Appendix H

SPECIALIST STUDIES

Appendix H.1

SOILS/AGRICULTURE ASSESSMENT

DAMANUTHA WIND (PTY) LTD

DALMANUTHA WIND ENERGY FACILITY (ALTERNATIVES 1 AND 2)

SOIL AND AGRICULTURAL POTENTIAL STUDY EIA REPORT

MAY 2023

CONFIDENTIAL

DAMANUTHA WIND (PTY) LTD

DALMANUTHA WIND ENERGY FACILITY (ALTERNATIVES 1 AND 2)

SOIL AND AGRICULTURAL POTENTIAL STUDY EIA REPORT

FINAL CONFIDENTIAL

PROJECT NO. 41103722

DATE: MAY 2023

DAMANUTHA WIND (PTY) LTD

DALMANUTHA WIND ENERGY FACILITY (ALTERNATIVES 1 AND 2)

SOIL AND AGRICULTURAL POTENTIAL STUDY EIA REPORT

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QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Final			
Date	May 2023			
Prepared by	Karen King			
Signature				
Checked by	Mark Aken			
Signature				
Authorised by	Nirvishee Juggath			
Signature				
Project number	41103722			
Report number	R01			
File reference	41103722-Dalmanutha_WEF_Soils Assessment_EIA_Report_2023_05.docx			

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APPENDICES

Appendix A CV
Appendix B Field Notes

1. INTRODUCTION

WSP in Africa (WSP), a wholly owned affiliate of WSP Global Inc., has been appointed by Dalmanutha Wind (Pty) Ltd to undertake a Soil and Agricultural Potential Assessment as input into a series of environmental authorisations for the proposed development of the Dalmanutha Wind Energy Facility (WEF) and Dalmanutha West WEF. These include a Basic Assessment (BA) for the Dalmautha West WEF Project, an Environmental Impact Assessment (EIA) for the Dalmanutha Wind Project and a second BA for the Common Collector Switching Station and Overhead Line Project (See Figure 1-1). As these facilities will be assessed through the abovementioned separate environmental application processes, this soils assessment report forms a part of the Environmental Impact Assessment (EIA) for the Dalmanutha Wind Project only, known hereafter as the Project. Two alternatives are provided for assessment for the Project: Alternative 1 - a fully wind energy facility with a capacity of up to 300MW comprising up to 70 wind turbines, and Alternative 2 - a hybrid facility with a capacity of up to 300MW comprising up to 44 wind turbines and two solar fields. The aim of this assessment was to provide descriptions of the soils identified and their distribution within the Project area, and to establish the soil properties, current land use and site soil-related sensitivities. The study also assessed the potential impacts of both Project alternatives on soils and provides recommended mitigation measures.

1.1. PROJECT DESCRIPTION

The Project study site lies approximately 7km southeast of Belfast in the Mpumalanga Province and falls within the Emakhazeni Local Municipality (see Figure 1-1). The Dalmanutha Wind Project will investigate two alternatives. Alternative 1 will comprise 70 wind turbines, each of which will require a foundation 25m in diameter and 3m deep. Roughly 60km of internal roads of width between 8m and 10m, which can be increased to approximately 12m on bends. The roads will be positioned within a 20m wide corridor to accommodate cable trenches, stormwater channels and bypass /circles of up to 20m during construction. Other aspects of the project that will potentially affect the site soils include a substation and battery energy storage system, operations and maintenance buildings, a construction camp and a temporary laydown area, cement batching plant, wind tower factory and yard (see Figure 1-2). Alternative 2 will be a hybrid project comprising 44 wind turbines of the same specifications as those mentioned above, as well as two solar fields. These will comprise solar panels to a height of 6m when the panel is horizontal. The entire footprint will comprise 160ha and will include associated infrastructure such as inverters and transformers (see Figure 1-3). The total proposed footprint of the Dalmanutha Project (Alternatives 1 and 2) is 400ha and the entire project area is 9179ha.

1.2. LEGISLATIVE CONTEXT

In the context of this study the legislation that is relevant includes:

- Government Gazette 43110 published in Government Notice No. 320 on the 20th of March 2020, which specifies the protocol for the agriculture specialist assessment and minimum report requirements for environmental impacts on agricultural resources.
- The Subdivision of Agricultural Land Act (Act 70 of 1970), which governs the preservation of viable farm portions. Land use changes need to be approved in terms of this act.
- The Department of Agriculture, Forestry and Fisheries (DAFF) guidelines for the evaluation and review of applications pertaining to renewable energy on agricultural land (September 2011).

These guidelines aim to preserve arable land by prohibiting the development of renewable energy facilities on cultivated and high potential agricultural land.

- The Conservation of Agricultural Resources (Act 43 of 1983) (CARA), which has direct implications for how soils are managed. The purpose of the CARA is to provide for the control over the utilization of the natural agricultural resources of the Republic so as to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants. The Act states that control measures may be applied to (amongst others):

  - The utilization and protection of land which is cultivated;
  - The prevention or control of waterlogging or salination of land;
  - The restoration or reclamation of eroded land or land which is otherwise disturbed or denuded.

  The Act further states that different control measures may be prescribed in respect of different classes of land users or different areas or in such other respects as the Minister may determine, stipulating that:

  - Any land user who refuses or fails to comply with any control measure which is binding on him, shall be guilty of an offence.

  The implication of this for the project is that control measures will be required to manage and where possible mitigate the impacts of the project on soil and land capability.

- Other environmental legislation such as the National Environmental Management Act (Act 107 of 1998) and the National Water Act (Act 36 of 1998) provide guidance on environmental activities and sets out the principles of Duty of Care, Pollution Control and Waste Management. The relevant sections of the CARA are discussed below.

