Environmental Regulatory Process Required to Amend and Consolidate the Mooikraal Colliery Environmental Management Programme, Sasolburg, Free State

Soils and Land Capability Assessment Report

Project Number:

SAS5175

Prepared for:

Sasol Mining (Pty) Ltd

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Project Name:	**Environmental Regulatory Process Required to Amend and Consolidate the Mooikraal Colliery Environmental Management Programme, Sasolburg, Free State**
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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.

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EXECUTIVE SUMMARY

Introduction

Sasol Mining (Pty) Ltd. (hereafter Sasol) appointed Digby Wells Environmental (hereafter Digby Wells) to undertake a soil classification and agricultural potential assessment at the Sigma Colliery which consists of two components, Sigma Colliery: Mooikraal (Mooikraal) and Sigma Colliery: 3 Shaft (3 Shaft). Mooikraal is an existing coal mine (established in 2005) situated south of the Vaal River Barrage and west of the R57 highway, southwest of the town Sasolburg in the Fezile Dabi District Municipality. The operation consists of underground mining operations where methods such as mechanised bord-and-pillar development and rib pillar extraction (high extraction) have been applied.

In order to identify the soils on site accurately, it was necessary to undertake a soil survey. The aim was to provide an accurate record of the soil resources at the soil sampling locations. Land capability, land use and agricultural potential were then determined from these results. This report presents the findings of a specialist soils and land capability assessment in support of the Basic Assessment Process being undertaken for Environmental Regulatory Process Required to Amend and Consolidate the Mooikraal Colliery Environmental Management Programme. This report presents the findings of a specialist soils and land capability assessment and the relevant project components include the following:

- Description of the soil forms;
- Determining the existing land capability;
- Determining the current land use;
- Soil chemical and physical properties;
- Identification and assessment of potential impacts on soils resulting from the existing and proposed activities; and
- Mitigation measures to minimise impacts associated with the existing and proposed activities.

Methodology

As part of the desktop assessment, baseline soil information was obtained from the 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 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 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 1.2m 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 use was determined by aerial imagery and ground-truthed during the site visit.

The soils and land capability report discusses the approach and findings of a desktop and field survey carried out in July 2018 on the study area. The following legislation was considered during the assessment:

- The National Environmental Management Act, 1998 (Act No.107 of 1998), (NEMA); and
- The Conservation of Agricultural Resources Act, 1993 (Act No. 43 of 1993), (CARA).

Findings

The land type data indicated that the dominant land types on site were Ca1 and Dc7, all dominated by poorly drained soils. The soils are dominated by Avalon (yellow-brown) forms and (black and greyish) Arcadia forms. The main land uses in the area are underground mining, cultivated land and veld for grazing. There are a lot of agricultural activities taking place within the project area and surroundings. The dominant land capabilities based on the soils, texture and fertility status found on the project area was Class IV (yellow brown soils) and Class V (black and greyish soils). Yellow brown soils are known to have a high susceptibility to water or wind erosion, very slow permeability of the subsoil, low water-holding capacity and moderate salinity or sodicity. Wetland capability represents the Arcadia soils. Although these soils are deeper, they have high expansible clay content and are physically difficult to manage.

All of the soil samples collected on the site showed the profile of Ca>Mg>K>Na concentrations as expected. Calcium (Ca), Magnesium (Mg) and Potassium (K) levels were adequate. Phosphorus concentrations were low and these levels would require fertilisation, should the soils have been used for agricultural purposes. The organic carbon content of the soils at the soil sampling locations ranged from 0.1 to 0.9% and would have required an external nutrient input source, should the soils have been used for agricultural purposes. The sodium levels ranged from 18 to 550mg/kg and soils with sodium levels below 200mg/kg (Sample 1, 3, 4, 5 and 6) are considered not to be sodic. However, Sample 2 had high (554mg/kg) sodium levels when compared with soil fertility guidelines and therefore classified as strongly sodic due to higher levels of sodium.

The clayey (black) soils are considerably better endowed with base cations, organic carbon, clay, and cation exchange capacity. Because of the high nutrient status and well buffered pH, soils with a vertic horizon are potentially very suitable for rehabilitation work.

Although the black clay is potentially difficult to work because of unfavourable consistency it has the advantage of a self-mulching habit meaning that clods will "weather" to a fine crumb structure due to shrinking and swelling with changes in water content.

The P levels encountered in the samples from the site were all very low with most values being >1mg/kg and the maximum 4mg/kg. Phosphorus fertilisation would have been required to establish good crop stand and growth, should agricultural activities have taken place. The organic carbon content of the soils at the soil sampling locations ranged from 0.1 to 0.9% and levels below 2% would have required an external nutrient input source, should the soils have been used for agricultural purposes. The soils can be described as clay, sandy clay loam, sandy loam and clay loam. Samples 1, 2 and 3 have high clay content and a low to marginal agricultural potential. Samples 4, 5 and 6 are a bit sandy and have a moderate agricultural potential.

The waste rock dump at Mooikraal is a potential source of contamination; once material is exposed to oxygen and rainfall, leachate generating reaction may occur and introduce contamination into the groundwater environment via seepage. Total concentration analysis identified Barium and Copper as potential elements of concern however these results are a worst case scenario. Leachable concentration analysis, which is the most representative of the expected leachate at the site, shows no concern within regards to the leachate expected to emanate from the dump.

Impact Assessment

Mooikraal is proposing to reconfigure and relocate the conveyer belt series and existing crusher facility currently located at the 3 Shaft primary plant areas. In addition, Mooikraal also wishes to amend and consolidate the approved Mooikraal Environmental Management Programme (EMPr) to include all activities and properties associated with the proposed operations.

During the construction phase site clearing is necessary for the preparation of surface infrastructure development where vegetation and topsoil will be removed. When soil is removed, the physical properties are changed, and the soils' chemical properties will deteriorate unless properly managed.

Vehicles will drive on the soil surface during the construction phase, thereby causing compaction of the soils.

High extraction method of mining could cause subsidence which would result in impacts to soil. The underground mining activities will cause a significant impact on the land capability of the identified soils causing subsidence and cracks (high extraction). The impacts of subsidence will be very high where for example, between 30 m and 100 m mining is going to be taking place and will result in a complete loss of land capability and land use.

During rehabilitation and decommissioning phase, the potential impacts associated are the risk of hydrocarbon spills, erosion and compaction, degradation and functionality of wetlands.

It is anticipated that the impact of construction of conveyor belt, crusher and plant on loss of soil as a resource - erosion and compaction, wetlands and land capability will be of **minor to moderate negative** significance. It is anticipated that the impact on soils will be of **minor to moderate** negative significance during the construction, operational and decommissioning phases. However, subsidence could have a **moderate to major** negative significance on soils and land capability.

Recommendations

The followings actions are recommended to minimise adverse effects of mining and the proposed activities on soils:

- Runoff must be controlled and managed by use of proper stormwater management;
- Fuel and oils spills are common, remediate using commercially available emergency clean up kits and focus on awareness of prevention;
- The soils stripped for any construction activities should be stripped and conserved for rehabilitation;
- Soil stockpiles should be well managed and protected from erosion, so that they are available for use in the rehabilitation process;
- Monitoring of undermined areas to assess the effects of subsidence at surface;
- Cracks caused by subsidence due to underground mining, must be rehabilitated once identified;
- Areas where vegetation is affected due to ponding, caused by subsidence due to underground mining must be rehabilitated;
- Subsided areas can be backfilled and re-shaped to match the original topography to mitigate ponding and waterlogging conditions depending on the degree of the collapse and available soil material;
- Planning for free drainage of ponded areas;
- The handling of the stripped topsoil should be minimised to ensure the soil's structure does not deteriorate significantly;
- The topsoil stockpiles should be vegetated to reduce the risk of erosion, and to reinstitute the ecological processes within the soil;
- The waste rock dump should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. Stormwater management must be placed around the facility to ensure dirty water is contained;
- Only the designated access routes are to be used to reduce any unnecessary compaction; and
- Ensure proper stormwater management designs are in place.

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CARA	The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
Cwb	Mesothermic climatic zone
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
DWAF	Department of Water and Forestry
DWE	Digby Wells Environmental
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
FS	Free State
GIS	Geographical Information System
GPS	Global Positioning System
Ha	Hectares
IFC	International Finance Corporation
LoM	Life of Mine
Mamsl	Metres above mean sea level
MR	Mining Right
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PCD	Pollution Control Dam
RoM	Run of Mine
SANAS	South African National Accreditation System

WUL	Water Use Licence

GLOSSARY OF TERMS

Term	Definition
Acidity	A property expressed by the pH value when this is below 7.0 in a soil/water suspension.
Alkalinity	A property expressed by the pH value when this exceeds 7.0 in a soil/water suspension.
Auger	A tool for drilling into the soil and withdrawing a small sample for field or laboratory observation.
Cation	An element with a positive charge.
Clay	A soil consisting of particles <0.002 mm in equivalent diameter.
Exchangeable cation	A positively charged ion held on or near the surface of a solid particle by a negative surface charge of a colloid and which may be replaced by other positively charged ions in the soil solution.
Infiltration	The downward entry of water into the soil through the soil surface.
Leaching	The removal of materials in solution from the soil.
Organic carbon	Gives an estimate of the amount of organic matter in a soil as a percentage by weight.
pH (soil)	A measure of the acidity or alkalinity of a soil. It represents the negative logarithm of the hydrogen ion concentration in a specified soil/water suspension on a scale of 0 to 14.
Salinity	The amount of soluble salts in a soil. The convention measure of soil salinity is the electrical conductivity of a saturation extract.
Sand	A soil particle that in the USDA soil texture system is of size 0.05 to 2.0 mm in diameter.
Silt	A soil particle that in the USDA soil texture system is of size 0.002 to 0.05 mm in diameter.
Sodicity	A property expressed by the amount of exchangeable sodium present relative to the cation capacity of a soil horizon.
Soil classification	The systematic arrangement of soils into groups or categories on the basis of similarities and difference in their characteristics.
Soil fertility	The condition of a soil that enables it to provide nutrients in adequate amounts and in proper balance for the growth of specified plants, when other growth factors, such as water, temperature and physical condition of soil, are favourable.

Soil texture	The relative proportions of the various separates in the soil as described by the classes of soil texture.

1 Introduction

Sasol Mining (Pty) Ltd (hereafter Sasol Mining) owns and operates the operational Sigma Colliery which consists of two components, Sigma Colliery: Mooikraal (Mooikraal) which is the operational shaft and Sigma Colliery: 3 Shaft (3 Shaft) which is the coal handling facility. Mooikraal is an underground coal mine located near Sasolburg. It currently operates under a consolidated Mining Right (MR) (Reference No. Free State (FS) 30/5/1/2/2/2/1/221) and approved amended Environmental Management Programme (EMPr) (Reference No. 30/5/1/2/3/2/1 (221) (EM) granted in April 2016. The authorisation permits the undertaking of various activities associated with the underground coal mining operation.

Mooikraal also holds a separate approved Environmental Authorisation (EA) (Reference No. EMB/28/14/43, dated 09 March 2015) for a 10 Mega litre (Ml)/day and 7Ml/day water transfer pipeline. The 7Ml/day pipeline will transfer water from the Kleinvlei ventilation shaft to the Pollution Control Dams (PCDs) (North and South PCD) at Mooikraal, and the 10Ml/day pipeline will transfer water from the PCDs at Mooikraal to Sasolburg Operation (SO), both pipelines are constructed along mine servitudes.

Mooikraal is now proposing to reconfigure and relocate the conveyer belt series and existing crusher facility currently located at the 3 Shaft primary plant areas. In addition, Mooikraal also wishes to amend and consolidate the approved Mooikraal EMPr to include all activities and properties associated with the proposed operations.

Digby Wells Environmental (hereafter Digby Wells) was appointed by Sasol Mining (Pty) Ltd. (hereafter Sasol) as the Independent Environmental Assessment Practitioner (EAP) to ensure compliance by undertaking the required environmental regulatory process required to obtain the necessary environmental authorisations at the Mooikraal Colliery which includes 3 Shaft. This report presents the findings of a specialist soils and land capability assessment that forms part of the Basic Assessment Process.

1.1 Project Background

Sasol Mining commenced with its mining operations in Sasolburg at Sigma Colliery in 1952 with the aim of supplying coal to SO from both its underground and opencast mining operations. Sigma Colliery ceased certain of its operations in 2006 (known as the Sigma Defunct Colliery) and established Mooikraal to supply coal to the SO.

Mooikraal is an underground coal mine that is currently mining five underground sections. The mine began operation in 2005 and has a Life of Mine (LoM) of 34 years until 2039. Mooikraal accesses the underground workings via an incline shaft which was constructed utilising the box cut method. The incline shaft is utilised to allow vehicles, machinery and personnel to both enter and exit the underground workings. Mooikraal extracts coal utilising the underground bord and pillar mining method, however in some areas high extraction mining is taking place to optimally mine the reserves. The coal mined at Mooikraal is referred to as Run of Mine (RoM) coal.

The RoM coal is transported via underground section belts and main belts to surface via the same incline/decline shaft which is used to enter the mine (MK1). The coal passes a crusher and is then stored in a silo. Subsequently the RoM coal is conveyed via an 18km overland conveyor belt (MK3 – MK7) from Mooikraal to 3 Shaft, where the coal is crushed and stockpiled, before it is transferred to Sasolburg Operations for further industrial use.

1.2 Project Locality

Mooikraal is an existing coal mine (established in 2005) situated south of the Vaal River Barrage and west of the R57 highway, southwest of the town Sasolburg in the Fezile Dabi District Municipality of the Free State Province, as depicted in Figure 1-1 and Figure 1-2.

