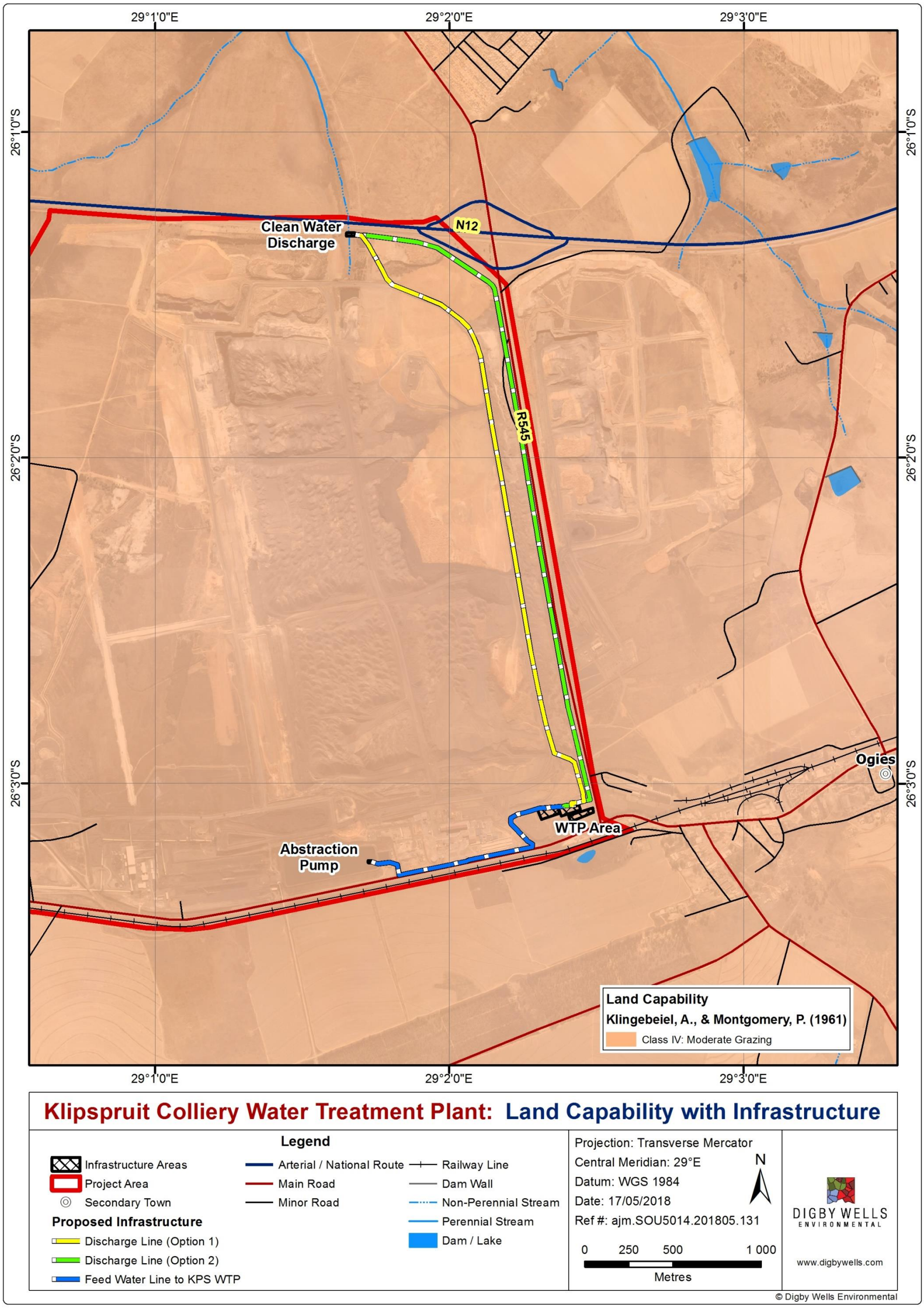

Figure 8-3: Land capability at KPS Colliery

8.3 Land Use

Current land use activities within the study area are largely dominated by mining activities as depicted in Figure 8-4. The study area is surrounded by mining activities and there is no loss of agricultural land as the proposed area is already impacted by mining activities.