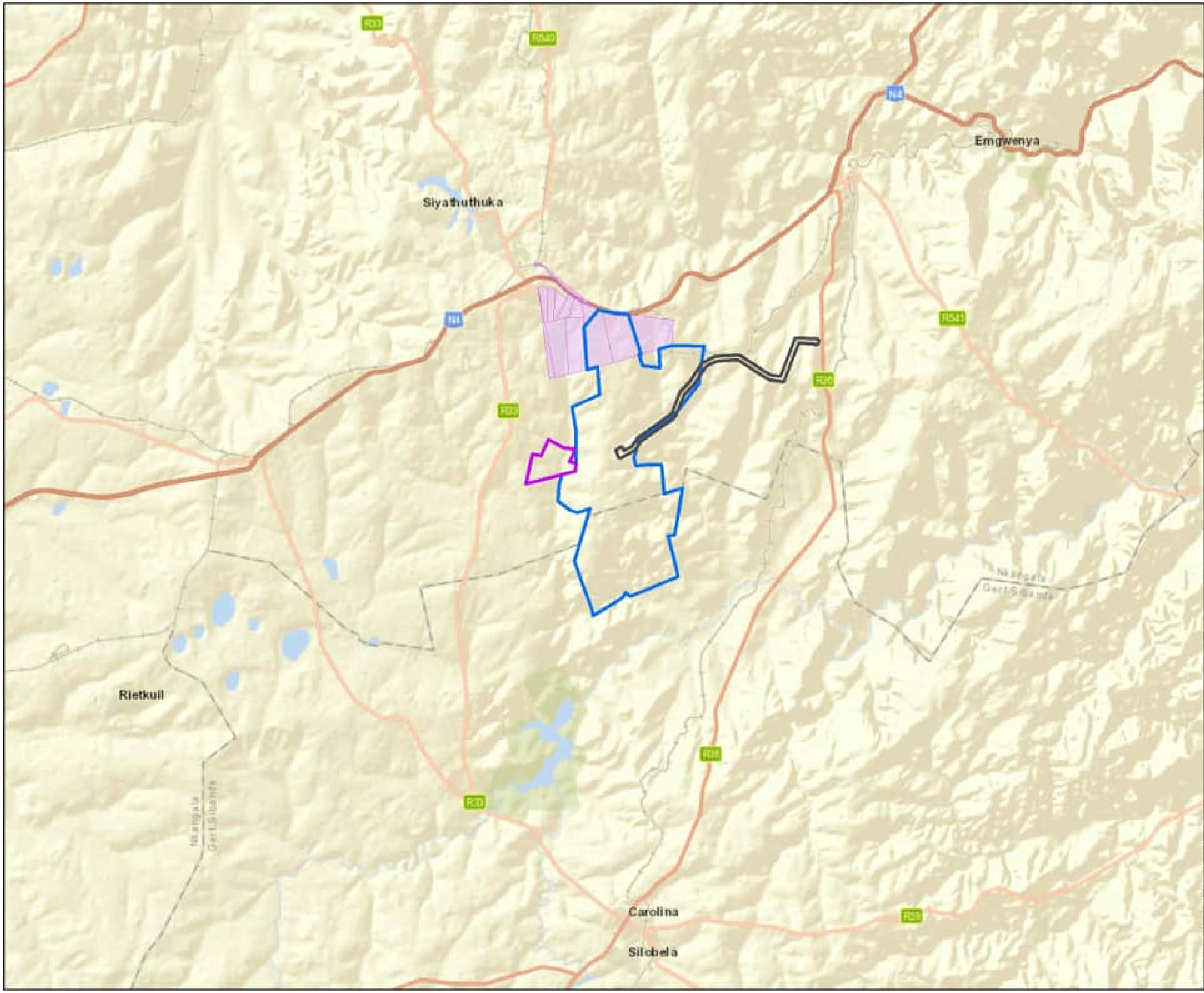
1.3. STUDY SPECIALIST

This report was prepared by Ms Karen King, a professional soil scientist (Pr.Sci.Nat, M.Sc.). Ms King has 17 years' work experience and specialises in agricultural studies, soil science and related risk assessments and management plans. Ms. King's Curriculum Vitae is included in Appendix A.

1.4. STUDY LIMITATIONS

- Cultivated lands have already had an impact on soils.
- The area demarcated as an Exclusion Area in the underlying images was not included in the study at the landowner's request.
- Site access was difficult owing to the terrain, a lack of access roads and inclement weather.
- The scope of the study dictated that sampling points for soil classification needed to target the initial proposed turbine positions only. The soil survey did not follow a grid survey pattern over the whole study area, which is a much costlier exercise. Grid surveys allow for improved interpolations between points. The trade-off with free format surveys is that if the positions of any turbines are shifted, additional micro-siting soil surveys will have to be undertaken on the new footprint areas.
- The final wind turbine layout plan was not yet available at the time of writing this report. As described above, if any turbines are repositioned additional micro-siting soil surveys of the footprint areas will need to be undertaken.
- The outcomes of this study cannot be used broadly to inform any additional studies.
- No geotechnical soils investigation was undertaken as a part of this agricultural soils study.

- Once the final turbine locations have been established, micro-siting will be necessary in order to establish with certainty the soil forms and characteristics that underlie these locations.
- Cumulative impact significance ratings are difficult to calculate as the extent to which impact mitigation measures are adhered to within nearby projects is unknown.



DALMANUTHA WIND (PTY) LTD

LOCALITY

Legend

- Dalmanutha 132kV Grid Connection
- Dalmanutha West
- Dalmanutha Wind Energy Facility
- Berg En Dal farm portions

N

0 2,600 5,200 7,800 10,400

Metres

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SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

COORDINATE SYSTEM: HARTEBEESTHOEK94 LO31

PROJECT TITLE
DALMANUTHA WEF

SCALE: 1:300,000	DRAWN BY: TS
DATE: 2023-06-17	REVIEWED BY: KK

FIGURE NO: 1-1	PROJECT NO: 41103723	REV

DALMANUTHA WIND (PTY) LTD

SITE LAYOUT
ALTERNATIVE 1

Legend

- Proposed infrastructure
- Proposed gridline 132kV powerline
- Proposed access roads
- Rivers - Perennial
- Proposed substations
- Site Boundaries
- Farm Portions
- Exclusion area
- National road
- Main road
- Secondary road
- Access road

N

0 890 1,780 2,670 3,560
Metres

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SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

COORDINATE SYSTEM: HARTEBEESTHOEK94 LO31

PROJECT TITLE
DALMANUTHA WEF

SCALE: 1:100,000	DRAWN BY: TS
DATE: 2023-06-17	REVIEWED BY: KK

FIGURE NO: 1-2	PROJECT NO: 41103723	REV

DALMANUTHA WIND (PTY) LTD

SITE LAYOUT
ALTERNATIVE 2

Legend

- Proposed infrastructure
- Proposed gridline 132kV powerline
- Proposed access roads
- Rivers - Perennial
- Proposed substations
- Solar footprint
- Site Boundaries
- Farm Portions
- Exclusion area
- National road
- Main road
- Secondary road
- Access road

N

0 890 1,780 2,670 3,560
Metres

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COORDINATE SYSTEM: HARTEBEESTHOEK94 LO31

PROJECT TITLE:
DALMANUTHA WEF

SCALE: 1:100,000	DRAWN BY: TS
DATE: 2023-05-17	REVIEWED BY: KK
FIGURE NO: 1-3	PROJECT NO: 41103723	REV

2. METHODOLOGY

2.1. DESKTOP ASSESSMENT

The baseline environment was established from reviewed literature of the Dalmanutha area, past environmental reports, site characteristics using GIS and aerial imagery and various DFFE databases.

2.2. SITE ASSESSMENT

Site visits were conducted during summer from 22-24 March, autumn from 17-20 May and spring from 19-22 September 2022. The season does not affect the soil classification outcomes. A free format soils classification survey of the study area was undertaken on foot at 73 points, using a spade and hand-held bucket and Dutch augers to identify soil forms present on site. Current activities at the site and areas of land use were noted and the soil forms encountered were mapped.

2.3. CLAY COMPOSITION

The clay composition percentage range into which the relevant top- and subsoils fall were established using the in-field ribbon method. This involves rolling a damp sample of soil into 'cigar shape' in the palm of your hand and pressing it into a flat ribbon. The length of ribbon that can be formed from the soil sample gives a good indication of its clay percentage, as shown in Table 2-1.

Table 2-1 – Ribbon Method Guidelines

Ribbon Length and Feel	Texture	Clay Percentage Range
No ribbon can be formed	Sandy	0-10%
Ribbon less than 2.5cm and gritty	Sandy Loam	15-20%
Ribbon less than 2.5cm and smooth	Silty Loam	0-25%
Ribbon less than 2.5cm and neither gritty nor smooth	Loam	7.5-27.5%
Ribbon 2.5-5cm and gritty	Sandy Clay Loam	20-35%
Ribbon 2.5-5cm and smooth	Silty Clay Loam	27.5-40%
Ribbon 2.5-5cm and neither gritty nor smooth	Clay Loam	27.5-40%
Ribbon more than 5cm and gritty	Sandy Clay	35-55%
Ribbon more than 5cm and smooth	Silty Clay	40-60%
Ribbon more than 5cm and neither gritty nor smooth	Clay	55-100%

2.4. SOIL CLASSIFICATION

The classification of the soil forms identified on site was undertaken using the South African soil taxonomic system (Soil Classification Working Group, 1991). All South African soil forms fall within 12 soil types; Duplex (marked accumulation of clay in the B horizon), Humic (intensely weathered, low base status, exceptional humus accumulation), Vertic (swelling, cracking, high activity clay), Melanic (dark, structured, high base status), Silicic (Silica precipitates as a dorbank horizon), Calcic (accumulation of limestone as a horizon), Organic (peaty soils where water inhibits organic breakdown), Podzolic (humic layer forms beneath an Ae or E), Plinthic (fluctuating water table causes iron re-precipitation as ferricrete), Oxidic (iron oxides weather and colour soils), Hydromorphic (reduced lower horizons) and Inceptic (young soils - accumulation of unconsolidated material, rocky B or disturbed) soils.