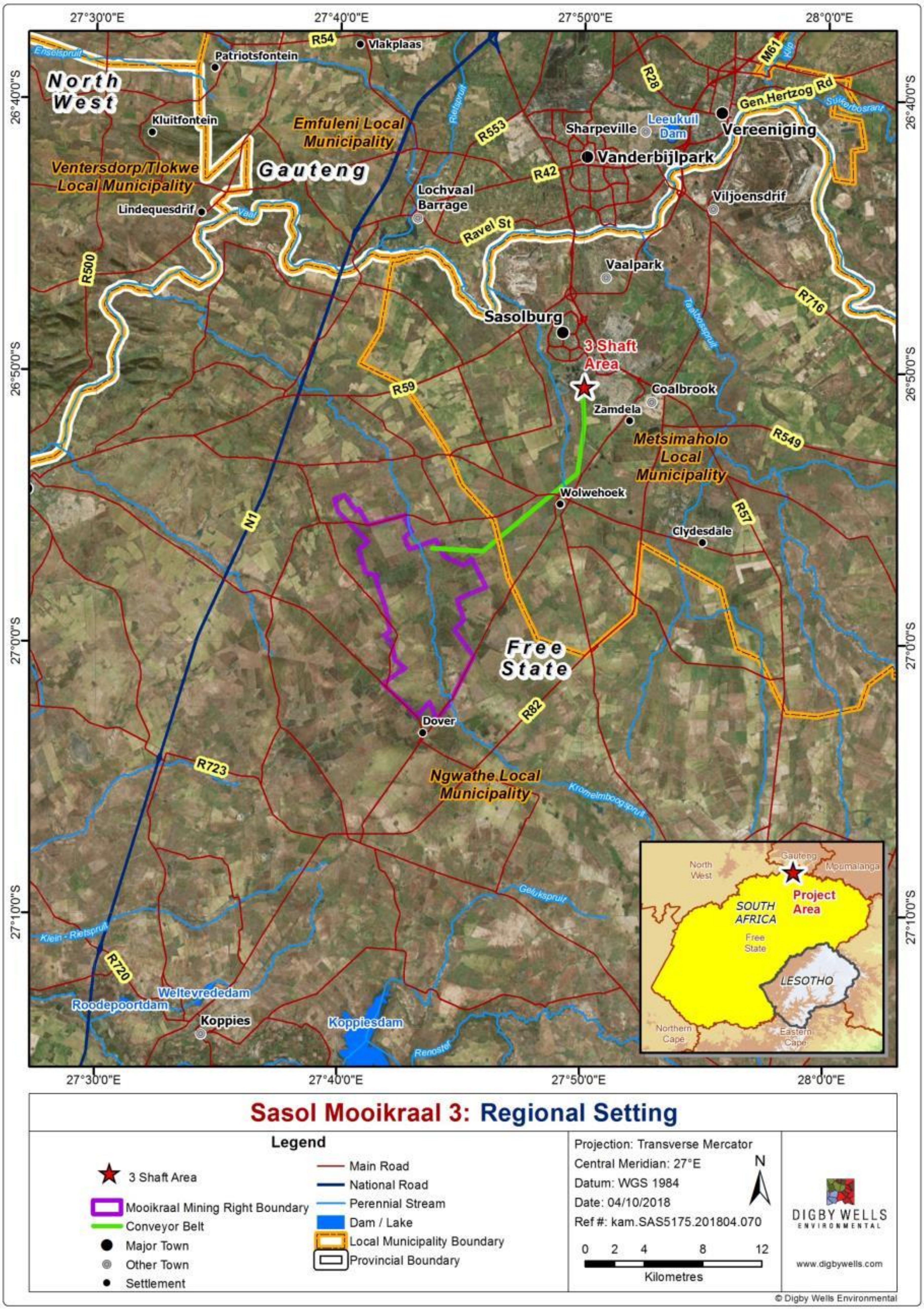

Figure 1-1: Regional Setting for the Mooikraal Colliery

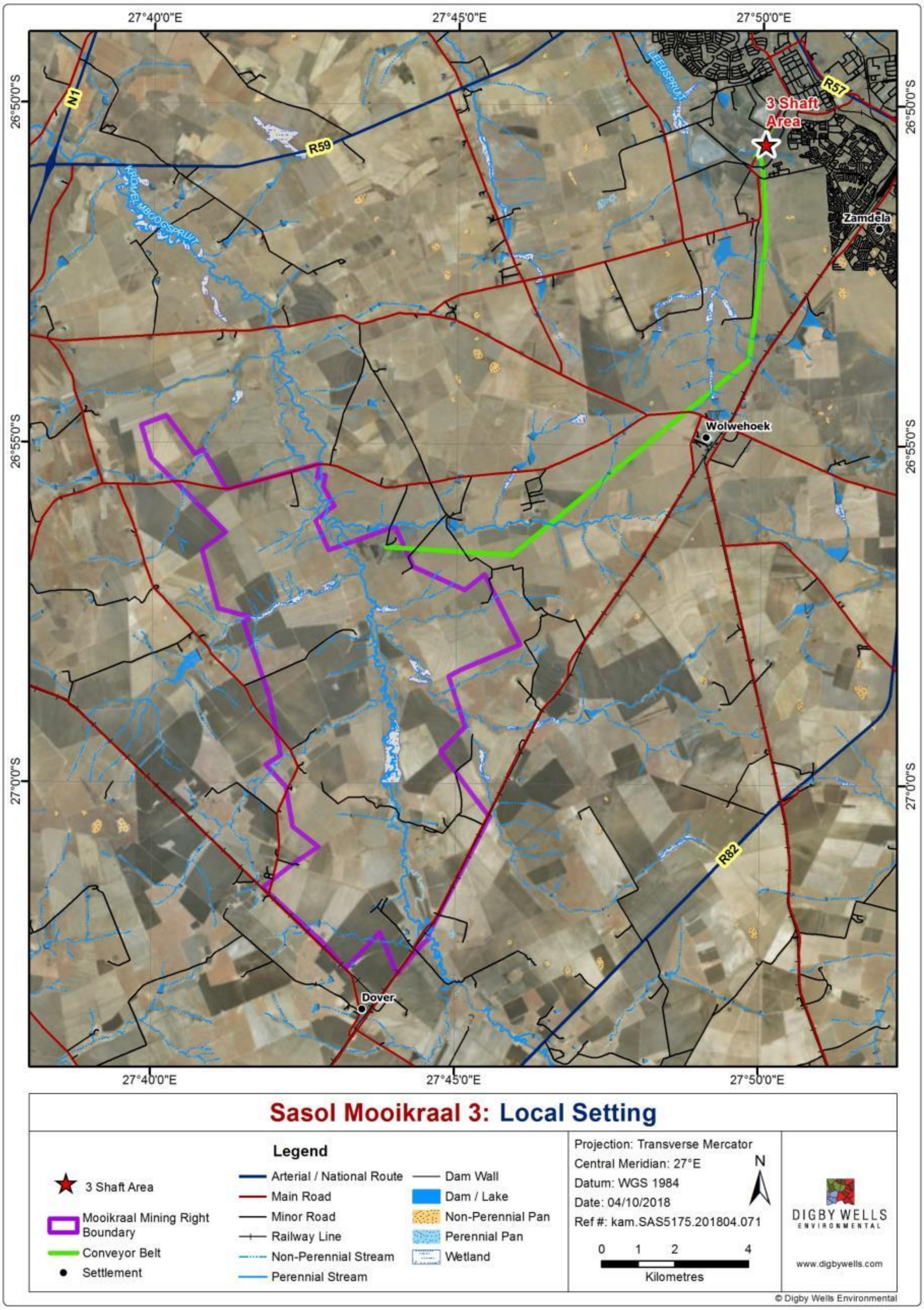

Figure 1-2: Local Setting at Mooikraal Colliery

1.3 Infrastructure

RoM coal from Mooikraal is transported by overland conveyor to 3 Shaft. The coal enters 3 Shaft via MK8 belt, the MK8 belt splits to either MK9 or MK10 which feeds the 4 Shaft bunker. Ultimately coal enters the crusher via CP4 belt. The crusher crushes and sizes the coal prior to stockpiling the coal on the stockpile area.

In order to implement stormwater management principles in accordance with Regulations on Use of Water for Mining and Related Activities Aimed at the Protection of Water Resources (Department of Water Affairs and Forestry, 2000) Government Notice No.704 (GN704), Mooikraal is proposing to relocate the primary plant which contains the crusher and coal bunker from within the delineated wetland area at 3 Shaft. It is proposed that Mooikraal will install a new primary plant with latest technology north east of the old primary plant located within the existing stockpile area. It is also proposed that the bunker that is currently located at the existing primary plant will be decommissioned.

This re-location of the crusher plant and its associated conveyor belt system (existing MK9 and CP2 belts) implies that a new conveyor will be constructed over the shortest distance from the MK8 transfer point to the relocated primary plant at the transfer point located at the stockpile area, this conveyor will be the new MK9 belt. The new conveyor belt will cross the delineated wetland at one section. This crossing is essential to maintaining current operational conditions and ensures an uninterrupted coal supply to the SO without impacting on production feedstock which would result in down times to the SO.

In summary the key infrastructure/activities (Figure 1-3) for this application include:

- Demolition of the existing conveyor belt, crushing facility and coal bunker which is currently situated within a wetland at the 3 Shaft (primary plant);
- Relocation/reconstruction of the primary plant (crusher facility) to the concreted stockpile area (to remain within the 3 Shaft footprint);
- Installing a conveyor belt from the MK8 transfer point to the stockpile area which will traverse a delineated wetland (within the 3 Shaft footprint);
- Proposed upgrade of the stormwater management system at 3 Shaft;
- Rehabilitation of the existing wetland at 3 Shaft and areas impacted from the operation of the existing conveyor belt, crushing facility and coal bunker;
- Drilling of exploration, monitoring and rescue boreholes within the approved Mooikraal Mining Right area and 3 Shaft;
- Incorporate all activities at Mooikraal, Kleinvlei, 3 Shaft and along both servitudes into the EMPr;
- Incorporate the 7 and 10 Ml/day pipeline EA into the EMPr; and
- Incorporate all properties located within Mooikraal, Kleinvlei, 3 Shaft and along both servitudes into the EMPr.

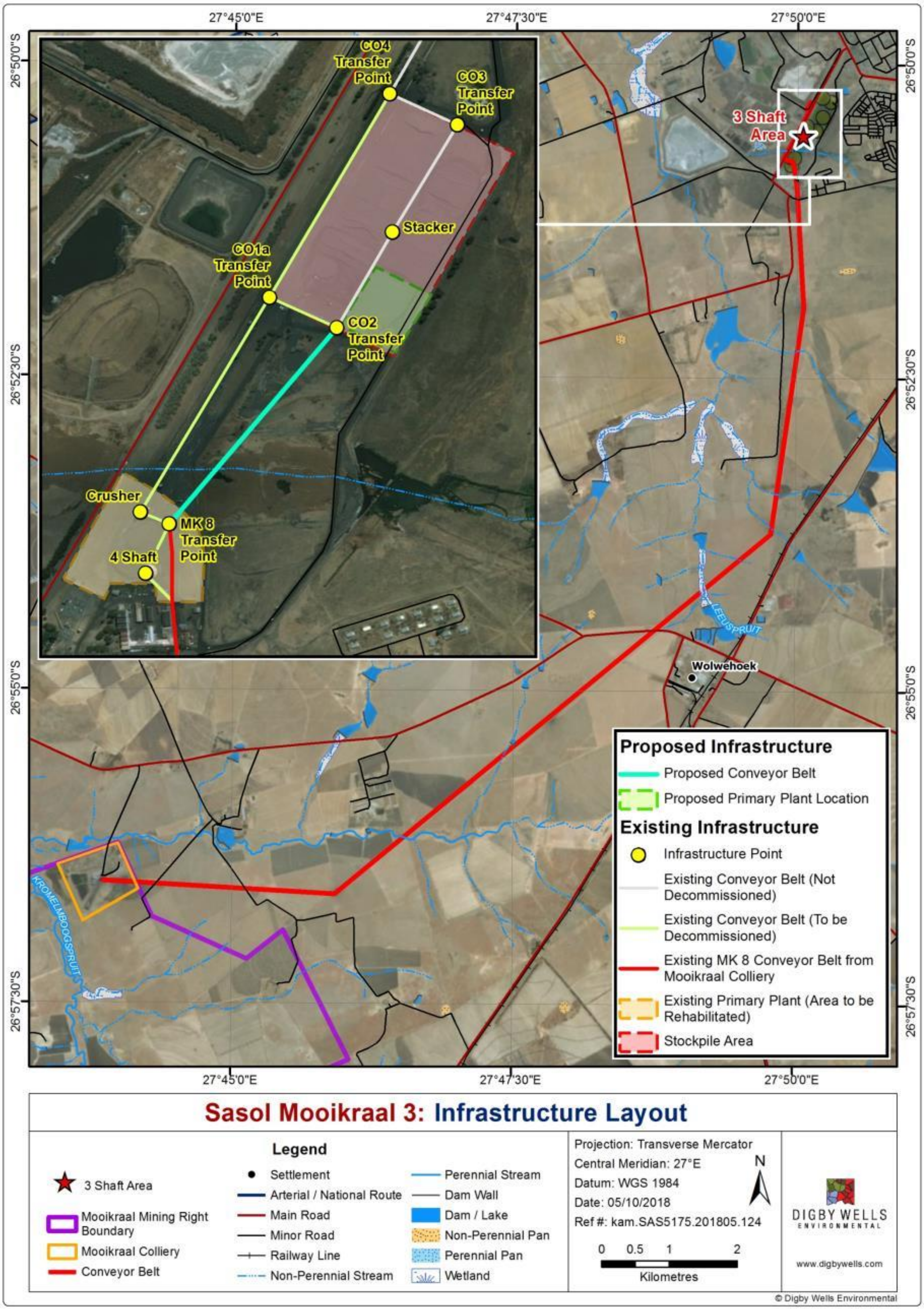

Figure 1-3: Existing and Proposed Infrastructure Located at 3 Shaft

1.4 Project Activities

Sasol Mining holds an approved EMPr and EA granted by the Department of Mineral Resources (DMR) for Mooikraal which includes the properties associated with the MRA. In additional, Sasol Mining has been granted an EA from the Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs for the 10Ml/day and 7Ml/day water transfer pipelines that operate between the Mooikraal and Sasolburg Operations. Table 1-1 and Table 1-2 below, shows a list of approved Listed Activities for the Mooikraal and the corresponding 2014 Listed Activities in terms of the National Environmental Management Act 107 of 1998 (NEMA), Amendment of the Environmental Impact Assessment (EIA) Regulations Listing Notice 2 of 2014.