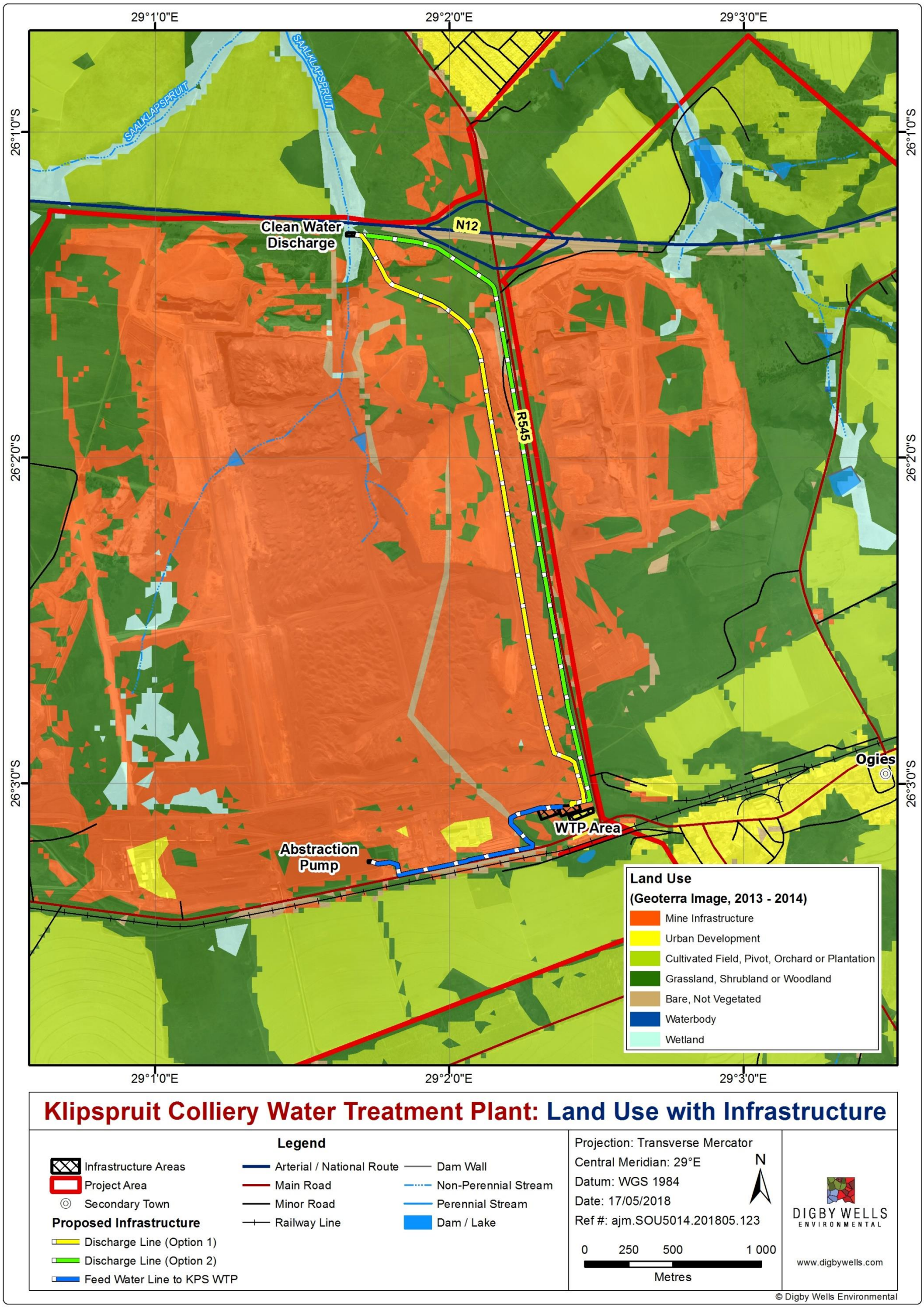

Figure 8-4: Land use at KPS Colliery

8.4 Soil Chemical and Physical Characteristics

Two (2) soil samples were analysed for chemical and physical properties. The objective of this section of the study is to characterise the soil physico-chemical properties assessed which included:

- Chemical properties (pH, organic carbon (OC), cations and phosphorus); and
- Soil texture (Clay, Silt and Sand).

Table 8-2 presents a summary of physico-chemical properties and local soil fertility guidelines are presented in Table 8-3 as a basis for interpreting these results.

8.4.1 Soil pH

The soil pH is determined in the supernatant liquid of an aqueous suspension of soil after having allowed the sand fraction to settle out of suspension. Soil pH influences plant growth in the following manner:

- Through the direct effect of the hydrogen ion concentration on nutrient uptake;
- The mobilisation of toxic ions such as aluminium which restrict plant growth; and
- Indirect impacts that include the effect on trace nutrient availability.

The pH was measured to determine the oxidation potential of the soils. The soil pH ranged from 4.5 to 5.5 as presented in Table 8-2 and these soils are considered to be acidic. The soil pH below 7 may be due to the acidic nature of the parent material from which the soils were derived and leaching of the nutrients. Lime such as dolomitic lime ($CaCO_3$+$MgCO_3$) is required to counteract acidity and to increase plant growth performance, should agricultural activities have taken place.

8.4.2 Cations

The levels of the basic cations Ca, Mg, K and Na are determined in soil samples for agronomic purposes through extraction with an ammonium acetate solution. In general, the amounts of exchangeable cations normally follow the same trend as outlined for soil pH and texture. For most soils, cations follow the typical trend Ca>Mg>K>Na.

Calcium, magnesium and potassium levels in the soils were generally adequate for crop production (Table 8-2), not below the required levels (Table 8-3) and these nutrients are not limiting any production or considered as toxic. There will not be a need to add Ca, K and Mg sources as the proposed is not going to be used for agricultural purposes.

8.4.3 Phosphorus

The Bray 1 extraction and analysis procedure for phosphorus is preferred for soils with pH levels below 7. The phosphorus (P) levels encountered in the samples from the site were all very low according to guidelines in Table 8-3, with most values being 2mg/kg and the

maximum 4mg/kg (Table 8-2). Phosphorus will be a limiting factor in terms of ecosystem function if the soil was going to be used for agricultural purposes and at least 15mg/kg would be required. Phosphorus fertilisation would have been required to establish good crop stand and growth, should agricultural activities have taken place over the area.

8.4.4 Soil Organic Carbon

Soil organic carbon provides an indication of organic matter content in a soil. Levels above 2 to 3% organic carbon are considered moderate to high according to du Preez *et al.* (2010). The organic carbon content of the soils on the proposed area ranged from 0 to 0.06% (Table 8-2) and levels below 2% would have required an external nutrient input source, should the soils have been used for agricultural purposes.

8.4.5 Soil Texture

The particle size distribution of the soil sampled in the area was classed into the percentages of sand, silt and clay present. The textural classes were obtained from plotting the three fractions on a textural triangle (Figure 7-3). The soils can be described as sandy clay loam (Table 8-2).