2.5. SOIL CAPABILITY ASSESSMENT

The soils identified were classified by form in accordance with the South African soil taxonomic system (Soil Classification Working Group, 1991) and the area's land capability was assessed and mapped based on the results of the classification study. The South African land capability classification system by Scotney *et al.* (1987) was used to classify and map land capability (see Table 2-1). This system is useful in that it is able to quickly provide an overview of the agricultural capability and limitations of the soils in question and is useful for land capability comparisons.

Table 2-2 - Land Capability Classification System (Scotney *et al.*, 1987)

Land Capability Group	Land Capability Class	Increased Intensity of use									Limitations
Arable	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very High arable potential. Very low erosion hazard.
	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards.
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
Grazing	V	W	-	LG	MG	-	-	-	-	-	Water course and land with wetness limitations
	VI	W	F	LG	MG	-	-	-	-	-	Limitations preclude cultivation. Suitable for perennial vegetation.
	VII	W	F	LG	-	-	-	-	-	-	Very severe limitations. Suitable only for natural vegetation.
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.
W: Wildlife F: Forestry LG: Light Grazing MG: Moderate Grazing IG: Intensive grazing LC: Light Cultivation MG: Moderate Cultivation IC: Intensive Cultivation VIC: Very Intensive Cultivation											

2.6. SOIL IMPACT ASSESSMENT

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology were to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects were reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considered direct , indirect , secondary as well as cumulative impacts.

A standard risk assessment methodology was used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects was determined and ranked by considering the criteria presented in Table 2-2.

Table 2-3 - Impact Assessment Criteria and Scoring System

Criteria	Score 1	Score 2	Score 3	Score 4	Score 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite

Criteria	Score 1	Score 2	Score 3	Score 4	Score 5
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probable	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

2.6.1. IMPACT MITIGATION

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan. The mitigation sequence/hierarchy is shown in Figure 2-1.

Avoidance / Prevention	Refers to considering options in project location, nature, scale, layout, technology and phasing to **avoid** environmental and social impacts. Although this is the best option, it will not always be feasible, and then the next steps become critical.
Mitigation / Reduction	Refers to considering alternatives in the project location, scale, layout, technology and phasing that would **minimise** environmental and social impacts. Every effort should be made to minimise impacts where there are environmental and social constraints.
Rehabilitation / Restoration	Refers to the **restoration or rehabilitation** of areas where impacts were unavoidable and measure are taken to return impacted areas to an agreed land use after the activity / project. Restoration, or even rehabilitation, might not be achievable, or the risk of achieving it might be very high. Additionally it might fall short of replicating the diversity and complexity of the natural system. Residual negative impacts will invariably still need to be compensated or offset.
Compensation / Offset	Refers to measures over and above restoration to remedy the residual (remaining and unavoidable) negative environmental and social impacts. When every effort has been made to avoid, minimise, and rehabilitate remaining impacts to a degree of no net loss, **compensation / offsets** provide a mechanism to remedy significant negative impacts.
No-Go	Refers to 'fatal flaw' in the proposed project, or specifically a proposed project in and area that cannot be offset, because the development will impact on strategically important ecosystem services, or jeopardise the ability to meet biodiversity targets. This is a **fatal flaw** and should result in the project being rejected.

Figure 2-1 - Mitigation Sequence/Hierarchy

3. BASELINE ENVIRONMENT

The Dalmanutha region is largely situated at an altitude of above 2000m above sea level, making this one of the highest and coldest parts of the country. Sheep and dairy farming take place in the area and maize, potatoes and timber are produced here. The project site vegetation includes maize, pastures, natural grasses and trees in the main. Coal and back granite are mined in the area (see Figure 4-10) and mining is the area's main economic sector. In late 2022 a coal prospecting right application was lodged on all portions of the Farm Berg en dal (see Figure 1-1).

The Klein Komati River runs from north to south directly to the west of the project site, crossing the site for about 2km. The river then runs from west to east along the southern boundary of the site, again crossing the site briefly, before it joins the Komati River and continues in an easterly direction. The Waaikraalloop River runs from north to south on the eastern side of the site, crossing the site for about 4km in the north, then also travels east to join the Komati River (see Figure 1-2). Many of the wetlands on the site make up a part of these river systems.

3.1. CLIMATE

The climate of the Dalmanutha region can be described as a subtropical highland climate and falls into Köppen climate type: Cwb. The average temperature for the year in nearby Belfast is 14.4°C and the warmest month is January with an average temperature of 18.2°C. The coolest month is June with an average temperature of 8.8°C. The mean annual precipitation for Belfast is 838.2mm. The month with the most rainfall is January with 162.6mm and the month with the least precipitation is July with an average of 5.1mm. These conditions give rise to chemically weathered red and yellow soils that are typical of subtropical upland areas, as was widely seen on site (see Figure 3-1 and Appendix B).

Figure 3-1 - Typical Subtropical Weathered Soil of the Shortlands Form

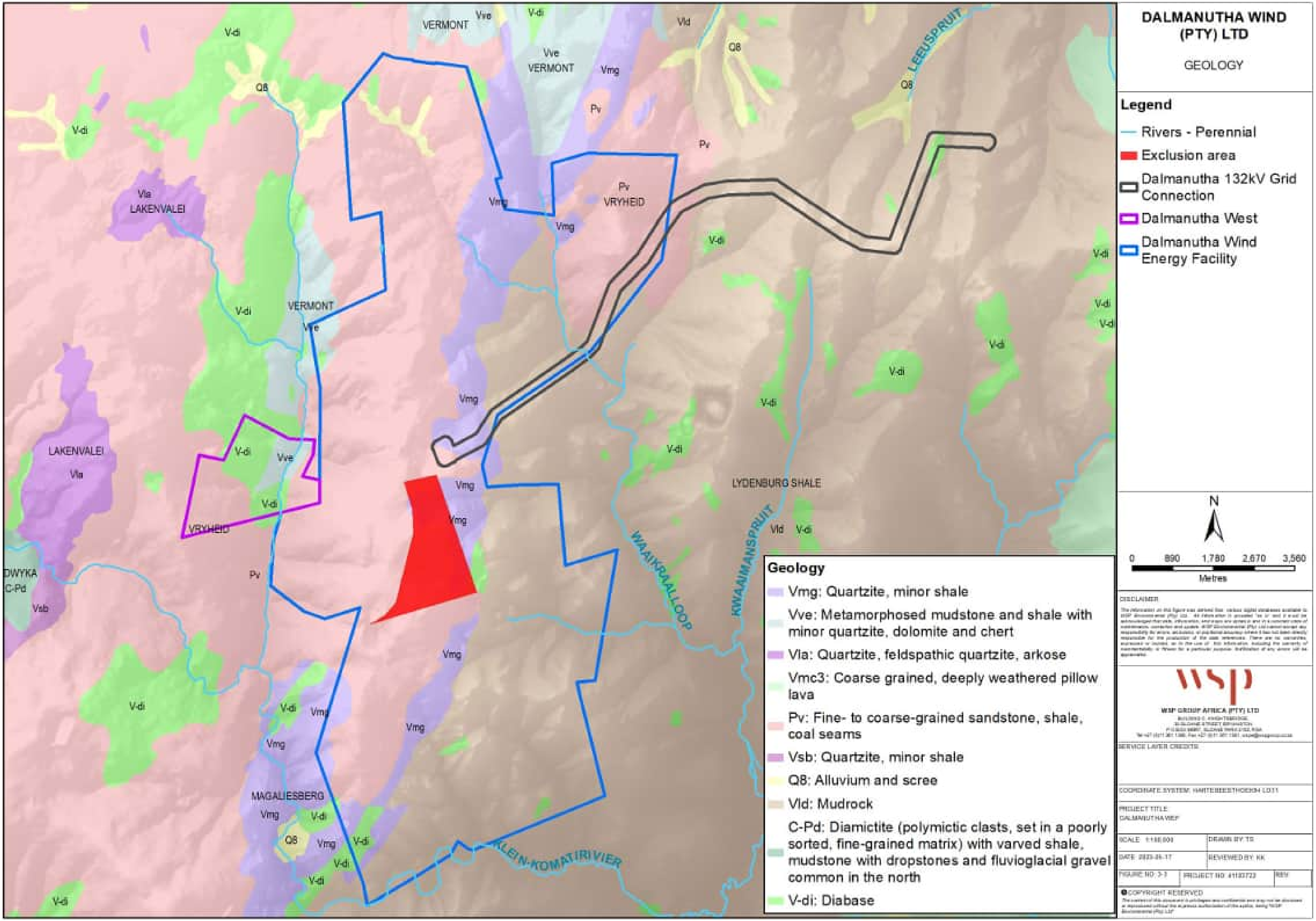
3.2. GEOLOGY

The site geology is dominated by fine- to course-grained sandstone and shale across the west, mudrock across the east and quartzite and shale along the middle section. The sandstone has given rise to some soils that contain kaolinitic clays; where the site is underlain by quartzite, rocky areas with very thin soils and minimal vegetation were encountered, and the areas underlain by mudrock have given rise to clay-rich, silty soils, all as expected (see Figure 3-3 and Appendix B).