Subsequently, Table 1-3 shows all new activities that will be undertaken as part of this proposed project and the listed actives which are triggered.

Table 1-1: Previously Authorised Listed Activities for Mooikraal Colliery (Ref: 30/5/1/2/3/2/1 (221) EM)

Name of Activity (Previously authorised by Approved EMPr)	Corresponding Listed Activities in terms of EIA Regulations, 2014 (as amended by 326 of 07 April 2017)
The construction of a coal silo	Activity 17 of GNR 325 – Listing Notice 2
Conveyor crossings over streams	Activity 17 of GNR 325 – Listing Notice 2
Dirty water storage dams (North Dam Pollution Control Dam (PCD) and South Dam PCD)	Activity 6 of GNR 325 – Listing Notice 2
Ongoing proving of the coal reserves during the life of mine	Activity 17 of GNR 325 – Listing Notice 2
Pumping out of groundwater influxes into the mine	No longer listed under NEMA. Governed under NWA
Access road to the shaft	Activity 24 of GN R 327 – Listing Notice 1
Development of the shaft area of the mine and conveyor infrastructure.	Activity 17 of GNR 325 – Listing Notice 2
The establishment of a coal mine and drilling to define the coal reserve.	Activity 17 of GNR 325 – Listing Notice 2
Kleinvlei vent shaft and downcast	Activity 15 of GNR 325 – Listing Notice 2
Borrow pits	Activity 21 of GN R 327 – Listing Notice 1
Waste Rock Dump at Mooikraal	Activity 6 of GNR 325 – Listing Notice 2
Sewage treatment plant	Activity 25 of GNR 325 – Listing Notice 2
Dust suppression at 3 shaft	Activity 6 of GNR 325 – Listing Notice 2

Table 1-2: Previously Authorised Listed Activities for Mooikraal Colliery 10Ml and 7ML Pipeline (Ref: EMB/28/14/43)

Name of Activity	Corresponding Listed Activities in terms of EIA Regulations, 2014 (as amended by 327 of 07 April 2017)
Construction and operation of the 10Ml/day and 7Ml/day pipeline to transfer mine water from Mooikraal to Sasolburg Operations, and to transfer mine water from Kleinvlei to Mooikraal.	▪ Activity 34 of GN R 327 – Listing Notice 1

Table 1-3: Proposed New Activities to be undertaken for the Proposed Project

Name of Activity	Listed Activity	Applicable Listing Notice
Relocation of the MK9 Conveyor Belt proposed to be constructed over a wetland.	X – 12	GN R 983 (as amended by GN R 327) – Listing Notice 1
Relocation of the MK9 Conveyor Belt proposed to be constructed over a wetland.	X - 19	GN R 983 (as amended by GN R 327) – Listing Notice 1
Demolition of the Crusher, Bunker and Conveyor Belt within a wetland.	X - 19	GN R 983 (as amended by GN R 327) – Listing Notice 1
Remediation of the wetland and associated watercourse which has been previously impacted by the operation of 3 Shaft Complex.	X - 19	GN R 983 (as amended by GN R 327) – Listing Notice 1
The Drilling of exploration, monitoring and rescue boreholes (within a wetland areas/in close proximity to a watercourse).	X - 19	GN R 983 (as amended by GN R 327) – Listing Notice 1
Drilling of boreholes (monitoring, exploration and emergency) within the Mooikraal Colliery MRA which may result in the clearance of vegetation.	X - 27	GN R 983 (as amended by GN R 327) – Listing Notice 1
The upgrade of stormwater infrastructure to ensure the separation of clean and dirty water around the 3 Shaft complexes. The infrastructure may exceed 1000 metres in length however this will be confirmed during the basic assessment process.	X - 45	GN R 983 (as amended by GN R 327) – Listing Notice 1
The upgrade of stormwater infrastructure to ensure the separation of clean and dirty water around the 3 Shaft complexes. Sumps and canals will also be constructed to contain the dirty water and ensure no discharge to the environment. The	X - 46	GN R 983 (as amended by GN R 327) – Listing

Name of Activity	Listed Activity	Applicable Listing Notice
infrastructure may exceed 1000 metres in length however this will be confirmed during the basic assessment process.		Notice 1

2 Details of the Specialists

The following is a list of Digby Wells' staff who was involved in the compilation and review of the soils and land capability report for Mooikraal Colliery.

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 Division 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 International Finance Corporation (IFC) Standards and World Bank Guidelines. Siphamandla has worked in projects in South Africa, Democratic Republic of the Congo, Malawi and Mali.

3 Scope and Purpose of this Report

The following tasks were undertaken as part of the soils and land capability assessment:

- Review of all the existing information;
- Soil survey: the soils occupying the project area were surveyed during a site visit. A hand soil auger was used to survey the soil types present and survey positions were recorded as waypoints;
- Description and categorisation of soils using the South African Soil Classification Taxonomic System;
- Land use/cover was mapped in conjunction with the soil survey;
- Land capability was assessed from the soil classification;
- Description of soils in terms of soil fertility: six soil samples were collected;
- Identification and assessment of potential impacts on soils resulting from the project using the prescribed impact rating methodology; and
- Mitigation measures were recommended to minimise impacts associated with the project.

4 Environmental Law Applicable to Study

The South African Environmental Legislation needs to be considered with reference to the management of soil and land use which includes:

- Soils and land capability are protected under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The NEMA requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and treated; and
- The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA). The CARA requires that protection of land against soil erosion, the prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained.

5 Assumptions

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 July 2018 and information reviewed from previous studies;
- A total of six soil samples were collected; and
- The information contained in this report is based on soil sampling points taken and visual observations on site.

6 Methodology

This section provides the methodology used in the compilation of the soils report. To complete the proposed scope of work, there were several tasks which needed to be completed and these tasks are explained separately below.

6.1 Desktop Assessment and Literature Review

Existing Land Type data was used to obtain generalised soil patterns and terrain types for the Mooikraal 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. Digby Wells conducted a desktop review of the baseline data and findings related to the soil surveys and other relevant existing documentation. The following sources of information were reviewed and utilised for the compilation of this report:

- Sasol Mining (Pty) Ltd - Environmental Regulatory Process Required to Amend and Consolidate the Mooikraal Colliery Environmental Management Programme Report, Sasolburg, Free State. Project Description Document, SAS5175. Digby Wells, September 2018;

- Sasol Mining (Pty) Ltd - Assessment of the Soils and Agricultural Potential for Mooikraal Colliery. Soils and Agricultural Potential Study Report. SAS5321. Digby Wells, August 2018;
- Sasol Mining (Pty) Ltd – Sigma Mooikraal Operation's Environmental Management Programme for FS/51/2/2/221 MR and FS/5/1/2/2/224 MR. January 2014; and
- Sasol Mining (Pty) Ltd – Basic Assessment Report: Sasol Sigma Mooikraal – Sasolburg Operations Pipelines. SAS2622. Digby Wells, October 2014.

6.2 Soil Classification

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 1.2 m 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).

6.3 Soil Sampling and Analysis

Figure 6-1 indicates the soil sampling locations. A total of six soil samples were collected and analysed at a certified laboratory (South African National Accreditation System (SANAS)). Samples (0 – 0.6 m) were analysed for soil acidity, fertility and texture as follows:

- Soil pH (KCl);
- Exchangeable cations: Calcium (Ca), Magnesium (Mg), Potassium (K) and Sodium (Na) (Ammonium acetate);
- Phosphorus (P) (Bray 1); and
- Soil Texture (Clay, Sand and Silt).

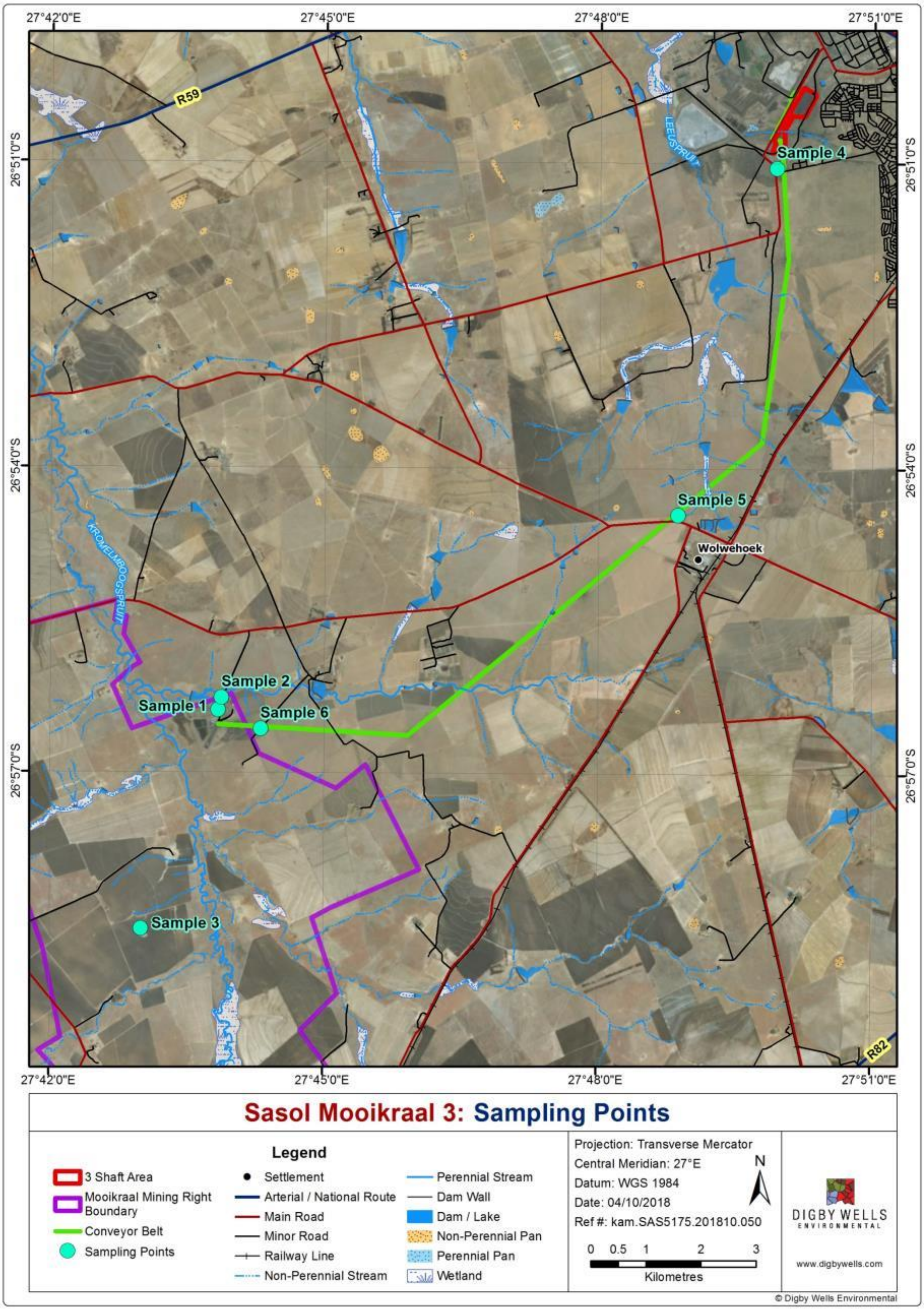

Figure 6-1: Soil Sampling Locations for the Mooikraal Colliery

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 6-2, determines one of 12 soil texture classes (Soil Classification Working Group, 1991), for example sandy loam, loam, sand and sandy clay loam. 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.

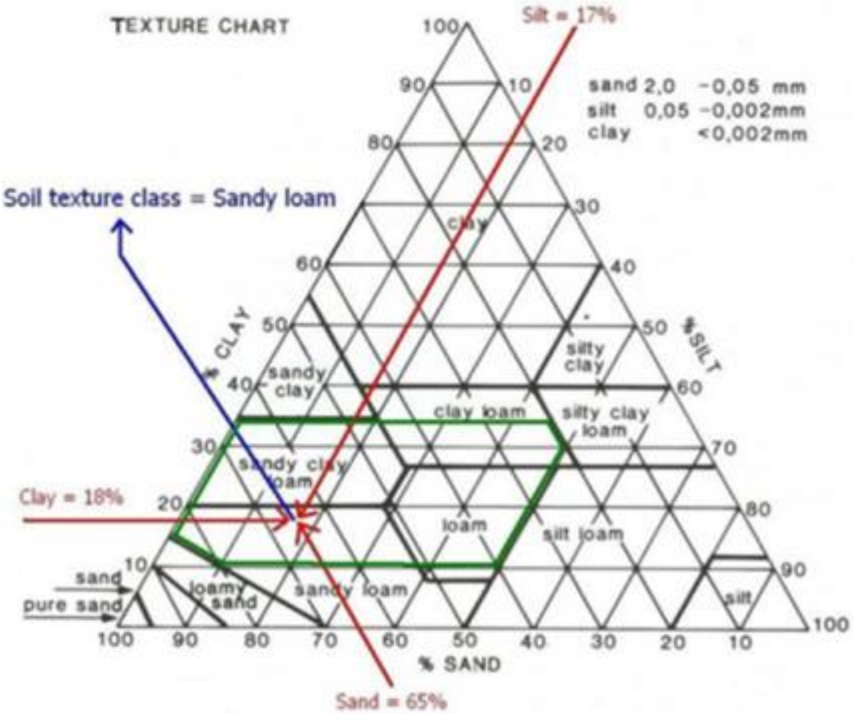

Figure 6-2: Soil Textural Triangle (SASA, 1999)

6.4 Land Capability and Land Use

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.

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

- Mines;
- Waterbodies;
- Urban built-up; and

- Cultivated areas.

7 Site Description

The description provided below is applicable to both Mooikraal and 3 Shaft and will be referred to as "Mooikraal".

7.1 Climate

According to the Köppen-Geiger system classification, Mooikraal lies in a mesothermic climatic zone (Cwb) and receives approximately 550mm or more rain per annum, mainly during summer and autumn. Rainfall in the Sasolburg region occurs mainly during the summer months and the average annual rainfall from 2001 to 2011 was 530 mm (South Africa Weather Service - Rainfall station: Vereeniging 04387843).