Table 8-2: Soil physico-chemical properties

Sample ID	pH(KCl)	P(Bray1)	Na	K	Ca	Mg	OC	Clay	Sand	Silt	Texture
		Mg/kg					%				
085	4.8	2	14	65	232	180	0.06	29	60	11	Sandy clay loam
087	5.2	4	23	56	315	114	0.06	25	57	18	Sandy clay loam

Table 8-3: Soil fertility guidelines

Guidelines (mg per kg)					
Macro Nutrient			**Low**	**High**	
Phosphorus (P)			<5	>35	
Potassium (K)			<40	>250	
Sodium (Na)			<50	>200	
Calcium (Ca)			<200	>3000	
Magnesium (Mg)			<50	>300	
pH (KCl)					
Very Acid	**Acid**	**Slightly Acid**	**Neutral**	**Slightly Alkaline**	**Alkaline**
<4	4.1-5.9	6-6.7	6.8-7.2	7.3-8	>8

8.5 Agricultural Potential

The dominant soil has low to moderate agricultural potential and has high erosion potential (Table 8-4).

Table 8-4: Agricultural and erosion potential for soils

Soil Form	Depth (m)	Agricultural Potential	Erosion Potential
Glencoe	0 – 0.6	Low to moderate	High

9 Potential Impacts

The impacts associated with the infrastructure development are the disturbance of the vegetation and soil profile consisting of soil horizons limited to foundations. The impacts on soils associated with the proposed infrastructure development can be divided into the following:

- The removal of topsoil (for foundations and pipeline) may lead to soil erosion by wind and water movement over the soil surface;
- Soil compaction in areas where construction will take place; and
- Chemical soil pollution may occur as a result of oil and fuel spills.

There is a risk of accidental spillages of hazardous substances, for example hydrocarbons or oils from vehicles or other construction machinery and from waste storage facilities during construction and operation. Accidental leakage/spillage of oils and hydrocarbons from equipment used can result in soil contamination. It must be ensured that the requirements of South African legislation are met for prevention of pollution.

In Digby Wells' opinion, the overall environmental impacts of the proposed WTP on soil and land capability will be low due to the area already being disturbed by mining and related activities.

10 Impact Assessment

The impacts are assessed based on the impact's magnitude as well as the receiver's sensitivity, concluding in an impact significance which identifies the most important impacts that require management. Based on the international guidelines and legislation, the following criteria will be taken into account when examining potentially significant impacts relating to soils and land capability:

- Nature of impacts (direct/indirect, positive/negative);
- Duration (short/medium/long-term, permanent (irreversible)/temporary (reversible), frequent/seldom;
- Extent (geographical area, size of affected population/species);
- Intensity (minimal, severe, replaceable/irreplaceable);
- Probability (high/medium/low probability); and
- Measures to mitigate avoid or offset significant adverse impacts.

10.1 Methodology used in Determining and Ranking the Nature, Significance, Consequence, Extent, Duration and Probability of Potential Environmental Impacts and Risks

Impacts and risks have been identified based on a description of the activities to be undertaken. Once impacts have been identified, a numerical environmental significance rating process will be undertaken that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a particular environmental impact.

The severity of an impact is determined by taking the spatial extent, the duration and the severity of the impacts into consideration. The probability of an impact is then determined by the frequency at which the activity takes place or is likely to take place and by how often the type of impact in question has taken place in similar circumstances.

Following the identification and significance ratings of potential impacts, mitigation and management measures will be incorporated into the Environmental Management Plan (EMPr).

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact/risk assessment formula:

Significance = Consequence x Probability x Nature

Where

Consequence = Intensity + Extent + Duration

And

Probability = Likelihood of an impact occurring

And

Nature = Positive (+1) or negative (-1) impact

Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts

The matrix calculates the rating out of 147, whereby intensity, extent, duration and probability are each rated out of seven as indicated in Table 10-3. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation proposed in this report. The significance of an impact is then determined and categorised into one of seven categories, as indicated in Table 10-2, which is extracted from Table 10-1. The description of the significance ratings is discussed in Table 10-3.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Table 10-1: Impact assessment parameter ratings

Rating	Intensity/ Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources or **highly** sensitive environments. Irreplaceable damage to **highly sensitive** cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or **moderate to highly** sensitive environments. Irreplaceable damage to cultural/social resources of **moderate to highly** sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur.>65 but <80% probability.

Rating	Intensity/ Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
5	Serious loss and/or damage to physical or biological resources or **highly** sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or **moderately** sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.

Rating	Intensity/ Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
3	Moderate loss and/or damage to biological or physical resources of **low to moderately** sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local including the site and its immediat surrounding area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	**Minor loss and/or effects** to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited extending only as far as the development site area.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

Rating	Intensity/ Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
1	**Minimal to no loss** and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 10-2: Probability/consequence matrix

Probability	Significance																																									
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Consequence

Table 10-3: Significance rating description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

10.2 Impact Assessment

The impact assessment is aimed at identifying impacts related to the various activities listed, from a soils perspective. The impact assessment is aimed at identifying impacts related to the various activities listed in Table 10-4.

Table 10-4: Proposed project activities

Construction
Site clearing, including the removal of vegetation and topsoil
Construction of related infrastructure
Operational
Use and maintenance of pipelines
Storage, handling and treatment of hazardous products including fuel, explosives, soil and waste.
Decommissioning
Demolition and removal of all infrastructure
Rehabilitation, including spreading of soil, re-vegetation and profiling
Post-closure monitoring and rehabilitation.

10.2.1 Construction Phase

Construction activities on the site will lead to land clearing and disturbance of the soil resulting in dust creation. It is anticipated that the impact of dust will be of low negative significance. The clearing of vegetation, the exposing of soil during construction of the WTP and unearthing of the pipelines, may lead to erosion due to wind or water. Vehicles will drive on the soil surface during the construction phase, thereby causing compaction of the soils. This reduces infiltration rates and ability for plant roots to penetrate the compacted soil. It is anticipated that the impact on soils will be of low to moderate negative significance. The land capability of the area is low and has been reduced by mining activities therefore there won't be any change.