3.3. TOPOGRAPHY

The topography of the area is varied and comprises largely rocky hillslopes interspersed by gullies. The site slopes upward from south to north, flattening in the middle section. As expected, thin, rocky soils exist on the hilltops, while deep, red and yellow-brown soils occur in the uplands and wet, gleyed soils can be found in the drainage lines. There was very little evidence of 'intermediate', poorly drained soils showing mottles or other signs of wetness, however. Figure 3-2 shows red soils (Shortlands form) next to the riverbed in which gleyed soils (Katspruit form) were identified.

Figure 3-2 - Terrestrial Soils Next to the Riverbed


DALMANUTHA WIND (PTY) LTD
GEOLOGY
Legend
Rivers - Perennial
Exclusion area
Dalmanutha 132kV Grid Connection
Dalmanutha West
Dalmanutha Wind Energy Facility
Geology
Vmg: Quartzite, minor shale
Vve: Metamorphosed mudstone and shale with minor quartzite, dolomite and chert
Vla: Quartzite, feldspathic quartzite, arkose
Vmc3: Coarse grained, deeply weathered pillow lava
Pv: Fine- to coarse-grained sandstone, shale, coal seams
Vsb: Quartzite, minor shale
Q8: Alluvium and scree
Vld: Mudrock
C-Pd: Diamictite (polymictic clasts, set in a poorly sorted, fine-grained matrix) with varved shale, mudstone with dropstones and fluvioglacial gravel common in the north
V-di: Diabase
N
0 890 1,780 2,670 3,560
Metres
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COORDINATE SYSTEM: HARTEBEESTHOEK94 LO31
PROJECT TITLE
DALMANUTHA WEF
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REVIEWED BY: KK
FIGURE NO: 3-1
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DWYKA
LYDENBURG SHALE
LEEUSPRUIT
WAIKRAALLOOP
KWAAIMANSPRUIT
KLEIN-KOMATIRIVIER

4. RESULTS AND DISCUSSION

4.1. SOIL FORM IDENTIFICATION AND CLASSIFICATION

The study area land types (DFFE, 2018) are shown in Figure 4-7. This dataset describes the project site as dominated by two soil types: red/yellow apedal (devoid of macrostructure) soils across the eastern length and very northern portion of the site, and plinthic soils across the western length of the site. Plinthic soils are iron-rich and exhibit signs of wetness as a result of a fluctuating water table. Locations of the soil forms identified on site are shown in Figure 4-8 and described below. The likely soil form areas are shown in Figure 4-9. These soil forms agree with the DFFE database in that they are largely red, iron-rich, arable soils. The soil forms identified, however, were mostly clay-rich and well structured, as opposed to apedal, and did not exhibit signs of wetness except for those in the riverbeds. More detailed classification point information is provided in Appendix B.

4.1.1. SHORTLANDS

The dominant soil form identified at the site is what is called a Shortlands in the South Africa taxonomic system (see Figure 4-1). These soils comprise an orthic topsoil and a red, structured B horizon with clayskins. The red colour is the result of the accumulation of iron oxides following mineral weathering.

Figure 4-1 - Shortlands Soils

The Shortlands soil form is a potentially fertile, manageable soil. It has good moisture intake and moisture holding characteristics. The Shortlands identified on site had effective rooting depths of around 80cm, relatively good drainage characteristics but were stony in places.

4.1.2. CLOVELLY

The Clovelly soil form was also identified on the site. This soil form is characterised by an orthic topsoil over a yellow brown apedal subsoil. It is a well-drained soil, so is suitable for agriculture when adequately fertilized (see Figure 4-2). The Clovelly soils identified on site had effective rooting depths in excess of 1m, very good drainage characteristics but were also stony in places.

Figure 4-2 - Clovelly Soils

4.1.3. MISPAH AND GLENROSA

The Mispah and Glenrosa soil forms were also identified across the site, especially at the higher points. These are shallow, stony soils that are not suitable for agriculture. The Mispah soil form (see Figure 4-3) is characterised by an orthic A horizon over hard rock, and the Glenrosa soil form (see Figure 4-4) is characterised by an orthic A horizon over a lithocutanic B horizon. This is a shallow, stony horizon.

Figure 4-3 - Mispah Soils

Figure 4-4 - Glenrosa Soils

4.1.4. KATSPRUIT

The Katspruit soil form was found in the riverbeds and is characterised by an orthic A over a G horizon. This is a horizon that is saturated for long periods so is dominated by grey, low chroma soil matrix colours.

Figure 4-5 - Katspruit Soils

4.1.5. VALSRIVIER

The Valsrivier soil form was found on some of the mid-slopes and is characterised by an orthic A over a pedocutanic B horizon over unconsolidated material without signs of wetness (see Figure 4-6). This is a duplex soil which means that there is a clear transition from the A to the B horizon as a result of clay illuviation. The B horizon is generally an impediment to root growth and water movement.