7.2 Topography

The topography of Mooikraal varies between 1 480 to 1 500 metres above mean sea level (mamsl). The highest surface elevations are found in the southern and eastern parts of the area and the surface elevations in these areas can go up to 1 500 mamsl. It is characterised by flat boundless plains. The slope is that of a gently sloping surface towards the Vaal River.

7.3 Geology

Mooikraal is situated within the Sasolburg-Vereeniging coal field and this Coal field is located on the Northern edge of the Karoo basin and according to the 1:250 000 geological map, is predominantly characterized by mudstone and sandstones of the overlying Beaufort Group (Adelaide Subgroup). The project area is located within the sub-basin, which is underlain by lava and dolomite as well as metasedimentary rocks of the Ventersdorp and Transvaal super groups respectively.

8 Findings

Information related to the soils associated with the project area is discussed in this Section. The laboratory analyses and results are also presented. The land type data gathered suggested that the dominant land types on site were Ca1 and Dc7, as depicted in Figure 8-1. Further information related to the soil within the project area is discussed in Section 8.1.

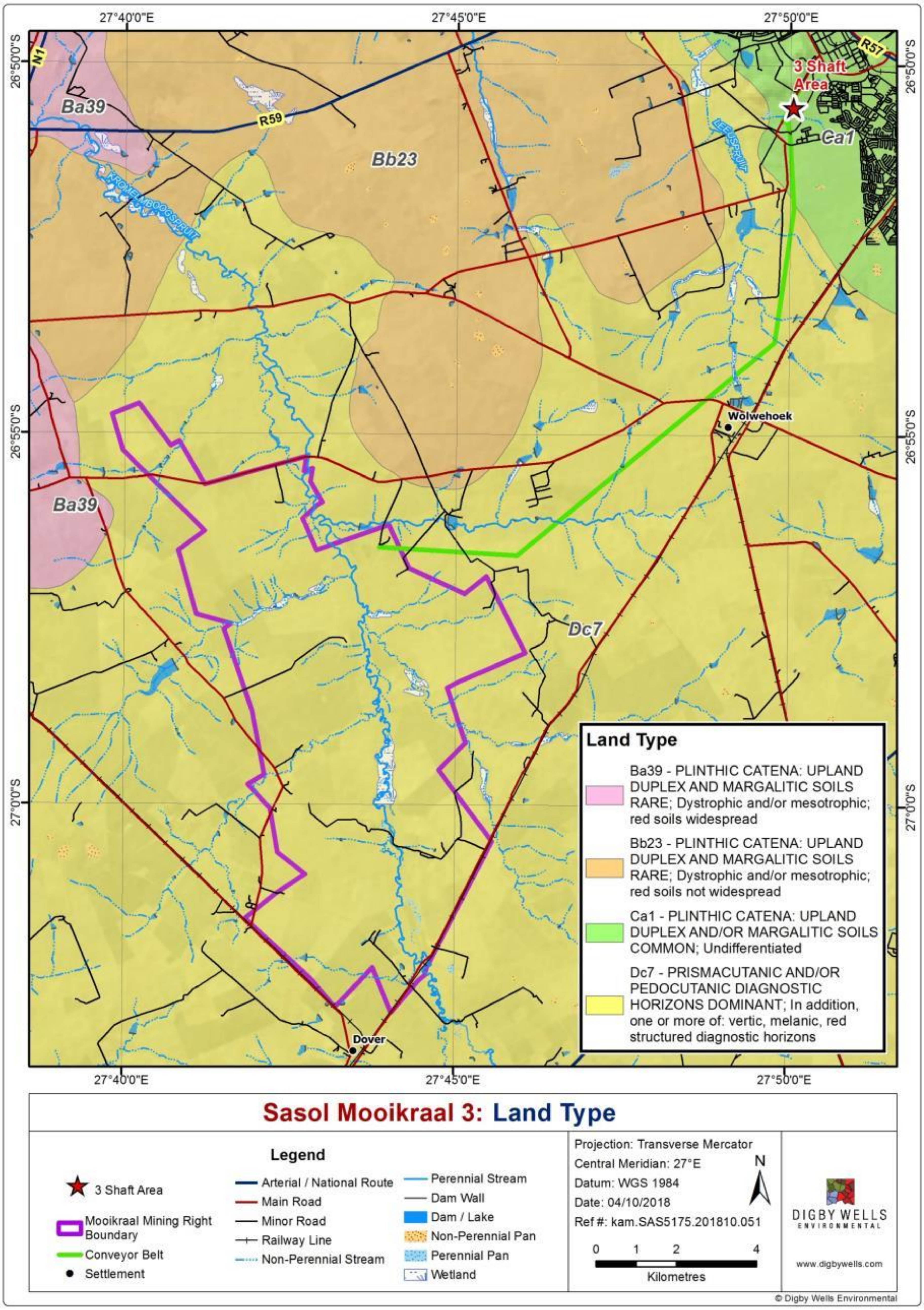

Figure 8-1: Land Type at Mooikraal Colliery

8.1 Land Type 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 Soils

Land Type	Description
Ca1 (Plinthic catena; upland duplex and/or margalitic soils)	Unit Ca indicates land that qualifies as a plinthic catena but which has, in upland positions, margalitic or duplex soils.
Dc7 (Prismacutanic and/or pedocutanic diagnostic horizons)	Unit Dc accommodate land where duplex soils are dominant. Also, the land type is made up of soils that have one or more of the following diagnostic horizons: vertic, melanic and red structured.

Figure 8-2: Soils found within the area (Left to right and top to bottom: Vertic, Vertic, Duplex and Vertic soil groups)

8.1.1 Arcadia Soil Form

The Arcadia soil form consists of a deep vertic A over unspecified material. They have shrink-swell properties (Fey *et al*., 2010). With the start of the rainy season, Arcadia soils are dry and cracked and water infiltration is high bypassing the soil body and potentially recharging the groundwater or downslope soils. When it rains, the soil swells and the cracks close and the infiltration rate slows (Fey *et al*., 2010). These soils hold large amounts of water which often are not available to crops. Arcadia soils can accommodate a selected composition of vegetation such as grazing vegetation for cattle or strong rooted crops such as cotton or sunflower.

8.1.2 Avalon Soil Form

The Avalon soil form consists of Orthic A, on a yellow-brown apedal B, over a soft plinthic B horizon. Avalon soils are freely draining and chemically active. Manganese and iron oxides accumulate under conditions of a fluctuating water table forming localised mottles or soft iron concretions of the soft plinthic B horizon.

8.2 Present Land Use and Land Capability

The present land use was identified from satellite images and from the site visit. The main land uses in the area are underground mining, cultivated land and veld for grazing. A large amount of agricultural activities are taking place within the project area and surroundings, as depicted in Figure 8-3.

Land capability was determined by assessing a combination of soil, terrain and climate features. The land classes were identified based on soil forms, texture and fertility. The classes were IV and V (Table 8-2). The ensuing paragraphs list in detail the limitations used to define the two classes.

Table 8-2: Land Capability Classification

Land Type	Land Capability Class	Agricultural Potential
Ca1	IV	*Low to moderate
Dc7	V	*Low

*Agricultural Potential rated low in a wetland context but can be high with suitable management.

8.2.1 Class IV

Land in Class IV has severe limitations that restrict the choice of plants, require very careful management or both; it may be used for cultivated areas, but more careful management is required. Conservation practices are more difficult to apply and maintain; restrictions to land use are greater than those in Class III.

8.2.2 Class V

Class V land capability coincides with the black clayey soils. Although these soils are deeper, they have high clay content and shrink/swell properties, making them very difficult to manage from an agricultural perspective. Land in Class V has little or no erosion hazard but has other limitations such as impractical to ameliorate which limit its use largely to grazing or wildlife. Limitations restrict the kind of plants that can be grown and prevent normal tillage of cultivated crops.

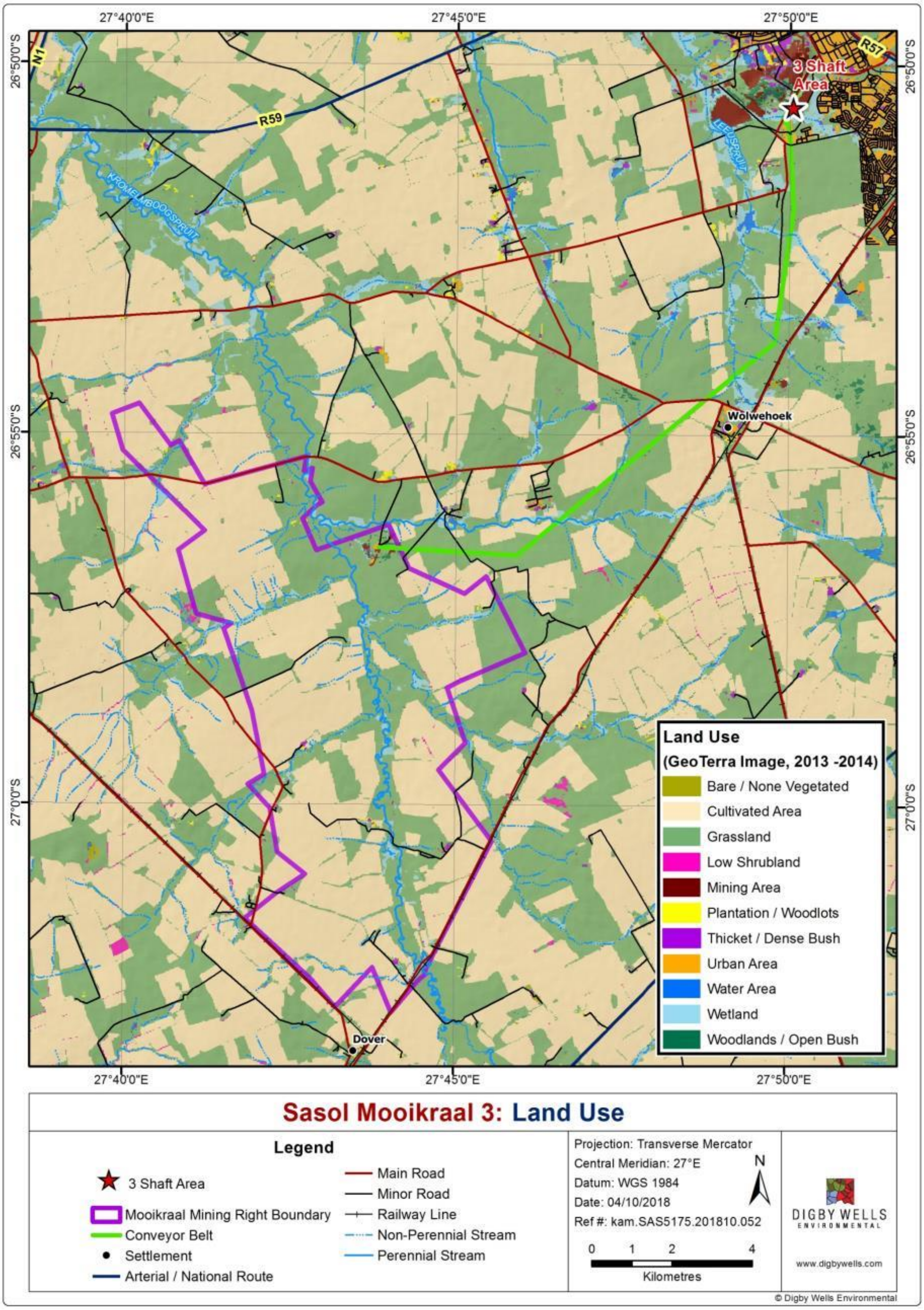

Figure 8-3: Land Use at Mooikraal and surrounding

8.3 Soil Chemical and Physical Properties

A total of six soil samples were analysed for the chemical and physical properties. The objective of this section of the study is to characterise the soil's physico-chemical properties which included:

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

The results of soil analysis are presented in Table 8-3 and as a basis for interpreting these results, some local fertility guidelines are presented in Table 8-4.

8.3.1 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 soil pH ranged from 4.9 to 6.1 as presented in Table 8-3. These soils are considered to be acidic to slightly acidic (Table 8-4). 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 is required to counteract acidity and to increase plant growth performance, should agricultural activities have taken place.

8.3.2 Exchangeable 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. For most soils, cations follow the typical trend Ca>Mg>K>Na.

Ca and Mg levels in the soil were generally high and adequate for crop production and these nutrients are not limiting any production on the site or not considered as toxic. Thus there is no need to add sources as they may suppress K uptake. Potassium levels are high and adequate when compared to the soil fertility guidelines. All of the soil samples collected on the site show the profile of Ca>Mg>K>Na concentrations as expected.

The Na levels ranged from 18 to 550mg/kg and soils with sodium levels below 200mg/kg are considered not to be sodic (Sample 1, 3, 4, 5 and 6). These Na levels are acceptable and are not of concern on the site. Soil dispersion is unlikely to occur and cause dense structure and drainage problems. However, sample 2 had high (554mg/kg) sodium levels when compared with soil fertility guidelines and therefore classified as strongly sodic. Soil dispersion is likely to occur and cause dense structure and drainage problems (de Villiers *et* *al*., 2003). The clayey (black) soils are considerably better endowed with base cations, organic carbon, clay, and cation exchange capacity. Because of the high nutrient status and well buffered pH, soils with a vertic horizon are potentially very suitable for rehabilitation work.

Although the black clay is potentially difficult to work because of unfavourable consistency, it has the advantage of a self-mulching habit meaning that clods will “weather” to a fine crumb structure due to shrinking and swelling with changes in water content. Also, the shrink-swell behaviour could potentially have a favourable effect in counteracting mechanical compaction caused by heavy machinery employed for rehabilitation. Vertic soils can be used successfully for crop and pasture production if managed judiciously (Fey *et al*., 2010). The sodic soils with the swelling and dispersion will have pore spaces blocked and infiltration rates and permeability will be greatly reduced.