10.2.1.1 Management Actions

Management actions and targets include the following:

- Ensure proper storm water management designs are in place;
- If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place;
- Use of water tankers to control dust;
- Only the designated access routes are to be used to reduce any unnecessary compaction; and

- Re-vegetation of disturbed areas or implementing covering measures such as paving.

Soils should be handled with care from the construction phase throughout the project life cycle.

10.2.1.2 Impact Ratings

The construction phase impacts are rated in Table 10-5, Table 10-6 and Table 10-7.

Table 10-5: Potential Impacts for the loss of topsoil as a resource (Dust, erosion and compaction)

Dimension	Rating	Motivation	Significance
Activity and Interaction: Clearing of vegetation and land			
Impact Description: Removal of topsoil and land may lead to dust generation and erosion, respectively. The movement of heavy machinery on the soil surface causes compaction which reduces the vegetation's ability to grow and as a result erosion could occur.			
Prior to Mitigation/Management			
Duration	3	Topsoil will be removed in preparation of the foundations for proposed WTP and impact is not more than 10 years	Minor (negative) - 32
Extent	3	Impact is limited to the development site area	
Intensity	2	Moderate loss of topsoil and damage of physical resources during construction	
Probability	4	Loss of topsoil will probably occur during construction	
Nature	Negative		
Mitigation/Management Actions			
▪ Only clear vegetation when and where necessary; ▪ Only remove topsoil when and where necessary ; ▪ Only the designated access routes are to be used; ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion from taking place; and ▪ Ensure proper storm water management designs are in place.			
Post-Mitigation			
Duration	2	Impact will be less than 5 years if mitigation measures are implemented	Negligible (negative) - 18

Dimension	Rating	Motivation	Significance
Extent	2	Loss of topsoil will occur within and around the project site	
Intensity	2	Loss of topsoil may result in degradation	
Probability	3	If mitigation measures are followed the impact will be lower	
Nature	Negative		

Table 10-6: Potential impacts for the loss of land capability and land use

Dimension	Rating	Motivation	Significance
Activity and Interaction: Clearing of vegetation and land			
Impact Description: Removal of soil layer will impact on the land capability. The land capability has been reduced already by previous mining activities. Land use will remain as mining since the water treatment and pipelines are within mining area.			
Prior to Mitigation/Management			
Duration	4	The removal of soil reduces the land capability and impact can be reversed	Minor (negative) - 40
Extent	3	Loss of land capability will be limited to the project area.	
Intensity	3	The land capability has been already reduced and land use will remain mining.	
Probability	4	By removing the topsoil the impact on land capability and land use is probable	
Nature	Negative		
Mitigation/Management Actions			
▪ No land capability mitigation measures are possible during this phase; and ▪ Effective monitoring and management of topsoil areas for compaction, erosion and compaction.			

Table 10-7: Potential Impacts for the loss of soil as a result of pipeline construction

Dimension	Rating	Motivation	Significance
Activity and Interaction: Pipeline route, site clearing and construction			
Impact Description: Loss of topsoil resources as a result of construction of pipeline route through compaction and erosion. Topsoil will be removed for the development of the operation for the preparation of the construction of pipes.			
Prior to Mitigation/Management			
Duration	5	Pipeline will be in place for the duration of the project.	Moderate (negative) - 78
Extent	3	Loss of topsoil (compaction and erosion) will occur within the pipeline route.	
Intensity	5	Loss of usable topsoil as pipelines will be constructed	
Probability	6	By excavating the soil it will certainly impact on the soil	
Nature	Negative		
Mitigation/Management Actions			
▪ Only clear vegetation where the infrastructure will be developed and avoid cultivated areas where feasible; ▪ Only the designated access routes are to be used; and ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion from taking place.			
Post-Mitigation			
Duration	4	Impact on soils will be less than a year if mitigation measures are implemented	Minor (negative) - 40
Extent	2	Loss of soil (compaction and erosion) will only occur within project area	
Intensity	4	Impact will be reduced if mitigation measures are implemented	
Probability	4	If mitigation measures are followed the impact will occur	
Nature	Negative		

10.2.2 Operational Phase

It is anticipated that the impact on soils will be of low negative significance. During the operational phase the following activities will impact on the soils:

- Maintenance and use of access of the pipelines and WTP; and
- Storage of hazardous chemicals/materials.

10.2.2.1 Management Actions

Management actions include the following:

- Maintenance and inspections of the soil along the pipeline route must be done to minimise compaction and erosion;
- Ensure designed storm water management plans are in place;
- Monitor dust in the surrounding areas;
- If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place; and
- Only the designated access routes are to be used to reduce any unnecessary compaction.

10.2.2.2 Impact Ratings

The operational phase impacts are rated in Table 10-8 and Table 10-9.

Table 10-8: Maintenance of the WTP and pipeline route

Dimension	Rating	Motivation	Significance
Activity and Interaction: Maintenance of pipeline routes			
Impact Description: The maintenance and inspections of the pipeline for contamination and erosion			
Prior to Mitigation/Management			
Duration	5	When the soil has eroded the impact will be permanent and is potentially irreversible	Minor (negative) - 30
Extent	2	Compaction and erosion will occur on a limited scale	
Intensity	3	Impact will be reduced if mitigation measures are implemented	
Probability	3	Impact is unlikely to occur if mitigation measures are implemented	
Nature	Negative		

Dimension	Rating	Motivation	Significance
Mitigation/Management Actions			
▪ Maintenance and inspections on the pipeline must be done to minimise compaction and erosion. ▪ Check leakages on the pipelines regularly to avoid major contamination			
Post-Mitigation			
Duration	2	Impact on soil can be less than a year if mitigation measures are implemented	Negligible (negative) - 14
Extent	2	Compaction and erosion will occur on a very limited scale	
Intensity	3	Intensity of the impact on soils will be reduced if mitigation measures are implemented	
Probability	2	Impact will rarely occur if mitigation measures are followed	
Nature	Negative		