Figure 4-6 - Valsrivier Soils

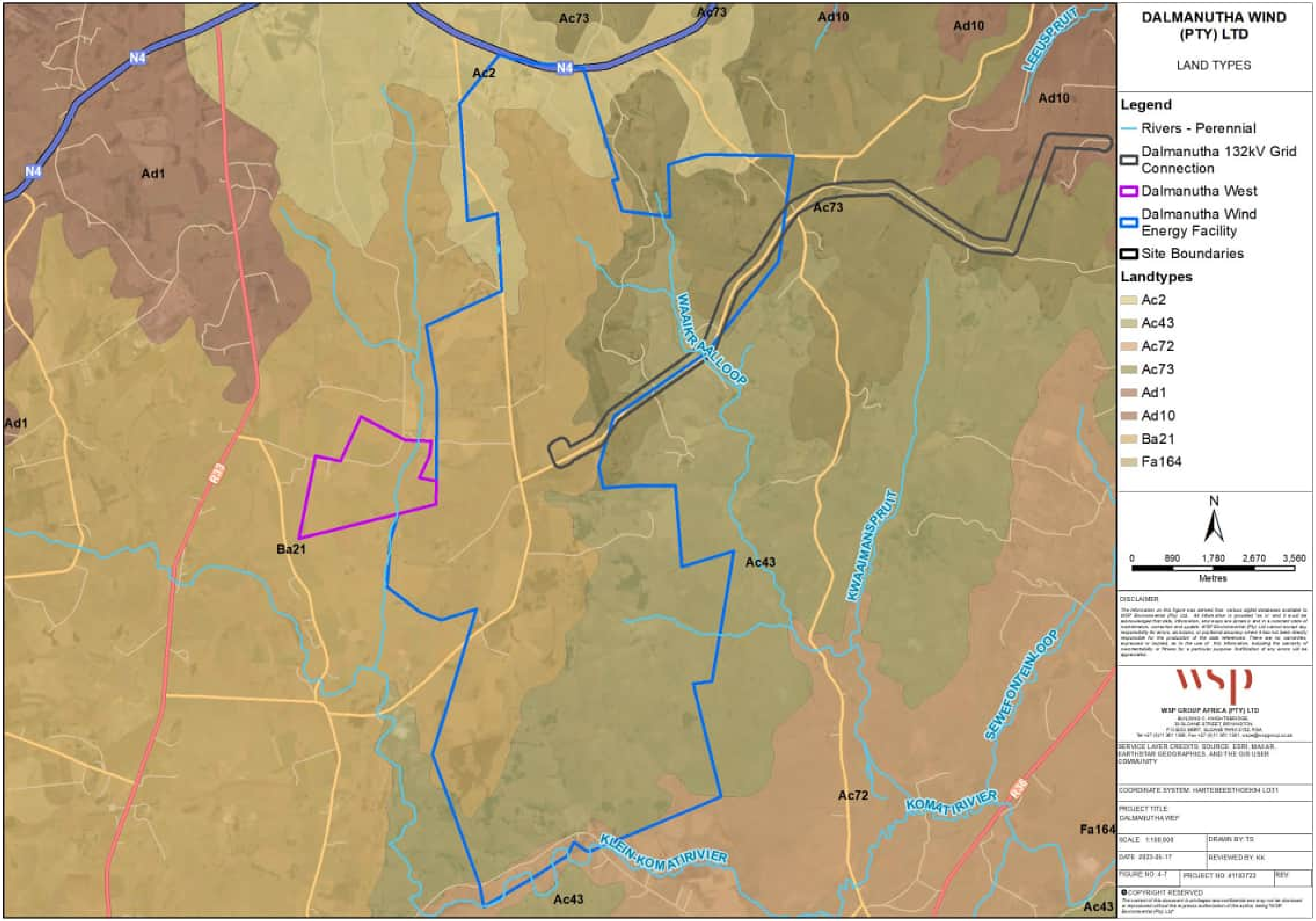
DALMANUTHA WIND (PTY) LTD
LAND TYPES
Legend
Rivers - Perennial
Dalmanutha 132kV Grid Connection
Dalmanutha West
Dalmanutha Wind Energy Facility
Site Boundaries
Landtypes
Ac2
Ac43
Ac72
Ac73
Ad1
Ad10
Ba21
Fa164
N
0
890
1,780
2,670
3,560
Metres
DISCLAIMER
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FIGURE NO: 4-7
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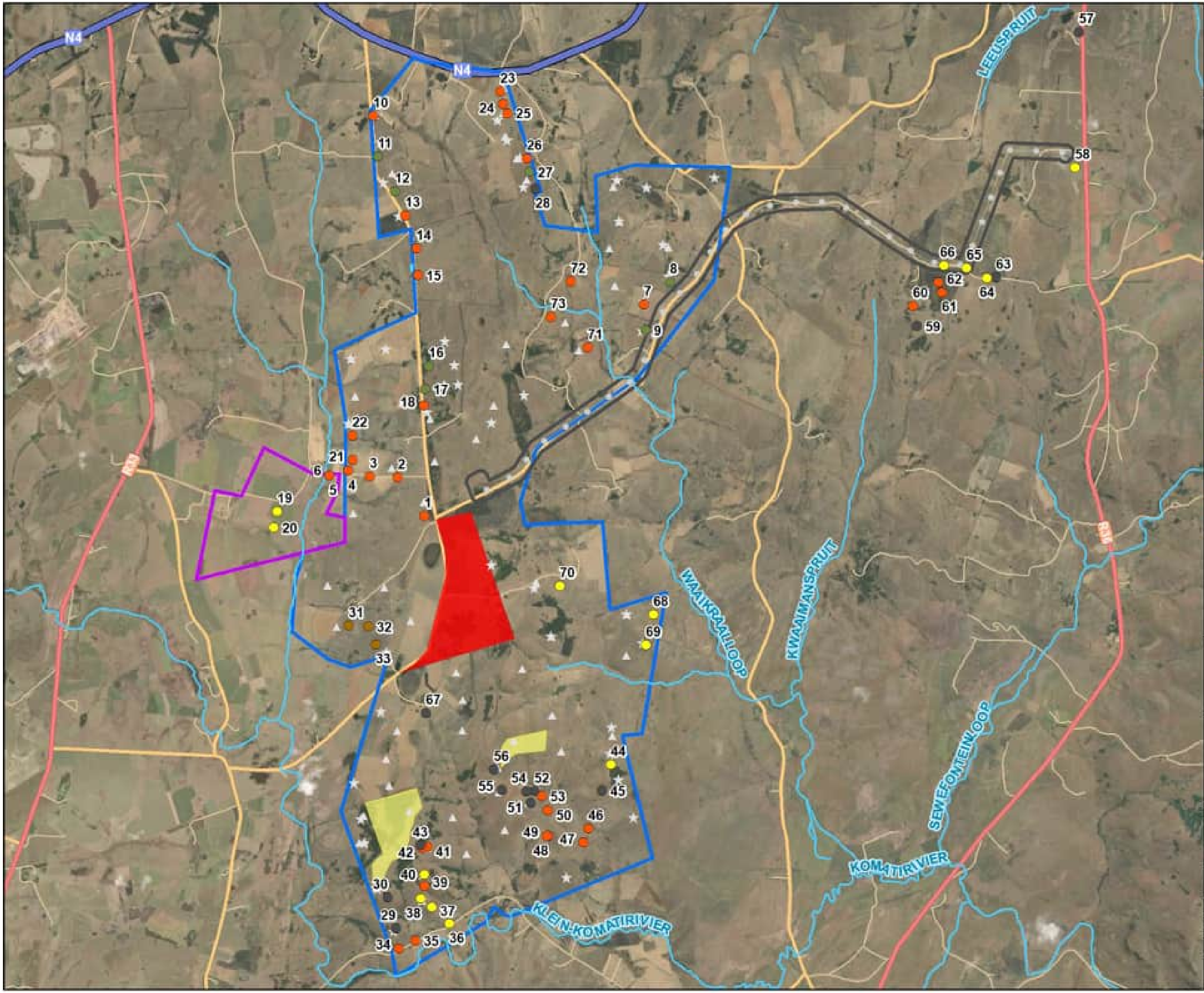
N4
R33
R36
Ad1
Ac73
Ac2
Ad10
Ac43
Ac72
Ba21
Fa164
LEEUSPRUIT
WAAIKRAALLOOP
KWAAIMANSPRUIT
SEWEFONTEINLOOP
KOMATIRIVIER
KLEIN-KOMATIRIVIER



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SOIL CLASSIFICATION

Legend

- Common gridlines
- Alternative 1, Turbines Locations
- Alternative 2, Turbine Locations
- Rivers - Perennial
- Exclusion area
- Solar footprint
- Dalmanutha 132kV Grid Connection
- Dalmanutha West
- Dalmanutha Wind Energy Facility