Table 8-3: Soil Chemical and Physical Properties

Sample ID	pH(KCl)	P(Bray1)	Na	K	Ca	Mg	OC	Clay	Sand	Silt	Texture
		mg/kg					%				
Sample 1	4.98	2	86	186	3512	1403	0.93	39	33	28	Clay loam
Sample 2	5.24	2	554	102	3768	1734	0.52	45	29	26	Clay
Sample 3	5.81	2	142	269	3730	1771	0.20	43	39	18	Clay
Sample 4	5.27	1	18	67	699	220	0.20	9	76	15	Sandy loam
Sample 5	5.89	4	49	223	3357	1255	0.35	25	56	19	Sandy clay loam
Sample 6	6.12	2	19	172	3338	1175	0.15	21	59	20	Sandy clay loam

Table 8-4: Soil Fertility Guidelines (Fertiliser Association of South Africa, 2003)

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

8.3.3 Phosphorus

The Bray 1 extraction and analysis procedure for P is preferred for soils with pH levels below 7. The P levels encountered in the samples from the site were all very low according to the guidelines in Table 8-4, with most values being >1mg/kg and the maximum 4mg/kg. Phosphorus will be a limiting factor in terms 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. The low available P status of the clayey soils reflects a probable history of no cropping or cropping has taken place for over a period of time.

8.3.4 Soil Organic Carbon

Soil organic carbon provides an indication of organic matter content in 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 at the soil sampling locations ranged from 0.1 to 0.9% and levels below 2% would have required an external nutrient input source, should the soils have been used for agricultural purposes.

8.3.5 Soil Texture

The particle size distribution of the soil sampled in the areas 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 6-2). The soils can be described as clay, sandy clay loam, sandy loam and clay loam. Clayey soils have a slow infiltration rate but a good water retention capacity and these soils are more fertile than sandy soils due to high plant nutrient retention (Sample 1, 2, 3, 5 and 6). Samples 1, 2 and 3 have high clay content and a low to marginal agricultural potential. Samples 4, 5 and 6 are a bit sandy and have a moderate agricultural potential.

8.4 Waste Classification

The waste rock dump at Mooikraal is a potential source of soil contamination; once material is exposed to oxygen and rainfall, leachate generating reaction may occur and introduce contamination into the groundwater environment via seepage. Total concentration analysis identified Barium and Copper as potential elements of concern however these results are a worst case scenario. Leachable concentration analysis, which is the most representative of the expected leachate at the site, shows no concern within regards to the leachate expected to emanate from the dump. More detailed information pertaining to the waste classification of the waste rock dump at Mooikraal can be obtained from the Groundwater Specialist Study.

9 Unplanned Events and Low Risks

There is a risk of accidental spillages of hazardous substances which can result in soil contamination, for example hydrocarbons or oils from vehicles or other construction machinery and from waste storage facilities during construction, operational and decommissioning phases.

9.1 Emergency Procedures

Hydrocarbon spills or leaks can occur; therefore, emergency procedures need to be put in place for remediation (Table 9-1). These procedures can include the following:

- Contractors must ensure that all employees are aware of the procedure for dealing with spills and leaks and properly trained to deal with such incidents;
- Ensure that emergency spill equipment is available to site personnel;
- All machines should be serviced at the workshop and refuelled at a diesel filling station on site;
- If a hydrocarbon spill occurs, it should be cleaned up immediately, if applicable the incident will be reported to the appropriate authorities and recorded; and
- Contaminated soils, if not effectively remediated *in-situ*, must be disposed in a registered and licensed Waste Land Facility.

Table 9-1: 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 at the workshop location specifically designed for servicing of machinery; ▪ Machinery must be parked within hard park areas and. Further the machinery must be inspected daily for fluid leaks; ▪ If a spill occurs it should be cleaned up (Drizit spill kit/ Enertech type spill kit, Oil or Chemical spill kit) immediately and if applicable reported to the appropriate authorities; and ▪ Emergency response plans should be in place.
Hazardous substance spillage from waste storage	Soil Contamination	▪ Prevent any spills from occurring; ▪ If a spill occurs it should be cleaned up (Drizit spill kit/ Enertech type spill kit, Oil or Chemical spill kit) immediately and if applicable reported to the appropriate authorities; and ▪ Emergency response plans should be in place.

10 Sensitivity

According to the Department of Water of Affairs (DWAF) (2005), the permanent zone of a wetland area could potentially be categorised by Katspruit, Rensburg, Arcadia, Champagne or Willowbrook soil forms as defined by the South African Classification System (Soil Classification Working Group, 1991). Also, the following soil forms are classified as wetland soils; Longlands, Kroonstad, Avalon, Westleigh, Pinedene and Fernwood (DWAF, 2005). Wetland soils have high sensitivity as they are protected by:

- Section 24 of the Constitution of the Republic of South Africa ,1996 (Act No. 108 of 1996);
- Section 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA); and
- Ramsar Convention on Wetlands of International Importance (1975) (Ramsar Convention).

The sensitive areas are depicted in Figure 10-1.

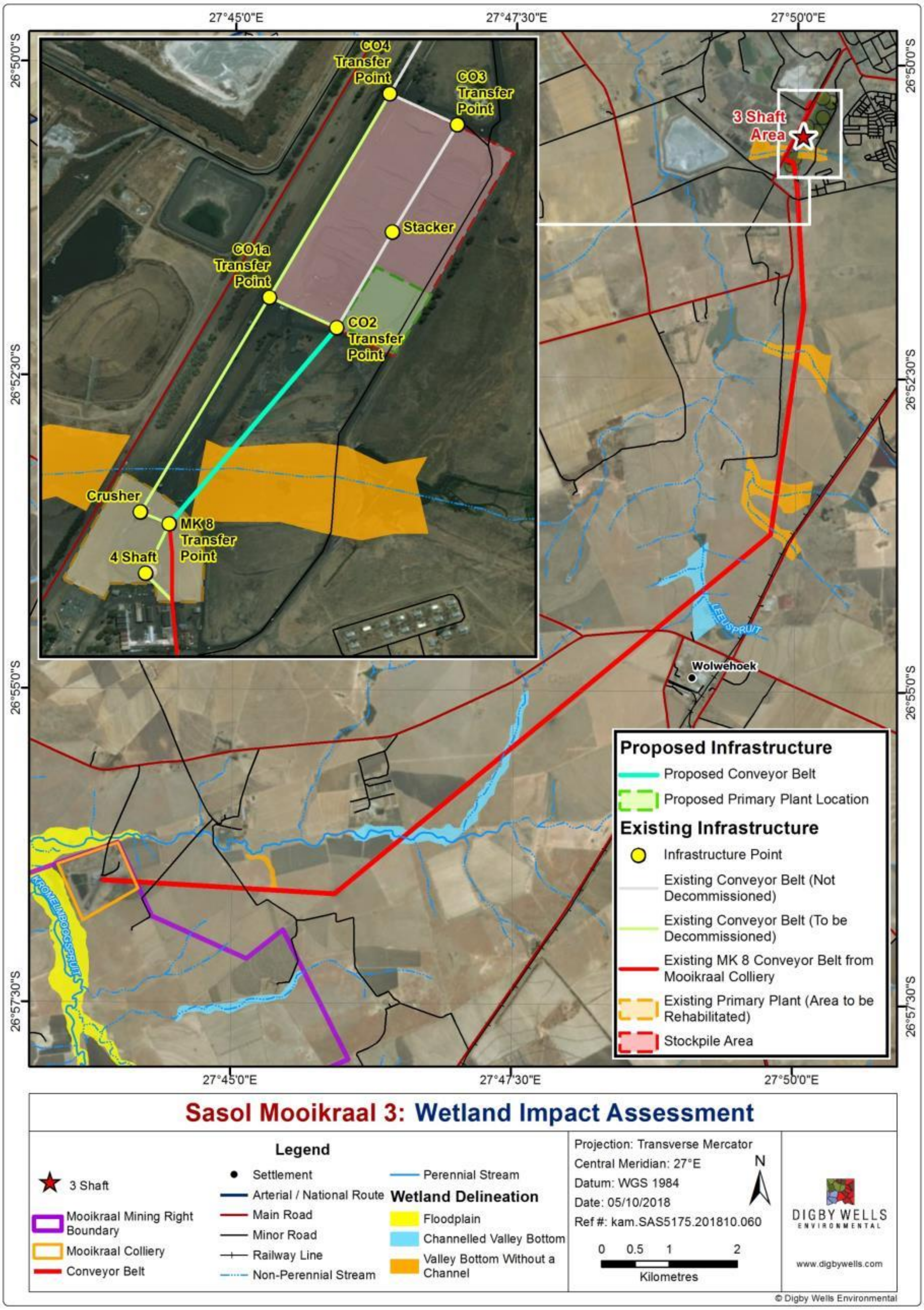

Figure 10-1: Wetlands Delineated on Site, Highlighting Sensitive Areas

11 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 considered 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.

11.1 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 an 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 Basic Assessment Report (BAR). 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 11-3. 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 11-2, which is extracted from Table 11-1. The description of the significance ratings is discussed in Table 11-3.

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 11-1: 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 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 because 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 11-2: 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 11-3: 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) (-)

11.2 Impact Rating

This section aims to rate the significance of the identified potential impacts pre-mitigation and post-mitigation. The potential impacts identified in this section are a result of both the environment in which the proposed project activities takes place, as well as the actual activities. The potential impacts are discussed per aspect and per each phase of the project i.e. the Construction Phase, Operational and Decommissioning/Post Closure Phases where applicable:

- Demolition of the existing conveyor belt, crushing facility and coal bunker which is currently situated within a wetland at the 3 Shaft (primary plant);
- Relocation/reconstruction of the primary plant (crusher facility) to the concreted stockpile area (to remain within the 3 Shaft footprint);
- Installing a conveyor belt from the MK8 transfer point to the stockpile area which will traverse a delineated wetland (within the 3 Shaft footprint);
- Proposed upgrade of the stormwater management system at 3 Shaft;
- Rehabilitation of the existing wetland at 3 Shaft and areas impacted from the operation of the existing conveyor belt, crushing facility and coal bunker;
- Drilling of exploration, monitoring and rescue boreholes within the approved Mooikraal Mining Right area and 3 Shaft Complex;
- Incorporate all activities at Mooikraal, Kleinvlei, 3 Shaft and along both servitudes into the EMPr;
- Incorporate the 7 and 10 Ml/day pipeline EA into the EMPr; and
- Incorporate all properties located within Mooikraal, Kleinvlei, and 3 Shaft and along both servitudes into the EMPr.

Additionally, decommissioning and rehabilitation activities with associated impacts for the Mooikraal must be undertaken. The following decommissioning activities include:

- Decommissioning of all linear structures including roads, pipelines and conveyor belts;
- Decommissioning of all redundant mining infrastructure (Mooikraal and 3 Shaft);
- Decommissioning of activities being undertaken within a water course (Roads, Pipelines, Conveyor Belts);
- Backfilling and sealing of shaft;
- Rehabilitation of areas affected by mining including ripping of soil, vegetation establishment, removal of any carbonaceous material; and
- Rehabilitation of areas where subsidence may have occurred.

11.2.1 Construction Phase

The activities that will be undertaken during the construction phase that will impact on the soils and land capability will include:

- Clearing of the footprint areas;
- Establishment of additional ventilation structures within the mining right area;
- Demolition of the existing conveyor belt, crushing facility and coal bunker;
- Relocation/reconstruction the primary plant (crusher facility) on the stockpile area (to remain within the 3 Shaft footprints); and
- Remediate/rehabilitation of the area where the conveyor belt, crushing facility and coal bunker used to be established as well as indirectly affected areas.

During the construction phase site clearing is necessary for the preparation of surface infrastructure development where vegetation will be removed along with topsoil. When soil is removed, the physical properties are changed, and the soils' chemical properties will deteriorate unless properly managed. When organic matter has been removed either by the clearing of an area for development or by erosion; the soils' fertility is reduced, or soil acidity could increase.

Land capability loss is anticipated to be restricted to the vicinity of the surface infrastructure. There is no loss in land capability and land use; as there will be no open pit, waste rock dumps and tailings storage facilities on site as they have already been constructed.

Soils should be handled with care from the construction phase through to the decommissioning phase.

11.2.1.1 Impact Ratings

The construction phase impacts are rated in the Table 11-4, Table 11-5 and Table 11-6.

Table 11-4: Potential Impacts for the Loss of Soils as a Resource: Erosion and Compaction

Dimension	Rating	Motivation	Significance
Site clearing and topsoil removal			
Impact Description: Loss of topsoil as a resource: During clearing of vegetation and removal of soil for establishment of conveyor belt and reconstruction of the plant, the soil chemical and physical properties are impacted on. The movement of vehicles 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	Vegetation and soil will be removed in preparation of plant and conveyor belt, but the impact may be less than 15 years	Minor (-50)
Extent	3	Loss of soil (erosion and compaction) will only occur within project area	
Intensity	4	Vehicles moving on the surface may result in compaction leading to erosion which can be serious but the impact can be reversed.	
Probability	5	By excavating the soil it will certainly impact on the soil and loss of topsoil is certain	
Nature	Negative		
Post-Mitigation			
Duration	2	Loss of soil will not be significant with mitigation measures impact will be less.	Negligible (-32)
Extent	3	Loss of soil will be local and extend across the project area.	
Intensity	3	Loss of soil will be reduced if mitigations measures are implemented	
Probability	4	Losses of soil as a resource will probable occur.	
Nature	Negative		

Table 11-5: Potential Impacts for the Rehabilitation Existing Wetland at 3 Shaft and Areas Impacted from the Operation of the Existing Conveyor Belt, Crushing Facility and Coal Bunker

Dimension	Rating	Motivation	Significance
Rehabilitation of impacted areas			
Impact Description: Rehabilitation of existing wetland at 3 Shaft and areas impacted from the operation of the existing conveyor belt, crushing facility and coal bunker			
Prior to Mitigation/Management			
Duration	3	The impact on soils and wetland will continue for few years after soils and wetland been rehabilitated	Moderate (-77)
Extent	3	The impact on soils and wetlands will have an effect on a local scale	
Intensity	5	Erosion and sedimentation is likely to occur due to expose surfaces. Pollutants might migrate and cause impacts on wetlands and their functionality	
Probability	7	Should no mitigation measures be implemented, impacts on soils and wetlands will definitely continue	
Nature	Negative		
Post-Mitigation			
Duration	3	The impact on soils and wetland will continue if mitigation measures are not implemented	Minor (-50)
Extent	3	The impact on soils and wetlands will have an effect on a local scale	
Intensity	4	Pollutants might migrate and cause impacts on wetlands and their functionality if mitigation measures are not implemented	
Probability	5	Should no mitigation measures be implemented, impacts on soils and wetlands will definitely continue	
Nature	Negative		