Table 10-9: Storage of hazardous chemicals/materials

Dimension	Rating	Motivation	Significance
Activity and Interaction: Uncontrolled dumping of waste material			
Impact Description: Dumping of waste material on soils could lead to contamination			
Prior to Mitigation/Management			
Duration	4	Spillages are likely to occur during the operational phase and impacts can be reversed with mitigation measures being implemented	Minor (negative) - 45
Extent	2	The impacts will be area specific or localised (site)	
Intensity	3	Hydrocarbons may lead to soil quality deterioration and impact on groundwater. Fuel and oil storage areas should be located in closed or paved areas	
Probability	5	Spillages are likely to occur during the operational phase and mitigation measures should be implemented	
Nature	Negative		

Dimension	Rating	Motivation	Significance
Mitigation/Management Actions			
▪ Spillages can be collected in a drip tray and drum to store; ▪ Ensure spill clean-up kits are readily available in the event of a spillage; ▪ Remove spill-affected soil for disposal at a registered facility; ▪ Emergency spill response plan is required to handle any unplanned spillages; ▪ Waste management plan; and ▪ All vehicles are to be serviced in a designated area or offsite at a workshop			
Post-Mitigation			
Duration	3	Impact would likely to occur, how mitigation measures need to be implemented to reduce impact.	Negligible (negative) - 21
Extent	2	Impact will occur within the proposed areas. Remediation should be implemented accordingly.	
Intensity	2	If mitigation measures are followed the impact will be lower.	
Probability	3	If mitigation measures are followed it is likely that the impact will occur.	
Nature	Negative		

10.2.3 Decommissioning Phase

During the decommissioning phase, the following activities will take place:

- Demolition of WTP and removal of the pipelines;
- Top soiling of all disturbed areas;
- Ripping of compacted areas to loosen soil; and
- Vegetation establishment in all disturbed areas.

When the decommissioning and removal of infrastructure takes place, vehicles could drive on the surfaces causing compaction and this in turn reduces infiltration rates as well as the ability for plant roots to penetrate the compacted soil. The impacts to consider in the rehabilitation of the site will be the loss of topsoil as a resource through erosion and compaction. During the rehabilitation phase, the impacted areas will be rehabilitated as per the rehabilitation guideline (see Rehabilitation Report compiled by Digby Wells). The management objectives are to limit the impacts that could occur on the site. Rehabilitated areas must be assessed for compaction, contamination and possible erosion, corrected and protected immediately. It is anticipated that the impact on soils will be of low to moderate negative significance.

10.2.3.1 Management Actions

The following management actions are provided:

- Implement land rehabilitation measures as defined in rehabilitation report;
- Compacted areas are to be ripped to loosen the soil and vegetation cover re-instated;
- Ensure proper storm water management designs are in place to ensure no run-off or pooling occurs; and
- Only designated access routes are to be used to reduce any unnecessary compaction.

10.2.3.2 Impact Ratings

The decommissioning impacts described are rated in Table 10-10.

Table 10-10: Impact rating during decommissioning of the infrastructure

Dimension	Rating	Motivation	Significance
Activity and Interaction: Demolishing of the infrastructure and removal of pipelines			
Impact Description: Decommissioning of associated infrastructure will cause compaction and erosion if rehabilitation is not done correctly.			
Prior to Mitigation/Management			
Duration	5	The impact on soils will occur if mitigations are not implemented	Minor (negative) - 36
Extent	2	Impact will occur on a limited scale	
Intensity	5	The intensity of the impact is serious and will be irreversible if mitigation measures are not implemented leading to chemical and physical degradation of the soil	
Probability	3	Impact will be unlikely to occur, if mitigation measures are not implemented will lead to compaction, erosion and loss of topsoil	
Nature	Negative		
Mitigation/Management Actions			
▪ Rehabilitate according to the rehabilitation plan; ▪ Return the land conditions capable of supporting prior land use or uses equal or better than prior land use to the extent feasible or practical.; ▪ Plant native vegetation to prevent erosion and encourage self-sustaining development of a productive ecosystem; and ▪ Remove buildings to foundation level. Demolished rubble must be disposed of in accordance with Rehabilitation Plan and approval from the South African Authorities.			
Post-Mitigation			
Duration	2	Impact will be less than a year if rehabilitation measures are implemented correctly	Negligible (negative) - 14
Extent	2	Impact will occur on a limited scale	
Intensity	3	The intensity will be reduced if mitigation measures are implemented	
Probability	2	Impact will be unlikely to occur if mitigation measures are implemented	

Dimension	Rating	Motivation	Significance
Nature	Negative		

11 Mitigation and Management Measures

The following management actions and targets are necessary for the proposed development areas:

- If erosion has occurred, usable soil should be sourced and replaced and shaped to reduce the recurrence of erosion;
- Only the designated access routes are to be used to reduce any unnecessary compaction;
- Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated;
- Soil erosion might pose a problem once topsoil is removed, thus erosion monitoring should take place especially for soils that have high erosion potential;
- The brine from the WTP should be transported to a waste site;
- For major hydrocarbon spills, if soils are contaminated they must be stripped and disposed of at a licensed waste disposal site; and
- In the event of a hydrocarbon spill, the spill must be cleaned up immediately to prevent further pollution.