Soil Classification

- Clovelly
- Glenrosa
- Mispah
- Shortlands
- Valsrivier

N

0 890 1,780 2,670 3,560

Metres

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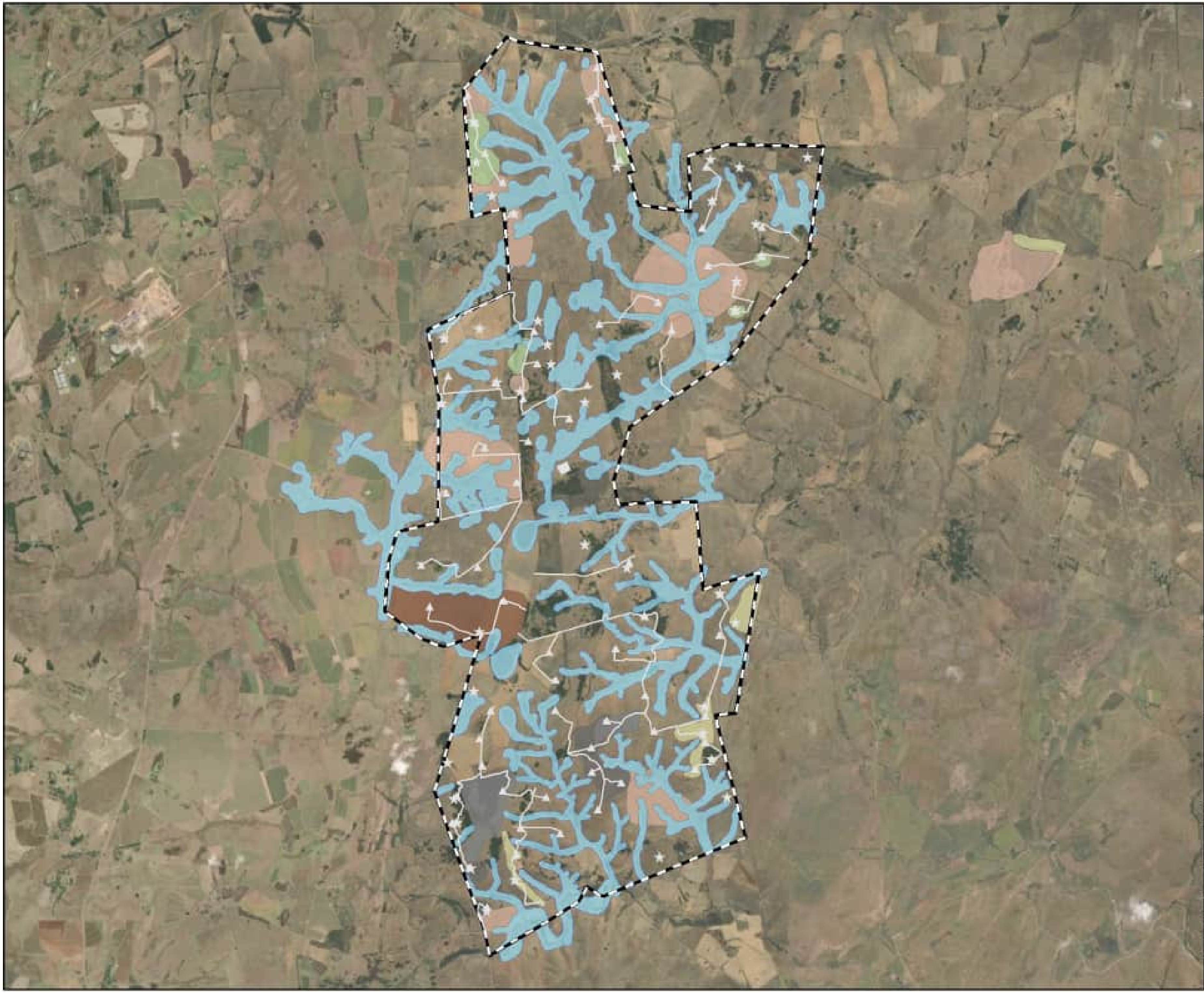
COORDINATE SYSTEM: HARTEBEESTHOEK94 LO31

PROJECT TITLE:
DALMANUTHA WEF

SCALE: 1:100,000	DRAWN BY: TS
DATE: 2023-05-17	REVIEWED BY: KK

FIGURE NO: 4-8	PROJECT NO: 41103723	REV



DALMANUTHA WIND (PTY) LTD

SOIL FORMS

Legend

- Alternative 1, Turbines Locations
- Alternative 2, Turbine Locations
- Proposed access roads
- Proposed substations
- Solar footprint
- Site Boundaries

Soil Form

- Clovelly
- Glenrosa
- Mispah
- Shortlands
- Valsrivier
- Wetlands

N

0 890 1,780 2,670 3,560

Metres

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COORDINATE SYSTEM: HARTEBEESTHOEK94 LO31

PROJECT TITLE
DALMANUTHAWEF

SCALE: 1:100,000	DRAWN BY: TS
DATE: 2023-06-17	REVIEWED BY: KK
FIGURE NO: 4-9	PROJECT NO: 41103723	REV

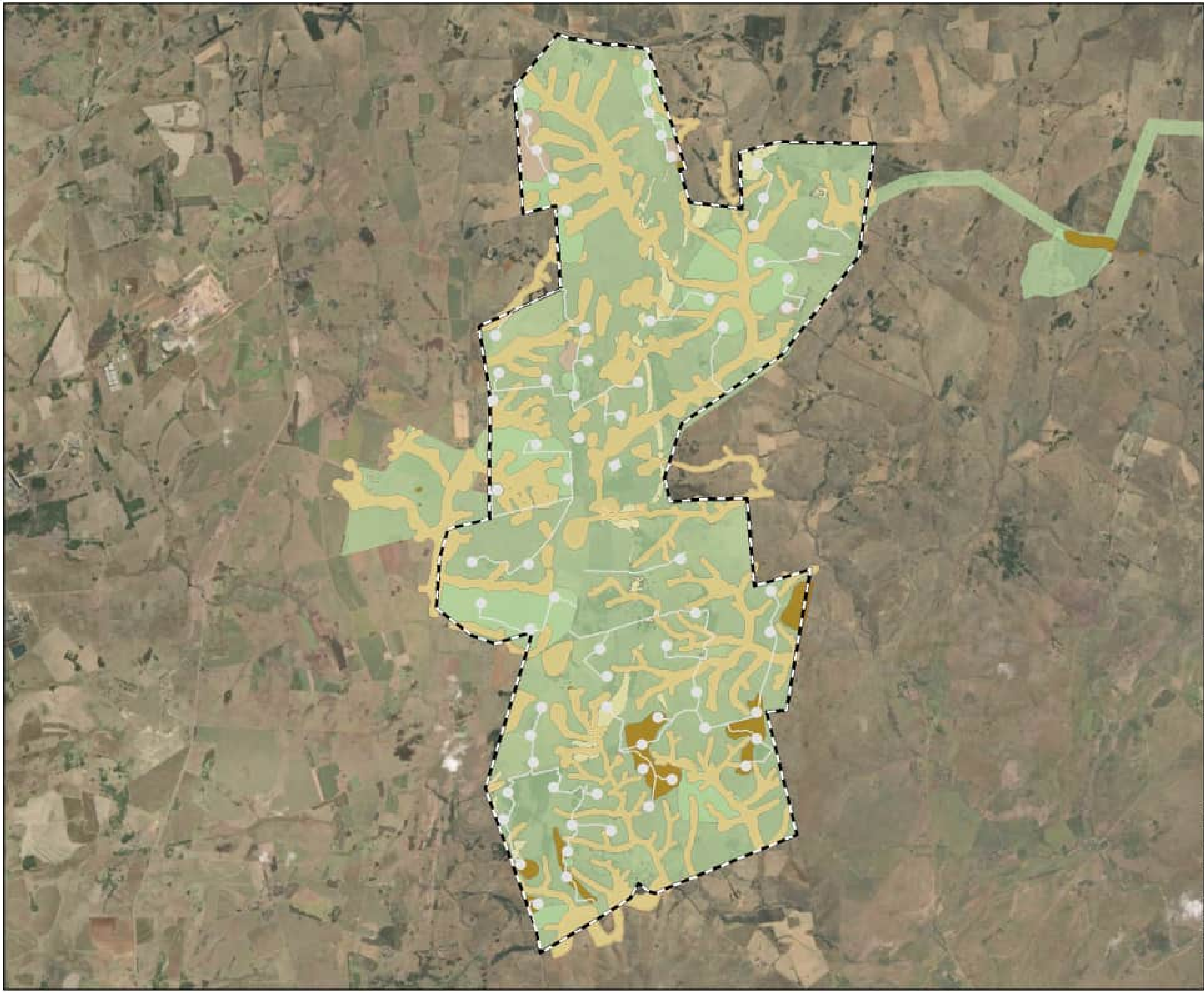
4.2. SOIL CAPABILITY ANALYSIS

Land capability is the inherent capacity of land to be productive under sustained use and specific management methods. The land capability of an area is the combination of the inherent soil properties and the climatic conditions as well as other landscape properties, such as slope and drainage patterns that may have resulted in the development of wetlands, as an example.