Table 11-6: Potential Impacts for the Contamination of Soil during Construction and Decommissioning of the Crusher, Plant and Conveyor Belt

Dimension	Rating	Motivation	Significance
Contamination of soil during construction and decommissioning of the crusher, plant and conveyor belt			
Impact Description: Spillages of hydrocarbons during decommissioning and construction of the crusher, plant and conveyor. There is a chance of the machines breaking down or leaking during these activities.			
Prior to Mitigation/Management			
Duration	5	Contamination of soils can be permanent if mitigation measures are not implemented	Moderate (-72)
Extent	2	Impact will only occur on a local scale	
Intensity	5	Impact on soils is serious and can be irreversible	
Probability	6	The impact on soils is very likely to occur and can be severe	
Nature	Negative		
Post-Mitigation			
Duration	4	Impact will be for less than 10 years if mitigation measures are implemented	Minor (-40)
Extent	3	The impact will occur on a local scale	
Intensity	3	The intensity of the impact will be reduced if mitigation measures are implemented	
Probability	4	Impact will probable occur if mitigation measures are not followed	
Nature	Negative		

11.2.1.2 Management Actions

Management actions and targets include the following:

- If possible, topsoil should be removed when the soil is dry, as to reduce compaction;
- If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place;
- The soils stripped for the ventilation shafts should be stripped and conserved for rehabilitation;
- Soil stockpiles should be vegetated, sloped and stockpiled at 3 to 4 m high and protected from erosion, so they are available for use in the rehabilitation process;
- The handling of the stripped topsoil should be minimised to ensure the soil's structure does not deteriorate significantly;
- The topsoil stockpiles should be vegetated to reduce the risk of erosion, and to reinstitute the ecological processes within the soil;
- Prevent any hydrocarbon spills from heavy machinery and construction vehicles from occurring;
- If a hydrocarbon spill occurs it is to be cleaned up immediately and, if applicable, reported to the appropriate authorities;
- All vehicles are to be serviced at the workshop;
- Place drip trays should be placed under on leaking vehicles;
- Only the designated access routes are to be used to reduce any unnecessary compaction; and
- Ensure proper stormwater management designs are in place and maintained.

11.2.2 Operational Phase

During the operational phase, the following activities are expected to take place that will impact on the soils and land capability:

- Potential surface subsidence after high extraction mining;
- Raw coal handling and processing;
- Drilling of exploration, monitoring and rescue boreholes within the approved Mooikraal MR area and 3 Shaft Complex;
- Loading of the coal brought to the surface to the conveyor at the shaft and the conveying of the coal to the processing plant;
- Stockpiling of coal before transporting it to the plant; and
- Dust suppression along access and conveyer routes from the shaft to the bunker.

High extraction mining can result in subsidence; in areas where the depth of mining is shallow, and the roof support is weak. High extraction mining and shallower mining activities will have greater negative impacts as the surface is at great risk from destabilisation, resulting in possible subsidence if mitigation measures are not carried out.

The following impacts might occur due to high extraction:

- Surface cracking at zones of expansion and contraction;
- Subsidence; and
- Ponding due to changes to topography and surface hydrology.

The significance of the impacts on soils on the project site differs according to the soil forms found:

- Free draining red and yellow brown soils; and
- Black and dark brown clay rich soils.

Surface subsidence due to high extraction method of mining will have a negative impact on soils especially wetland soils as they will lose a lot of water and will create a potential for collapse of the surface. This may significantly restrict post-mining land capability and agricultural productivity, for example if the subsided areas result in ponds/waterlogging conditions, sinkholes and/or cracking of the surface.

The WRD at Mooikraal is a potential source of soil contamination once material is exposed to oxygen and rainfall. Leachate generating reaction may occur and introduce contamination into the groundwater environment via seepage which intern can have an impact on soil quality. Leachable concentration analysis, which is the most representative of the expected leachate at the site, shows no concern within regards to the leachate expected to emanate from the dump.

11.2.2.1 Impact Ratings

The operational impacts described are rate in Table 11-7 to Table 11-11.

Table 11-7: Potential Impact of Surface Subsidence from Collapsed Underground Mine Roof

Dimension	Rating		Significance
Activity and Interaction: Potential surface subsidence from collapsed underground mine roof			
Impact Description: Collapsed underground mine roof from the use of high extraction mining method could potentially cause significant surface subsidence. This may restrict post mining land capability and agricultural productivity. Surface cracking and subsidence will occur due to large areas that could be affected by high extraction. Due to this land capability will potentially be altered reducing the capability to land with a high degree of limitations for land use.			
Prior to Mitigation/Management			
Duration	7	As a result of the mining method it is expected that the impact would be beyond the project life without mitigation adopted.	Moderate (-76)
Extent	5	Without mitigation the impact is expected to occur within the region.	
Intensity	7	Serious impacts to the land capability and land use will occur as a result of mining (30-100 m) and adopting no mitigation as a result of potential subsidence.	
Probability	4	The impact on soils will definitely occur.	
Nature	Negative		
Post-Mitigation			
Duration	6	With mitigation the duration would be limited to the project life	Minor (-48)
Extent	4	With mitigation the duration of the impact would be limited to the project area.	
Intensity	6	Even with mitigation being adopted there will be a serious loss of agricultural productivity	
Probability	3	It is expected that the impact is likely to occur.	
Nature	Negative		

Table 11-8: Potential Impacts of Maintenance of Roads, Stormwater and Conveyor Belts

Dimension	Rating	Motivation	Significance
Activity and Interaction: Maintenance of roads, stormwater and conveyor belts			
Impact Description: Topsoil losses can occur during the operational phase as a result of rainwater runoff and wind erosion from roads. Compaction of soils during operational phase will occur due to movement of vehicles.			
Prior to Mitigation/Management			
Duration	5	Roads will be used during this phase for the length of this operation therefore posing an impact on soils if not mitigated accordingly.	Moderate (-91)
Extent	3	Loss of topsoil will only occur within project area	
Intensity	5	Loss of usable topsoil may result in loss of land capability and land use. Soil regeneration takes a very long time.	
Probability	7	Compaction and erosion of soil if mitigations are not implemented will definitely occur	
Nature	Negative		
Post-Mitigation			
Duration	4	Roads will be used during this phase for the length of this operation therefore posing an impact on soils if not mitigated accordingly	Minor (-36)
Extent	2	With mitigation the impact should be limited to the extent to where the stockpiles will be located.	
Intensity	3	With mitigation this should significantly be reduced.	
Probability	4	With mitigation the likelihood of the impact occurring is limited.	
Nature	Negative		

Table 11-9: Potential Impacts for the Contamination of Soil during Operational Phase

Dimension	Rating	Motivation	Significance
Contamination of soil during operational phase			
Impact Description: Spillages of hydrocarbons during the operational phase. There is a chance of the machines breaking down or leaking during these activities. Coal falling off the conveyor belt can cause contamination to soils and wetlands.			
Prior to Mitigation/Management			
Duration	5	Contamination of soils can be permanent if mitigation measures are not implemented	Minor (-66)
Extent	3	Impact will only occur on a local scale	
Intensity	3	Impact on soils is serious and can be irreversible	
Probability	6	The impact on soils is very likely to occur and can be severe	
Nature	Negative		
Post-Mitigation			
Duration	4	Impact will be for less than 10 years if mitigation measures are implemented	Minor (-40)
Extent	3	The impact will occur on a local scale	
Intensity	3	The intensity of the impact will be reduced if mitigation measures are implemented	
Probability	4	Impact will probable occur if mitigation measures are not followed	
Nature	Negative		

Table 11-10: Potential Impacts Associated with Drilling of Exploration, Monitoring and Rescue Boreholes, Raw Coal Handling and Processing

Dimension	Rating	Motivation	Significance
Site clearing and topsoil removal			
Impact Description: Loss of topsoil as a resource: During clearing of vegetation and removal of soil for the preparation of drilling for boreholes.			
Prior to Mitigation/Management			
Duration	3	Vegetation and soil will be removed in preparation of boreholes, but the impact may be less than 15 years	Minor (-50)
Extent	3	Loss of soil (erosion and compaction) will only occur within project area	
Intensity	4	Vehicles moving on the surface may result in compaction leading to erosion which can be serious but the impact can be reversed.	
Probability	5	By excavating the soil it will certainly impact on the soil and loss of topsoil is certain	
Nature	Negative		
Post-Mitigation			
Duration	2	Loss of soil will not be significant with mitigation measures impact will be less.	Negligible (-32)
Extent	3	Loss of soil will be local and extend across the project area.	
Intensity	3	Loss of soil will be reduced if mitigations measures are implemented	
Probability	4	Losses of soil as a resource will probable occur.	
Nature	Negative		

Table 11-11: Potential Impacts of the Waste Rock Dump at Mooikraal on the Soil Environment

Dimension	Rating	Motivation	Significance
Soil contamination as a result of the WRD leachate into the ground			
Impact Description: A contamination plume may emanate from the WRD and seep into the soil			
Prior to mitigation/ management			
Duration	Medium term (3)	Soil contamination from the dump (if any) is expected to be minimal and dilution is expected over time.	Minor (-21)
Extent	Limited (2)	The contamination plume from the WRD is expected to be limited to the project area.	
Intensity x type of impact	Minimal (2)	The intensity of the contamination will be minimal. This is based on the outcomes of the expected leachate quality derived from geochemical analysis.	
Probability	Unlikely (3)	The impact is unlikely to occur.	
Nature	Negative		
Post management			
Duration	Medium term (3)	Soil contamination from the dump (if any) is expected to be minimal and dilution is expected over time.	Negligible (-18)
Extent	Very limited (1)	The plume is expected to be limited to be limited to isolated parts within the immediate vicinity of the dump.	
Intensity x type of impact	Minimal (2)	The intensity of the contamination will be minimal. This is based on the outcomes of the expected leachate quality derived from geochemical analysis.	
Probability	Unlikely (3)	The impact is unlikely to occur.	
Nature	Negative		

11.2.2.2 Management Actions

Management actions and targets include the following:

- Monitoring of undermined areas to assess the effects of subsidence at surface;
- Rehabilitation of surface cracks, caused by surface subsidence due to underground mining, must be rehabilitated once identified;
- Areas where vegetation is affected by ponding, caused by surface subsidence due to underground mining, must be rehabilitated once identified;
- Subsided areas can be backfilled and re-shaped to match the original topography to mitigate ponding and waterlogging conditions depending on the degree of the collapse and available soil material;
- 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;
- Topsoil stockpiles are to be maintained in a fertile and erosion free state by sampling and analysing annually for macro nutrients and soil pH, and vegetating the stockpiles to reduce erosion;
- Planning for free drainage of ponded areas;
- Prevent any hydrocarbon spills from machinery and vehicle from occurring;
- If a hydrocarbon spill occurs it is to be cleaned up immediately and, if applicable, reported to the appropriate authorities;
- Vehicles leaking hydrocarbons will have drip trays place under them where the leak is occurring;
- The waste rock dump should be maintained with slopes that reduce pooling of water, to reduce the amount of leachate generation. Stormwater management must be placed around the facility to ensure dirty water is contained;
- All vehicles are to be serviced in a correctly bunded area (workshop); and
- Emergency spill response plan is required to handle any unplanned/accidental hydrocarbon spillages.

11.2.3 Decommissioning, Rehabilitation and Closure Phase

The major impacts to consider in the decommissioning and rehabilitation of the site will be the loss of topsoil as a resource through erosion and compaction. When the decommissioning and removal of infrastructure takes place, vehicles will drive on the surface compacting it and this reduces infiltration rates as well as the ability for plant roots to penetrate the compacted soil. Vegetation cover will be reduced and increases runoff potential, therefore increased runoff potential leads to increased erosion hazards. The loss of topsoil as a resource is a serious impact as the natural regeneration of millimetres of topsoil takes hundreds of years.

During the decommissioning and rehabilitation phase, the infrastructure areas will be rehabilitated as per the rehabilitation guideline. The infrastructure areas need to be rehabilitated and as a result the impact may be reduced if mitigation measures are implemented. After the infrastructure removal and rehabilitation, the areas must be assessed for compaction and possible erosion risk and corrected immediately.

The WRD is proposed to be backfilled into the shaft therefore it will not exist as a potential contamination source at the surface.

11.2.3.1 Impact Ratings

The rehabilitation impacts described are rated in Table 11-12 to Table 11-14.