Table 11-1: Soil and land capability mitigation and management plan

Activities	Phase	Impact	Size and scale of disturbance	Mitigation Measures	Compliance
Site clearing and topsoil removal	Construction	Loss of topsoil, compaction, dust and erosion	Infrastructure footprint	▪ Ensure proper storm water management designs are in place. ▪ Only the designated access routes are to be used to reduce unnecessary compaction. ▪ If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place. ▪ If possible topsoil removal should occur during dry months as to reduce compaction.	National Environmental Management Act 107 of 1998 Conservation of Agricultural Resources Act 43 of 1983
Site clearing and topsoil removal	Construction	Contamination of soil	Infrastructure footprint	▪ Emergency spillage response plan must be in place. ▪ Spill kits should be in place and accessible to the responsible monitoring team. ▪ Waste management plan must be in place throughout the project life cycle. ▪ Ensure that building rubble and all waste material is removed off and disposed of at an appropriate facility.	National Environmental Management Act 107 of 1998 National Environmental Management Act: Waste Act 59 of 2008
Monitoring	Post-construction/ operational	Compliance to applicable legislation and authorisation	Infrastructure footprint	▪ Disturbed areas must be rehabilitated and be assessed once every 6 months for compaction and erosion. ▪ Compacted areas must be ripped to loosen the soil structure.	National Environmental Management Act 107 of 1998 Conservation of Agricultural Resources Act 43 of 1983 Mineral and Petroleum resources development act 28 of 2002

12 Unplanned Events and Low Risks

There is a risk of accidental spillages of hazardous substances, for example brine, hydrocarbons or oils from vehicles or other construction machineries and from waste storage facilities during operations. Contamination is the result of leakage of oils and hydrocarbons from equipment used. It must be ensured that the requirements of South African legislation are met to prevent pollution.

12.1 Emergency Procedures

Brine, hydrocarbon spills or leaks can occur; therefore emergency procedures need to be put in place for remediation. These procedures can include the following:

- Contractors must ensure that all employees are aware of the procedure for dealing with spills and leaks and undergo training on site;
- Ensure that emergency spill equipment are available to site personnel;
- All machines should be serviced and refuelled in demarcated bunded areas, workshops or at an off-site location specifically designed for servicing of machinery;
- If a spill occurs, it should be cleaned up immediately, reported to the appropriate authorities and recorded;
- The brine will be collected and disposed in a registered and licensed Waste Land Facility; and
- Contaminated soils must be disposed in a registered and licensed Waste Land Facility.

Table 12-1: Unplanned events and their management measures

Unplanned event	Potential impact	Mitigation/Management/Monitoring
Hydrocarbon leaks from vehicles and machinery or hazardous materials	Soil Contamination	▪ Place drip trays where the leak is occurring if vehicles are leaking; ▪ All vehicles should be serviced in a concrete bunded area or at an off-site location specifically designed for servicing of machinery. ▪ Machinery must be parked within hard park areas and drip trays must be used. Further the machinery must be inspected daily for fluid leaks.
Hazardous substance spillage from pipelines or waste storage	Soil Contamination	▪ Prevent any spills from occurring; ▪ If a spill occurs it should be cleaned up (Drizit spill kit/ Zupazorb type spill kit, Oil or Chemical spill kit) immediately and reported to the appropriate authorities; ▪ Pipelines must be inspected regularly for leaks;

Unplanned event	Potential impact	Mitigation/Management/Monitoring
		▪ Integrity of pipelines must be maintained; and ▪ Emergency response plans should be in place.

13 Monitoring Requirements

A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented together with ensuring effectiveness of the management measures in place.

13.1 Supervision and Contractor Management

A very important aspect is the supervision and monitoring during construction and operational phase. The following should be observed when clearing and removing topsoil:

- Close supervision will ensure that soils are not being removed incorrectly;
- Environmental officer is responsible to determine effectiveness of the erosion control structures; and
- Contractor is responsible to undertake the clearing and removing of topsoil.

13.2 Monitoring Requirements

The following items should be monitored continuously:

- Soils:
  - Erosion status;
  - Compaction;
  - Runoff; and
  - Contamination.
- Vegetation:

  The vegetation cover established on the disturbed areas needs to be monitored annually for the first two years after rehabilitation has been carried out, to ensure that the rehabilitation work has been successful in terms of stabilising the newly formed surfaces (preventing air and water erosion from affecting those surfaces), and that the newly established vegetation cover is trending towards convergence with the original vegetation cover found on the areas prior to disturbance (and on adjacent undisturbed areas) (Dawson, 2007).
  - Vegetation cover; and
  - Species diversity.

The following maintenance is required:

- Repair any damage caused by erosion;
- Traffic should be limited where possible while the vegetation is establishing;
- The area must be fenced and animals should be kept off the area until the vegetation is self-sustaining;
- Fertilize grassed area with nitrogen containing fertiliser after germination of seeds;
- If soil is polluted, treat the soil by means of in-situ bio-remediation; and
- If in-situ treatment is not possible then the polluted soil must be classified according to the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Material and disposed at an appropriate, permitted or licensed disposal facility.

14 Consultation Undertaken

The project manager/personnel were contacted prior to the soil assessment and on the day of the site visit in May 2018. This was to obtain the required permission to enter the property and explain the purpose of the study.

15 Comments and Responses

The comments or concerns have not been received and recorded from any registered Interested and Affected Parties during the Public Participation Process.

16 Conclusions and Recommendations

The proposed WTP, laydown area and pipeline route are within land type Ba4 and noted soil form was Glencoe on the WTP and laydown area. The land capability is dominated by the Class IV (Moderate grazing) and the land use within the proposed area is mining.

The fertility status of the soils is generally considered moderate. The area has low soil pH and lime such as dolomitic lime ($CaCO_3$+$MgCO_3$) is required to counteract acidity and to increase plant growth performance, should the soils have been used for agricultural purposes. All of the soil samples collected on the site showed the profile of Ca>Mg>K>Na concentrations as expected. Calcium, magnesium and potassium levels were adequate. Phosphorus concentrations were low and these levels require fertilisation, should the soils have been used for agricultural purposes. The soil can be described as sandy clay loam. The soil organic carbon content of the soils on the proposed area ranged from 0 to 0.06 % and would have required an external nutrient input source, should the soils have been used for agricultural purposes.