Using the Scotney *et al.* (1987) system and based on the soils identified on the Project site, a portion of the site's land capability class is Arable II (underlain by Shortlands and Clovelly soils), a portion thereof is Grazing VI (underlain by Valsrivier soils), a portion thereof is Wildlife VIII (underlain by Mispah and Glenrosa soils) and the watercourse and wetland areas (WSP, 2022a) are Grazing V. Because the site soil classification was undertaken in a freeform manner according to an early version of the turbine layout, and not based on a set grid across the whole site, vegetation community information (WSP, 2022b) has been used to augment the soil forms information in order to better inform the soil capability mapping (see Figures 4-10 and 4-11).

According to the DFFE 2021 database, the current land use of the site is a combination of cultivated land, forested land, wetland and grassland. A very small portion of the site is built up. Figure 4-12 shows the DFFE land uses of the project area. Further investigation (WSP, 2022b) shows that 16% of the Project area is or has been cultivated, 17% of the Project area comprises wetlands and an area immediately around the wetlands (buffer area), and 57% of the Project area is grasslands (see Figure 4-13). This does not, however, mean that 57% of the land's soil capability is only suited to grasslands or is non-arable (Grazing or below). This area has simply not been cultivated. Less than 3% of the grassland area is rocky grassland, which is the grassland area that is too shallow for cultivation, and its capability would be Grazing or below.

When combining the soils information, the wetland information (WSP, 2022a) and the vegetation information (WSP 2022b), the cultivated lands (old and new) and areas underlain by Shortlands and Clovelly soils have been ascribed Arable II, the Grasslands (both disturbed and not), alien trees and areas underlain by Valsrivier soils have been ascribed Grazing VI, the rocky grasslands and areas underlain by Mispah and Glenrosa soils have been ascribed Wildlife VIII and the watercourse and wetland areas have been ascribed Grazing V (see Figures 4-10 and 4-11).



DALMANUTHA WIND (PTY) LTD

SOIL CAPABILITY
ALTERNATIVE 1

Legend

Proposed infrastructure
Proposed access roads
Proposed substations
Site Boundaries

Soil Capability

Arable II
Grazing V
Grazing VI
Grazing VII
Wildlife VII

N

0 890 1,780 2,670 3,560
Metres

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PROJECT TITLE
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FIGURE NO: 4-18	PROJECT NO: 41103723
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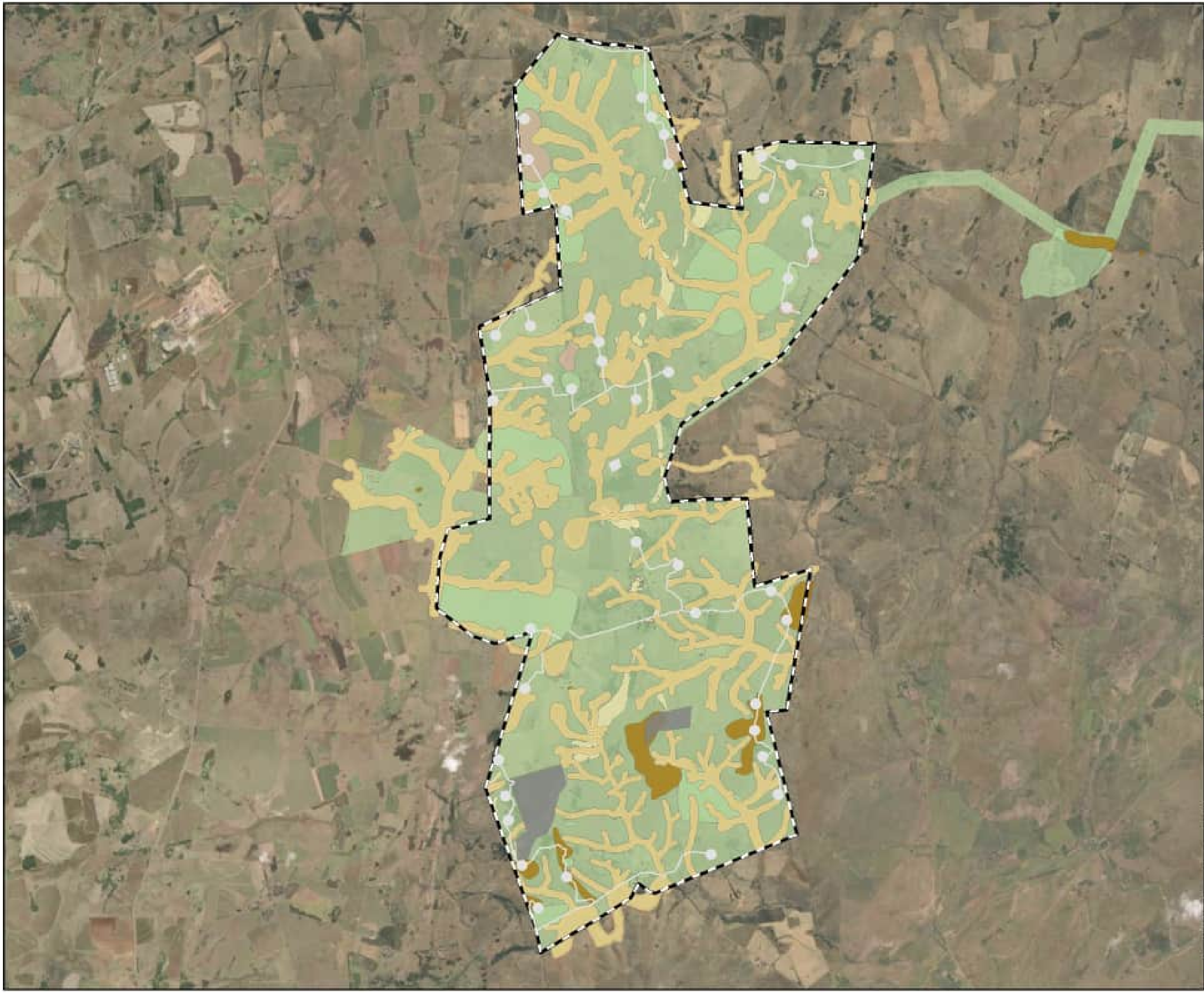

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SOIL CAPABILITY
ALTERNATIVE 2

Legend

- Proposed infrastructure
- Proposed access roads
- Proposed substations
- Solar footprint
- Site Boundaries

Soil Capability

- Arable II
- Grazing V
- Grazing VI
- Grazing VII
- Wildlife VII

N

0 890 1,780 2,670 3,560
Metres

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PROJECT TITLE
DALMANUTHA WEF