Table 11-12: Impact Rating during Rehabilitation of Infrastructure Areas, Roads and Subsided Areas

Dimension	Rating	Motivation	Significance
Rehabilitation of infrastructure areas, roads and subsided areas			
Impact Description: Rehabilitation of roads, infrastructure and subsided areas could cause compaction and erosion if rehabilitation is not done correctly. This could result in poor vegetation establishment which would result in exposed surfaces and increase the risk of erosion.			
Prior to Mitigation/Management			
Duration	5	The impact on soils would likely to occur if mitigations are not implemented	Minor (-36)
Extent	2	Impact will occur on a limited scale	
Intensity	5	The intensity of the impact is serious and might be irreversible if mitigation measures are not implemented leading to chemical and physical degradation of the soil	

Dimension	Rating	Motivation	Significance
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		
Post-Mitigation			
Duration	2	Impact will be less than a year if rehabilitation measures are implemented correctly	Negligible (-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	
Nature	Negative		

Table 11-13: Impact Rating during Rehabilitation of Wetlands

Dimension	Rating	Motivation	Significance
Rehabilitation of wetland areas			
Impact Description: Rehabilitation of wetlands and areas impacted from the decommissioning of the existing conveyor belt, crushing facility and coal bunker			
Prior to Mitigation/Management			
Duration	3	The impact on soils and wetland will continue for few years after soils and wetland been rehabilitated	Moderate (-77)
Extent	3	The impact on soils and wetlands will have an effect on a local scale	
Intensity	5	Erosion and sedimentation is likely to occur due to expose surfaces. Pollutants might migrate and cause impacts on wetlands and their functionality	
Probability	7	Should no mitigation measures be implemented, impacts on soils and wetlands will definitely continue	
Nature	Negative		
Post-Mitigation			

Dimension	Rating	Motivation	Significance
Duration	3	The impact on soils and wetland will continue if mitigation measures are not implemented	Minor (-50)
Extent	3	The impact on soils and wetlands will have an effect on an local scale	
Intensity	4	Pollutants might migrate and cause impacts on wetlands and their functionality if mitigation measures are not implemented	
Probability	5	Should no mitigation measures be implemented, impacts on soils and wetlands will definitely continue	
Nature	Negative		

Table 11-14: Potential Impacts of The Waste Rock Dump At Mooikraal

Dimension	Rating	Motivation	Significance
Soil contamination as a result of the WRD			
Impact Description: Contamination plume in the groundwater during operation			
Prior to mitigation/ management			
Duration	Medium term (3)	Soil contamination from the dump (if any) is expected to be minimal, especially considering the extent of the shaft compared to that of the mine void and dilution is expected over time.	Minor (-21)
Extent	Limited (2)	The plume is expected to be limited to the project area	
Intensity x type of impact	Minimal (2)	The intensity of the contamination will be minimal. This is based on the outcomes of the expected leachate quality derived from geochemical analysis.	
Probability	Unlikely (3)	The impact is unlikely to occur.	
Nature	Negative		
Post management			
Duration	Medium term (3)	Soil contamination from the dump (if any) is expected to be minimal and dilution is expected over time	Negligible (-16)

Extent	Very limited (1)	The plume is expected to be limited to be limited to isolated parts within the immediate vicinity of the shaft	
Intensity x type of impact	Minimal (1)	The intensity of the contamination will be minimal. This is based on the outcomes of the expected leachate quality derived from geochemical analysis. Additionally, flooding of the shaft will hinder contamination generating reactions	
Probability	Unlikely (3)	The impact is unlikely to occur	
Nature	Negative		

11.2.3.2 Management Actions

Management actions and targets include the following:

- Remove buildings to foundation level. All rubble to be relocated to a specified approved rubble dump or used to seal shafts;
- Contour slopes to minimise erosion and run-off;
- Seal all boreholes drilled into the mine as per procedure;
- Limit the footprint area of the decommissioning and rehabilitation activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas);
- All spills from machinery should be immediately cleaned up and treated accordingly and disposed of at an appropriate licenced facility;
- Plant native vegetation to prevent erosion and encourage self-sustaining development of a productive ecosystem;
- Use waste rock, as stockpiled on Mooikraal, to backfill the incline/ decline shaft ,followed by topsoil to the extent feasible;
- Compacted areas are to be ripped to loosen the soil and vegetation cover re-instated;
- An inventory of hazardous waste materials stored on site should be compiled, including volumes stored, as well as method of disposal;
- Seal the shaft by placing concrete plugs. The plug would be of structural quality concrete, cast in controlled conditions, and superior to a grout intruded plug formed underwater. The reverse flow technique must be considered the best solution to seal off the water source;
- Ensure proper stormwater management designs are in place;

- Surface inspection on the fully rehabilitated areas must be undertaken to ensure a surface profile that allows good drainage. This will ensure improvement or increased catchment yield on to the surrounding water streams;
- The waste rock material which will be backfilled into the shaft should be completely flooded; to eliminate exposure to oxygen, this will hinder contamination generating reactions;
- Conduct soil contamination assessments to assess if any remediation is required prior to future land use development; and
- Only designated access routes are to be used to reduce any unnecessary compaction.

11.2.4 Post Closure Phase

Post closure monitoring must continue to determine any potential post closure surface subsidence due to underground mining, resulting in surface cracks, or ponding.

11.2.4.1 Soil Erosion

Excessive stormwater run-off from areas where vegetation has not re-established may result in erosion. The impact of the potential increase in erosion will be low significance after the implementation of the mitigation measures. Soil erosion on site needs to be prevented and erosion control measures will need to be implemented in most areas sensitive to erosion.

11.2.4.2 Loss of land with low agricultural potential (vent shaft)

After decommissioning the vent shaft will be sealed and the agricultural potential of the land at the sealed vent shaft will be lost. The potential impact on loss of the land cannot be mitigated and the impact of the potential will be moderate significance.

11.2.4.3 Subsidence

After the infrastructure removal and rehabilitated, the areas must be assessed for possible subsidence and corrected immediately. Also subsidence and cracking of soils must be monitored closely.

11.2.4.4 Impact Rating

The post closure impacts for subsidence described are rated in Table 11-15

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Table 11-15: Impact Rating for Post Closure Subsidence

Dimension	Rating	Motivation	Significance
Post closure impact of subsidence on soils			
Impact Description: Post closure monitoring and rehabilitation determine the level of success of the rehabilitation. Monitoring will include cracks, erosion and areas of ponding. There is a possibility of loss of land capability if subsidence occurs. A geotechnical assessment and risk assessment will be required and mitigations will need to be incorporated to eliminate the risk of subsidence.			
Prior to Mitigation/Management			
Duration	5	The impact will continue after the rehabilitation of the project has been completed.	Minor – 44 (negative)
Extent	3	Subsidence will affect the local soils and land capability directly.	
Intensity	3	Should no management or mitigation measures be implemented, subsidence could result in a moderate loss of soils and land capability	
Probability	4	Should no precautionary measures be implemented, further impacts to the soil system present are considered probable.	
Nature	Negative		
Post-Mitigation			
Duration	4	The impact will probable occur if mitigation measures are not implemented.	Negligible – 27 (Negative)
Extent	3	Subsidence will affect the local soils and land capability directly.	
Intensity	2	The project could result in only a minor impact on soils and land capability.	
Probability	3	The appropriate management and mitigation measures be implemented, impacts are considered unlikely.	
Nature	Negative		

11.2.4.5 Management Actions

The following management actions and targets are required:

- Repair any damage caused by erosion. Use low wire netting and jute geotextile fences with thick mulch layer to slow and trap water runoff on steep to moderate slopes;
- Only designated access routes are to be used to reduce any unnecessary compaction. Surface cracks must be effectively rehabilitated by agricultural deep ripping or by a dozer ;
- The topsoil should be shaped taking the pre-mining landscape into consideration;
- Vehicular movement across rehabilitated areas 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 to promote good growth and development;
- Drainage controls such as cut-off trenches and culverts must be used to ensure proper management of water runoff to prevent soil erosion and sedimentation;
- Grow indigenous grass to form a vegetative barrier and protect the land from surface erosion; and
- Trenching to dewater surface ponds will decrease the extent of surface ponding. Drains need to be checked on a regular basis to ensure that they remain effective.

Table 11-16: Soils and Land Capability Mitigation and Management Plan

Activities	Phase	Impact	Size and scale of disturbance	Mitigation Measures	Compliance
Decommissioning and Relocation of infrastructure from site (crusher facility, coal bunker and conveyor belt)	Construction	Loss of topsoil, erosion and sedimentation	Infrastructure footprint and surrounding areas	▪ If erosion occurs, corrective actions must be taken to minimise any further erosion from taking place; ▪ Ensure that decommissioning activities are restricted to the area where the activities are being undertaken; ▪ Waste management plan must be in place; and ▪ Ensure that building rubble and all waste material that arises from the decommissioning of the coal bunker, conveyor belt and crusher facility is removed off site and disposed of at an appropriate facility.	NEMA CARA NEMWA
Site clearing and topsoil removal	Construction	Loss of topsoil, compaction, dust and erosion	Infrastructure footprint	▪ 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; and ▪ If possible, topsoil removal should occur during dry months as to reduce compaction.	NEMA CARA
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; and	NEMA NEMWA

Activities	Phase	Impact	Size and scale of disturbance	Mitigation Measures	Compliance
				▪ Ensure that building rubble and all waste material is removed off and disposed of at an appropriate facility.	
High extraction mining	Operational	Subsidence	Infrastructure footprint and surrounding areas	▪ Rehabilitation of cracks, caused by surface subsidence due to underground mining, once identified, as well as areas where vegetation is affected by ponding; ▪ Planning for free drainage of ponded areas; ▪ Monitoring of undermined areas to assess the effects of subsidence at surface; ▪ Ensure hydrocarbon spill kits are in place and immediately available; and ▪ Only the designate access routes are to be used to reduce any unnecessary compaction.	Chamber of Mines Guidelines
Maintenance of the conveyor belt, roads and stockpiles	Operational	Contamination of soil, soil erosion by water or wind	Infrastructure areas	▪ Ensure proper stormwater management designs are in place; ▪ Emergency spillage response plan and spill kits should be in place and accessible to the responsible monitoring team; ▪ If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; and ▪ Only the designate access routes are to be used to reduce any unnecessary compaction.	Chamber of Mines Guidelines NEMWA
Demolition of infrastructure and	Decommissioning & Rehabilitation	Soils	Infrastructure footprint	▪ Compacted areas must be ripped to loosen the soil structure;	Chamber of Mines Guidelines

Activities	Phase	Impact	Size and scale of disturbance	Mitigation Measures	Compliance
rehabilitation of disturbed areas				▪ Implement rehabilitation measures as defined in rehabilitation report; ▪ Topsoil should be replaced for rehabilitation purposes only; and ▪ Topsoil stockpiles should be used for their designated final purposes.	
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; ▪ Surface subsidence due to underground mining must be monitored; ▪ Only designated access routes should be used to reduce any unnecessary compaction; and ▪ Corrective actions must be taken to minimise any further erosion from taking place.	NEMA CARA

12 Monitoring Requirements and Responsibilities

12.1 Monitoring

A monitoring programme at Mooikraal and 3 Shaft 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.

12.1.1 3 Shaft

The following items should be monitored monthly during construction, operational, decommissioning and post closure phases:

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

12.1.2 Mooikraal

The following items should be monitored monthly during operational, decommissioning and post closure phases:

- Soils:
  - Runoff;
  - Subsidence; and
  - Contamination.

Table 12-1: Soil Monitoring Requirements

Aspect	**Activities**	**Impacts requiring monitoring programmes**	**Functional requirements for monitoring**	**Roles and responsibilities (For the execution of the monitoring programmes)**	**Monitoring and reporting frequency and time periods for implementing impact management actions**	**Type of Requirement (Monitoring, Auditing and/or Reporting)**
Flora	Soil disturbance	Establishment of alien plant species	Alien plant monitoring	Qualified botanist	Quarterly monitoring for two years	Monitoring
Soils	Operational, decommissioning and Post-closure	Erosion, loss of soil fertility, compaction	The rehabilitated area must be assessed for compaction, fertility, and erosion and must meet the Chamber of Mines Guidelines	The soils must be assessed by a soil specialist yearly (during the dry season so that recommendations can be implemented before the start of the wet season) so as to correct any nutrient deficiencies.	The rehabilitated area must be assessed once a year for compaction, fertility, and erosion during the dry season	Monitoring

Aspect	Activities	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions	Type of Requirement (Monitoring, Auditing and/or Reporting)
Wetlands	All activities	All impacts and threats to wetlands, predicted or not.	Monitoring of activities through all phases to ensure all impacts are remediated as soon as possible; thus preventing and long term residual impacts to the system that compromises wetland functionality.	The closure officer of the mine should monitor the wetlands at all times as part of managing the site and the surrounding area. Independent wetland specialist should carry out monitoring on a regular basis during all phases of the mining project and provide recommended remedial actions where required.	**ECO:** Internal monitoring should be done as often as possible according to the management practices of the mine. **Independent wetland specialist:** regularly and when needed, i.e. after an incident.	Monitoring

Aspect	Activities	Impacts requiring monitoring programmes	Functional requirements for monitoring	Roles and responsibilities (For the execution of the monitoring programmes)	Monitoring and reporting frequency and time periods for implementing impact management actions	Type of Requirement (Monitoring, Auditing and/or Reporting)
	Mine closure and post-mining environmental status	Possible post-mining water decant and potential decant	Monitor for all risks and remediate. If a greater extent of wetlands are destroyed due to decant, passive treatment of water will need to be considered along with rehabilitation and a wetland offset strategy.		**Independent wetland specialist:** Monitoring should be done annually and when needed, i.e. after an incident.	Monitoring

Table 12-2: Monitoring requirements and frequency

Aspect		Phase	Area to Monitor	Method of Monitoring	Monitoring period	Frequency of monitoring during the monitoring period
Soils	Erosion status	Operational	3 Shaft	▪ Conduct a visual assessment to determine areas of	First year	Monthly
		Operational	3 Shaft		Second year	Quarterly
		Decommissioning and Post Closure	Decommissioned areas		Year 3 - 5	Bi-annually

Aspect		**Phase**	**Area to Monitor**	**Method of Monitoring**	**Monitoring period**	**Frequency of monitoring during the monitoring period**
				potential erosion; and ▪ Undertake field investigations, fixed point photography to document the significance of the erosion occurring on site		
	Compaction	Operational	3 Shaft	▪ Conduct a visual assessment to determine areas of potential compaction; and ▪ Undertake field investigations, fixed point photography to document the significance of the compaction occurring on site	First year	Monthly
		Operational	3 Shaft		Second year	Quarterly
		Decommissioning and Post Closure	Decommissioned areas		Year 3 - 5	Bi-annually

Aspect		Phase	Area to Monitor	Method of Monitoring	Monitoring period	Frequency of monitoring during the monitoring period
	Runoff	Operational	3 Shaft and Mooikraal	▪ Conduct a visual assessment to determine areas of potential runoff; and ▪ Undertake field investigations, fixed point photography to document the significance of the runoff occurring on site	First year	Monthly
		Operational	3 Shaft		Second year	Quarterly
		Decommissioning and Post Closure	Decommissioned areas		Year 3 - 5	Bi-annually
	Contamination	Operational	3 Shaft and Mooikraal	▪ soil samples must be taken and analysed for the following as listed in terms of the “Soil Screening Values from GNR 331 of 2014 National Norms and Standards for the	First year	Once
		Operational	3 Shaft		Second year	Once
		Decommissioning and Post Closure	Decommissioned areas		Year 3 - 5	Every year

Aspect		Phase	Area to Monitor	Method of Monitoring	Monitoring period	Frequency of monitoring during the monitoring period
				Remediation of Contaminated Land and Soil Quality		

Soil contamination monitoring at Mooikraal and 3 Shaft should be implemented and soil samples must be taken and analysed for the following as listed in terms of the "Soil Screening Values from GNR 331 of 2014 National Norms and Standards for the Remediation of Contaminated Land and Soil Quality":

- Metals: As, Cd, Co, Cu, Pb, Mn, Hg, Ni, V, Zn and Cr;
- Anions: chloride, fluoride, nitrate, nitrite, and sulphate; and
- Soil pH and electric conductivity.