The impact on soil is low to moderate, if mismanaged. The impacts associated with the proposed development on soils include:

- Loss of topsoil during clearing;

- Erosion due to exposed soil surfaces;
- Compaction of soils due to construction vehicles; and
- Soil contamination through brine and hydrocarbon spills.

The findings of the proposed WTP and associated infrastructure will result in:

- Low risk of loss of soil due to erosion and compaction; and
- Brine and hydrocarbon spills pose a low risk at the proposed development areas.

The major consideration during construction of the infrastructure is to restrict the soil disturbance or removal to the site composed of Glencoe soils.

The following recommendations are made to minimise the impact on the soils:

- Runoff must be controlled and managed by use of proper storm water management facilities;
- Fuel and oil spills are common, remediate using commercially available emergency clean up kits; and
- Clearing and removal of soils should be done during dry months (May to September) to reduce erosion and compaction on soils.

17 Reasoned Opinion of the Specialist

The proposed WTP project falls within already disturbed areas of the KPS Colliery. The land capability is low (moderate grazing) due to Glencoe soil form resulting in poor effective depth. Further available land will not support viable economic crop and livestock production. It is anticipated that the impact on soils will be of low to moderate negative significance.

Soil management measures should be followed as outlined in this report and land needs to be rehabilitated to prevent possible soil erosion, contamination and compaction.

It is therefore of my opinion that this project is feasible and could be authorised. Soil management measures and monitoring requirements as set out in this report should form part of the conditions of environmental authorisation and be included in the EMPr.

18 References

BHP1591. Environmental Impact Assessment for Klipspruit South. Soil Survey Report. Digby Wells, November 2014.

BHP2690. Environmental Impact Assessment for KPSX: Weltevreden. Soil Survey Report. Digby Wells, January 2015.

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Land Type Survey Staff. 1972 – 2006. Land Types of South Africa: Digital Map (1:250 000) and soil inventory databases. Agricultural Research Council – Institute for Soil, Climate and Water, Pretoria.

South African Sugar Association. 1999. Identification & management of the Soils of the South African Sugar Industry. Mount Edgecombe: South African Sugar Association Experiment Station.

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Soil Classification of Working Group. 1991. *Soil Classification A Taxonomic System for South Africa. Pretoria*: The Department of Agricultural Development.

Appendix A: CV

Mr Siphamandla Madikizela

Soil Scientist

Manager: Rehabilitation & Soil

Digby Wells Environmental

1 Education

1.1 Formal

- 2012 – 2014: MSc in Soil Science – University of KwaZulu-Natal.
- 2011 – 2011: BSc Honours in Soil Science – University of KwaZulu-Natal.
- 2008 – 2010: BSc in Hydrology and Soil Science – University of KwaZulu-Natal.

1.2 Short Courses

- Certificate of Attendance: Wild Fire Suppression – Proto team (1-2 June 2015, Bathurst, Port Alfred).
- Certificate of Attendance: Basic Labour Relations (2 September 2015, Cape Town).
- Certificate of Attendance: Conflict Management Workshop (26 October 2015, Port Elizabeth).
- Certificate of Completion: Technical Report Writing (21 & 22 November 2016).
- Certificate of Completion: Assessment and Remediation Techniques for Groundwater & Contaminated Soil (25 & 26 August 2017).

2 Language Skills

- English (2nd language).
- Xhosa (1st language).

3 Employment

- March 2016 – Present: Digby Wells Environmental - Soil Scientist.
- August 2013 – March 2016: EcoPlanet Bamboo (Pty) Ltd - Assistant Plantation Manager.
- 2010 – 2013: University of KwaZulu-Natal - Student demonstrator (2nd and 3rd year student majoring in Soil Science).
- 2012: Jeffares & Green Consulting Company - Field Assistant.

4 Experience

Siphamandla Madikizela is a Soil Scientist, completed his MSc in Soil Science at University of KwaZulu-Natal and is a Professional Natural Scientist (Registration no. 400154/17) in the Republic of South Africa. Prior to his employment at Digby Wells Environmental, Siphamandla worked as an Assistant Plantation Manager at EcoPlanet Bamboo SA. He is the part of the Closure, Rehab and Soils Department at Digby Wells Environmental. His role involves conducting soil surveys; soil, land capability and land use environmental impact assessments; soil and agricultural potential studies; soil contamination assessments; interpreting results of soil samples; soil management plans and writing detailed scientific reports in accordance to local legislation and IFC standards and World Bank Guidelines. Siphamandla has worked in projects in South Africa, Democratic Republic of the Congo, Malawi and Mali.

5 Hydrocarbon-related Project Experience

Client Name	Project Name	Geographical Location
Harmony Gold Mining Company Ltd	Virginia 2 Shaft Closure – Soil Contamination Assessment	Virginia, Free State, South Africa
Kongskilde South Africa (Pty) Ltd	Contamination Assessment for Kongskilde Warehouse, Boksburg	Boksburg, Johannesburg, South Africa
Mota-Engil Africa	Environmental and Social Impact Assessment for the Liwonde Dry Port Project, Malawi (Soil Contamination Assessment)	Liwonde, Malawi
Sasol Mining (Pty) Ltd	Middelbult West Shaft Waste and Closure and Brandspruit 3E Service Shaft Waste Assessment (Soil Contamination Assessment)	Middelbult, Mpumalanga, South Africa
Sibanye Stillwater	Soil Management Plan – Cooke Operations	Randfontein, Johannesburg, South Africa
Holdings Limited	Land Contamination Assessment: Elandspruit Colliery	Middelburg, Mpumalanga, South Africa
Wescoal Holdings Limited	Land Contamination Assessment: Intibane Colliery	Middelburg, Mpumalanga, South Africa

Wescoal Holdings Limited	Land Contamination Assessment: Wescoal Processing Plant (Goedehoop)	Ogies, Mpumalanga, South Africa
Wescoal Holdings Limited	Land Contamination Assessment: Khanyisa Colliery	Ogies, Mpumalanga, South Africa

6 Environmental Impact Assessment-related Project Experience

- Scoping and Environmental Impact Reporting for Proposed Palmietkuilen Colliery near Springs – Canyon Resources (Pty) Ltd – Soil Scientist.
- Scoping and Environmental Impact for an Environmental Authorisation Application in support of the Prospecting Right Applications – Anglo American Platinum Ltd – Soil Scientist.
- Scoping and Environmental Impact for Grootvlei TSF Reclamation Project - Ergo Mining (Pty) Ltd – Soil Scientist.
- Risk Assessment and Associated Water Use License Application for the Proposed KPSX Northern Bypass, in Mpumalanga – South32 SA Coal Holdings (Pty) Limited – Soil Scientist.
- Environmental and Social Impact Assessment Update for the Sadiola Sulphides Project (2016), Mali - Société d'Exploitation des Mines d'Or de Sadiola S.A – Soil Scientist.
- Environmental Impact Assessment for the proposed infrastructure expansion at Grootegeluk Coal Mine – Exxaro Reductants (Pty) Ltd – Soil Scientist.
- Gap analysis for the Environmental Authorisation for the Rietspruit Rehabilitation Project – South32 SA Coal Holdings (Pty) Ltd – Soil Scientist.
- Reviewing of the Soils, land capability and land use Environmental Impact Assessment for Hendrina Reserve – Glencore Operations South Africa (Pty) Ltd – Soil Scientist.
- Rehabilitation Guidelines for Sedibelo West – Sedibelo Platinum Mines Limited – Soil Scientist.
- Soil and Agricultural Potential Assessment for Training Facility and Firestation Project, Gauteng – Savannah Environmental (Pty) Ltd – Project Manager and Soil Scientist.
- Agricultural Potential Study, Gumu, Kibali, DRC – Randgold Resources – Project Manager and Soil Scientist.

- Basic Assessment for proposed Borrow Pits near Lephalale – Ledjadja Coal (Pty) Ltd – Soil Scientist.
- Klipspruit Environmental Management Programme Consolidation – South 32 SA Coal Holdings (Pty) Ltd – Soil Scientist.
- Extension on Farm Middelbult for the Universal Kangala Coal Mine – Universal Kangala Coal Mine – Soil Scientist.
- Soil, Land Capability and Land Use Assessment for Vaalkop Area, Mpumalanga – Sasol Mining (Pty) Ltd – Soil Scientist.
- Environmental and Social Impact Assessment for Bougouni Lithium Project, Mali – Birimian Gold Limited – Soil Scientist.

7 Research

- The Use of Hydrogel Application at Planting for *Bambusa Balcooa* Species at different rates – EcoPlanet Bamboo southern Africa – Assistant Plantation Manger.
- The Effect of Herbicide Application on *Bambusa Balcooa* – EcoPlanet Bamboo southern Africa – Assistant Plantation Manager.
- The Effect of Plastic Mulch on Growth and Yield on *Bambusa Balcooa* - EcoPlanet Bamboo southern Africa – Assistant Plantation Manager.
- Effect of Nitro-S fertilizer on growth and yield of *Bambusa Balcooa* and *Oxytenanthera Abyssinica*.

8 Professional Affiliations

- Soil Science Society of South Africa (SSSA).

9 Professional Registration

- 2017: Registered as a Professional Natural Scientist with The South African Council for Natural Scientific Professions. Registration number: 400154/17.

Appendix B: Laboratory Certificate

AGRICULTURAL SERVICES

Farm Elandsfontein
District Bapsfontein
Gauteng, South Africa

SOIL ANALYSIS REPORT

intertek
Total Quality. Assured.

Certificate Number : AGRI 05_18-0177-0
Report date : 2018/05/31

CERTIFICATE OF ANALYSIS

Customer : Digby Wells

CN : AGRI 05_18-0177-0				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	Cmol H+/Kg Soil	%	%	%	%	Calculation	Calculation	Calculation	Calculation	Calculation (Ca+ Mg+K+Na)	Calculation	Calculation (Ca+ Mg+K+Na+H)	g/ml	mg/kg	%	%	%	%	Digby Wells	
			S 003	S 007	S 009	S 009	S 009	S 009	*	*	*	*	*	*	*	*	*	*	*	*	*	S 003	*	*	*	*	*		
Batch Seq Number	Land Reference	Stikker No	pH (KCl)	PBray1	K	Na	Ca	Mg	Exchngeable acid	%Ca	%Mg	%K	%Na	Acid Saturation %	Ca:Mg	(Ca+Mg)/K	Mg:K	S-Value	Na:K	CEC	Digtheid	S	Clay	Sand	Silt	C	Date Received	Date Reported
AGRI 05_18-0177-1		085	4.83	2	65	14	232	180	0.00	40.6	51.5	5.8	2.2	0.0	0.8	15.9	8.9	2.9	0.4	2.9	1.161	24.87	29	60	11	0.06	2018/05/28	2018/05/31
AGRI 05_18-0177-2		087	5.16	4	56	23	315	114	0.00	57.3	34.0	5.2	3.6	0.0	1.7	17.6	6.6	2.7	0.7	2.7	1.212	16.57	25	57	18	0.06	2018/05/28	2018/05/31

ilac-MRA
sanas Testing Laboratory
T0627

Nelson Motlhako
Soil Section leader

Results marked as not SANAS accredited (*) in this report are not included in the SANAS Schedule of Accreditation for this laboratory. Measurement of uncertainty values are available upon request.