The concentrations should be compared to the baseline concentrations if available. The soil contamination assessments will facilitate the identification of potential source, pathway and receptor elements where contamination occurs and consequently reveal appropriate remedial action (s) where necessary.

Soils should be compared with the existing limits listed in Table 12-3 and Table 12-4.

Table 12-3: Soil Quality Variables (Anions)

Anions	DEA (2014)
	mg/kg
Chloride	12 000
Fluoride	30
Nitrate (NO3)	120
Nitrite (NO2)	120
Sulphate (SO4)	4 000

Table 12-4: Soil Quality Variables (Heavy Metals)

Parameter	SSV1 (DEA, 2014)	SSV2 (DEA, 2014)
	mg/kg	
Arsenic	5.8	150
Cadmium	7.5	260
Chromium	46 000	790 00
Cobalt	300	5 000
Copper	16	19 000
Lead	20	1 900
Manganese	740	12 000
Mercury	0.93	6.5

Parameter	SSV1 (DEA, 2014)	SSV2 (DEA, 2014)
	mg/kg	
Nickel	91	10 000
Vanadium	150	2 600
Zinc	240	150 000

12.2 Subsidence, Cracking and Ponding

Cracks, subsidence and ponding need to be rehabilitated in the following manner:

- Areas of ponding, the land will need to be reshaped and rehabilitated to enable free drainage to occur;
- If cracks occurred, topsoil should be cleared around cracks and a mixture of subsoil will be compacted into the crack; and
- Topsoil should be spread over the rehabilitated areas.

Areas where no remedial action is possible, farmers will need to be compensated for the loss of productive land.

12.3 Responsibilities

Table 12-5 provides roles and responsibilities of the people that will be responsible for implementing decommissioning and relocation procedures. The responsibilities of the contractor need to be documented in contract documents.

Table 12-5: Responsibilities

Environmental Aspect	Measures and Actions	Responsibility	Timeframes
Waste management	Bins must be provided for disposal of waste during construction, operational and decommissioning phases	Contractors, Environmental Control Officer and Project Manager	Construction, operational and decommissioning phase
Equipment maintenance and storage areas	Equipment maintenance must be done at the workshops or hard surface areas with stormwater	Contractors, Environmental Control Officer and Project Manager	During construction phase

Environmental Aspect	Measures and Actions	Responsibility	Timeframes
	management. Storage areas must be within the fenced area and located away from all sensitive areas		
Hazardous materials	Spillage plan must be developed. Refuelling must be done on concreted areas or diesel areas to prevent potential soil pollution from spillage	Contractors and Environmental Control Officer	During construction phase to end
Soil erosion and sediment control	Clearing activities must be restricted to the footprint of the plant and conveyor belt (i.e. development areas)	Contractors, Environmental Control Officer and Project Manager	During construction phase
Erosion and sediment control	Removed soil must be stored away from drainage areas	Contractors, Environmental Control Officer and Project Manager	During construction phase
Soil management	Soil must not be stockpiled for more than six months. However, if stockpiled for more than six months the topsoil must be ameliorated.	Contractors, Environmental Control Officer and Project Manager	During construction phase

13 Rehabilitation Actions

The potential risks identified in this section are a result of both the environment in which the project activities take place, as well as the actual activities. These activities along with the rehabilitation actions can be seen as indicated in Table 13-1

Table 13-1: Rehabilitation Actions

Phase	Project Activity	Rehabilitation (Remediation) Actions
Construction, Operational and Decommissioning	▪ Site clearing, including the removal of topsoil and vegetation	▪ Special care must be taken to ensure that excessive loss of vegetation must is avoided by restricting construction activities to the project foot point area ▪ The removal of any, soils, fauna and flora from the site must be strictly prohibited unless unavoidable and essential for construction activities related to the project; ▪ During construction, the construction footprint must be kept to a minimum as far possible and as much of the natural vegetation must be retained where possible, to assist in preventing erosion.
	▪ Stockpiling of soil once excavated	▪ Use stockpiled soils and topsoil during the construction phase; ▪ Reseed with unpalatable grasses and improve species diversity; ▪ Monitoring of erosion; and ▪ Remove alien invasive vegetation.
	▪ Water Management	▪ Alteration of natural hydrology can be prevented by installing energy dissipaters at the discharge point to avoid erosion of the riverbed and banks. These could be in a form of gabions, silt trap, chutes spillway, etc. to ensure reduction of water velocity refer to (Jones & Wagener, 2018).
	▪ Construction activities within a water courses and wetlands	▪ Limit the footprint area of the construction activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in wetland areas); ▪ If it is absolutely unavoidable that any of the wetland areas present will be affected, disturbance must be minimised and suitably rehabilitated, e.g. a wetland offset strategy to compensate for the loss of wetland area due to the canals and berms construction. ▪ All erosion noted within the construction footprint should be remedied immediately and included as part of an ongoing rehabilitation plan;

Phase	Project Activity	Rehabilitation (Remediation) Actions
		▪ Active rehabilitation, re-sloping, and re-vegetation of disturbed areas immediately after construction; ▪ All soils compacted as a result of construction activities should be ripped/scarified (<300mm) and profiled; and ▪ A wetland offset strategy should be developed in order to compensate for the loss of wetland and instream areas due to the canals and berms. Ideally, the PES and EIS of wetlands and instream areas within Sasol's mining lease area should be improved.
	▪ Temporary storage of hazardous products, including waste and fuel	▪ Remove diesel tanks and associated infrastructure from site (it is assumed that all potential contamination is removed during operations); ▪ Dispose of contaminated material at a hazardous waste facility; ▪ Once the site has been cleared of all infrastructure and rubble and no contamination is present, the exposed area should be reshaped to create a gently sloping, free-draining topography; ▪ Reseed with unpalatable grasses and improve species diversity. Additionally, replant species that were relocated during construction phase; ▪ Monitor and maintain vegetation establishment; and ▪ Remove alien invasive vegetation.
	▪ Utilise existing roads to access the various sections	▪ The footprint area should be ripped to alleviate compaction and to assist with vegetation establishment; ▪ Reseed with unpalatable grasses and improve species diversity. Additionally, replant species that were relocated during construction phase; ▪ Monitor and maintain vegetation establishment; and ▪ Remove alien invasive vegetation.

14 Comments and Responses

No comments have been received yet on the Soils and Land Capability Assessment from the public and if received, this section of the report will be updated to include the comments and responses provided.

15 Conclusions and Recommendations

The land type data indicated that the dominant land types on site were Ca1 and Dc7, all dominated by poorly drained soils. The soils are dominated by Avalon (yellow-brown) forms and (black and greyish) Arcadia forms. The main land uses in the area are underground mining, cultivated land and veld for grazing. There are a lot of agricultural activities taking place within the project area and surroundings. Therefore, mitigation measures must be implemented to avoid harsh impacts on the soils.

The dominant land capabilities based on the soils, texture and fertility status found on the project area was Class IV (yellow brown soils) and Class V (black and greyish soils). Yellow brown soils are known to have a high susceptibility to water or wind erosion, very slow permeability of the subsoil, low water-holding capacity and moderate salinity or sodicity. Wetland capability represents the Arcadia soils. Although these soils are deeper, they have high expansible clay content and are physically difficult to manage.

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 organic carbon content of the soils at the soil sampling locations ranged from 0.1 to 0.9% and would have required an external nutrient input source, should the soils have been used for agricultural purposes.

The sodium levels ranged from 18 to 550mg/kg and soils with sodium levels below 200mg/kg (Sample 1, 3, 4, 5 and 6) are considered not to be sodic. However, sample 2 had high (554mg/kg) sodium levels when compared with soil fertility guidelines and therefore classified as strongly sodic due to higher levels of sodium. The P levels encountered in the samples from the site were all very low with most values being >1mg/kg and the maximum 4mg/kg. Phosphorus fertilisation would have been required to establish good crop stand and growth, should agricultural activities have taken place.

The organic carbon content of the soils at the soil sampling locations ranged from 0.1 to 0.9% and levels below 2% would have required an external nutrient input source, should the soils have been used for agricultural purposes. The soils can be described as clay, sandy clay loam, sandy loam and clay loam. Samples 1, 2 and 3 have high clay content and a low to marginal agricultural potential. Samples 4, 5 and 6 are a bit sandy and have a moderate agricultural potential.

The impacts associated with the project on soils include:

- Erosion due to exposed soil surfaces;

- Compaction of soils due to construction vehicles; and
- Soil contamination through hydrocarbon spills.

High extraction method of mining will definitely cause subsidence which will result in a significant impact to soil. The underground mining activities will cause a significant impact on the land capability of the identified soils causing subsidence and surface cracks (high extraction). The impact assessment from the findings of this report indicates that most of the proposed activities pose a **low to moderate** probability of impacting the soils and wetlands over the longer term. However, subsidence could have a **moderate to major** negative significance on soils and land capability. Based on the findings of this report and the proposed mitigation measures, the anticipated impacts of the proposed project can be reduced to a moderate to low level of significance through implementation of the proposed integrated mitigation and management measures.

16 Reasoned Opinion of the Specialist

Soil management measures should be followed and mitigation measures implemented as outlined in this report and disturbed land needs to be rehabilitated to prevent possible soil erosion, contamination and compaction. It is anticipated that the impact on soils will be of **low to moderate** negative significance. However, subsidence could have a **moderate to major** negative significance on soils and land capability should it occur.

Based on the baseline of information and the impact assessment ratings of significance, it is the opinion of the specialist that this project is feasible and could be considered if the management and mitigation measures tabled are rigorously adhered to for the project to minimise potential impacts on the soils and to maintain their land capability for future land use.

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.

17 References

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Soil Classification Working Group. 1991. Soil Classification, A Taxonomic System for South Africa. Soil and Irrigation Research Institute, Department of Agricultural Development, Pretoria.

Appendix A: CV

Mr Siphamandla Madikizela

Soil Scientist

Mine Closure and Rehabilitation Services

Digby Wells Environmental

Education

- 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.

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 years majoring in Soil Science).
- 2012: Jeffares & Green Consulting Company - Field Assistant.

Experience

Siphamandla Madikizela is a Soil Scientist and completed his MSc in Soil Science at University of KwaZulu-Natal. Prior to his employment at Digby Wells, Siphamandla worked as an Assistant Plantation Manager for EcoPlanet Bamboo southern Africa. He joined Digby Wells in March 2016 and is part of the Terrestrial and Mine Department. His role involved conducting soil surveys, soil contamination assessment, and identification of soil forms, interpreting results of soil samples, land use and land capability environmental impact assessments and writing detailed scientific reports.

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.
- Contamination Assessment for Konskilde Warehouse, Boksburg, Johannesburg, South Africa – EDF Fenice – 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.

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*.

Responsibilities

- Plant management including adaptive fertilizer applications, pest management and irrigation schemes.
- Managing daily operations including the oversight of large staff teams of unskilled and semi-skilled workers, scheduling of operations and maintenance of farm equipment.
- Managing a schedule of community development activities
- Managing weekly activities in the nursery, including staff and overseeing the arrival and transplanting of new plants.
- Tracking and recording productivity data of the general workers and prepare the weekly KPI's for the corporate office.
- Adherence to international certification standards, in particular the Forest Stewardship Council (FSC), through plantation planning and administrative work.

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)
- Current: Project Management

Professional Affiliations

- Soil Science Society of South Africa (SSSA).

Professional Registration

- 2013: Registered as a Candidate Natural Scientist with The South African Council for Natural Scientific Professions. Registration number: 100033/13.

Appendix B: Laboratory Certificate

AGRICULTURAL SERVICES

Farm Elandsfontein
District Bapsfontein
Gauteng, South Africa

SOIL ANALYSIS REPORT

Total Quality. Assured.

Certificate Number : AGRI 07_18-0119-0

Report date : 2018/07/20

CERTIFICATE OF ANALYSIS

Customer : Digby Wells

CN : AGRI 07_18-0119-0				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 07_18-0119-1	Sample	1	4.98	2	186	86	3512	1403	0.00	58.7	38.5	1.6	1.2	0.0	1.5	61.0	24.2	29.9	0.8	29.9	1.118	41.47	39	33	28	0.93	2018/07/17	2018/07/20
AGRI 07_18-0119-2	Sample	2	5.24	2	102	544	3768	1734	0.00	52.8	39.8	0.7	6.6	0.0	1.3	126.5	54.4	35.7	9.1	35.7	1.185	50.50	45	29	26	0.52	2018/07/17	2018/07/20
AGRI 07_18-0119-3	Sample	3	5.81	2	269	142	3730	1771	0.00	54.1	42.1	2.0	1.8	0.0	1.3	48.3	21.1	34.5	0.9	34.5	1.234	54.72	43	39	18	0.20	2018/07/17	2018/07/20
AGRI 07_18-0119-4	Sample	4	5.27	1	67	18	699	220	0.00	63.0	32.4	3.1	1.4	0.0	1.9	30.7	10.4	5.5	0.5	5.5	1.296	15.06	9	76	15	0.20	2018/07/17	2018/07/20
AGRI 07_18-0119-5	Sample	5	5.89	4	223	49	3357	1255	0.00	60.3	36.9	2.0	0.8	0.0	1.6	47.5	18.1	27.9	0.4	27.9	1.151	33.17	25	56	19	0.35	2018/07/17	2018/07/20
AGRI 07_18-0119-6	Sample	6	6.12	2	172	19	3338	1175	0.00	62.2	35.9	1.6	0.3	0.0	1.7	59.9	21.9	26.8	0.2	26.8	1.097	37.33	21	59	20	0.15	2018/07/17	2018/07/20

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.

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