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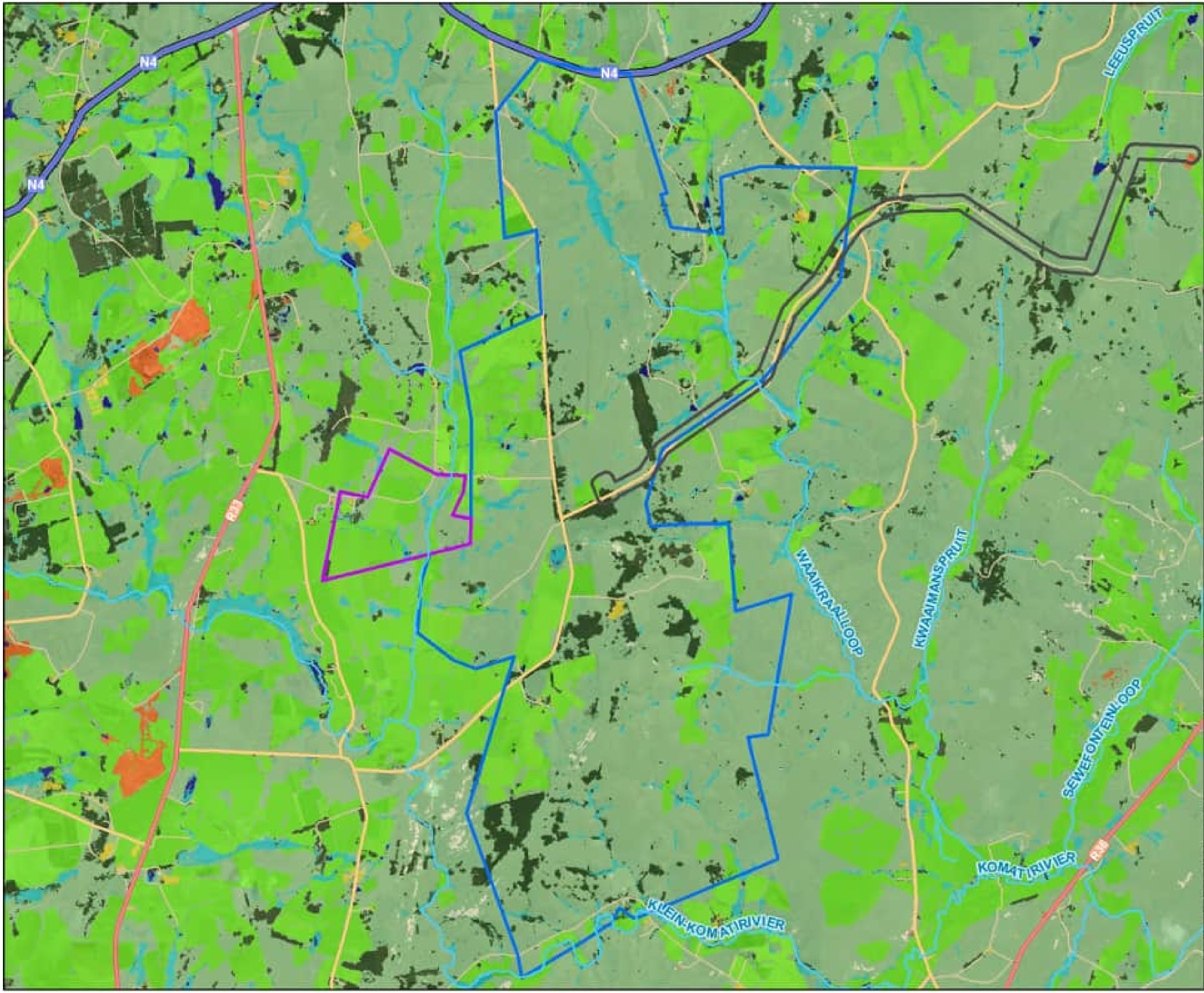
DATE: 2023-06-17	REVIEWED BY: KK
FIGURE NO: 4-11	PROJECT NO: 41103723
REV	



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LANDCOVER

Legend

- Rivers - Perennial
- Dalmanutha 132kV Grid Connection
- Dalmanutha West
- Dalmanutha Wind Energy Facility

Landcover (GTI, 2020)

- Barren Land
- Built-up
- Cultivated
- Forested Land
- Grassland
- Mines & Quarries
- Waterbodies
- Wetlands

N

0 890 1,780 2,670 3,560

Metres

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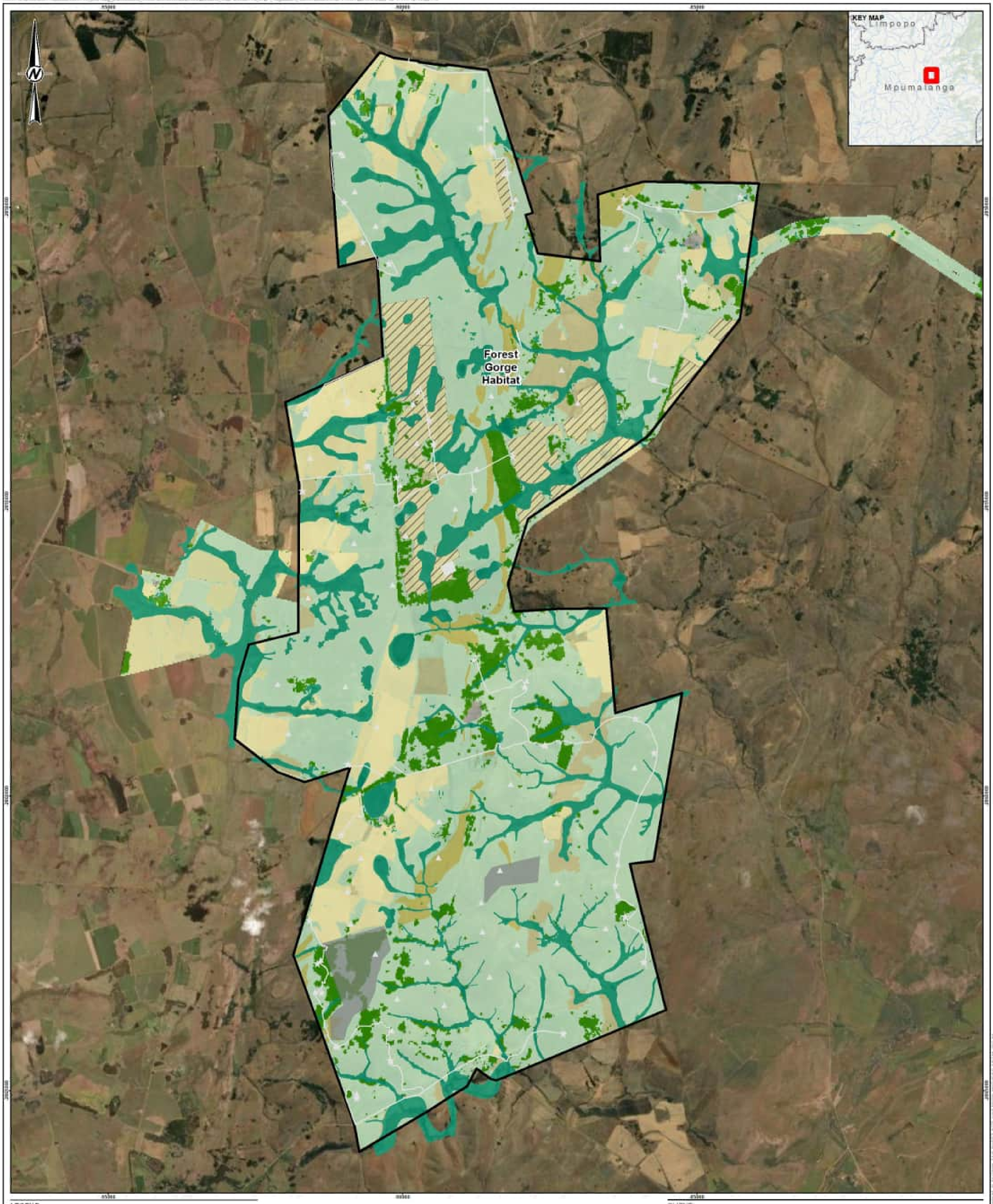
COORDINATE SYSTEM: HARTEBEESTHOEK94 LO31

PROJECT TITLE
DALMANUTHA WEF

SCALE: 1:100,000	DRAWN BY: TS
DATE: 2023-06-17	REVIEWED BY: KK

FIGURE NO: 4-12	PROJECT NO: 41103723	REV



LEGEND

- Alternative 1, Turbines Locations
- Alternative 2, Turbine Locations
- Proposed access roads
- Proposed substations
- Solar footprint
- Site Boundaries

Vegetation Communities

- Alien Tree Plantations
- Cultivated Fields
- Cultivated Fields (new)
- Disturbed Grassland
- Dry Mixed Grassland
- Forest Gorge Habitat
- Infrastructure
- Moist grassland and wetland
- Rocky Grassland
- Transformed Land

0 800 1,600

1:60,000 METRES

NOTE(S)

REFERENCE(S)
1. COORDINATE SYSTEM: HARTEBEESTHOEK94 LO31
2. SERVICE LAYER CREDITS: SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
ESRI, GARMIN, GEBCO, NOAA NGDC, AND OTHER CONTRIBUTORS

CLIENT
DALMANUTHA WIND (PTY) LTD

PROJECT
DALMANUTHA WIND ENERGY FACILITY

TITLE
VEGETATION COMMUNITIES

CONSULTANT

YYYY-MM-DD	2023-05-17
DESIGNED	
PREPARED	TS
REVIEWED	AD
APPROVED	AS

PROJECT NO.	CONTROL	REV.	FIGURE
21500715			4-13

5. IMPACT ASSESSMENT

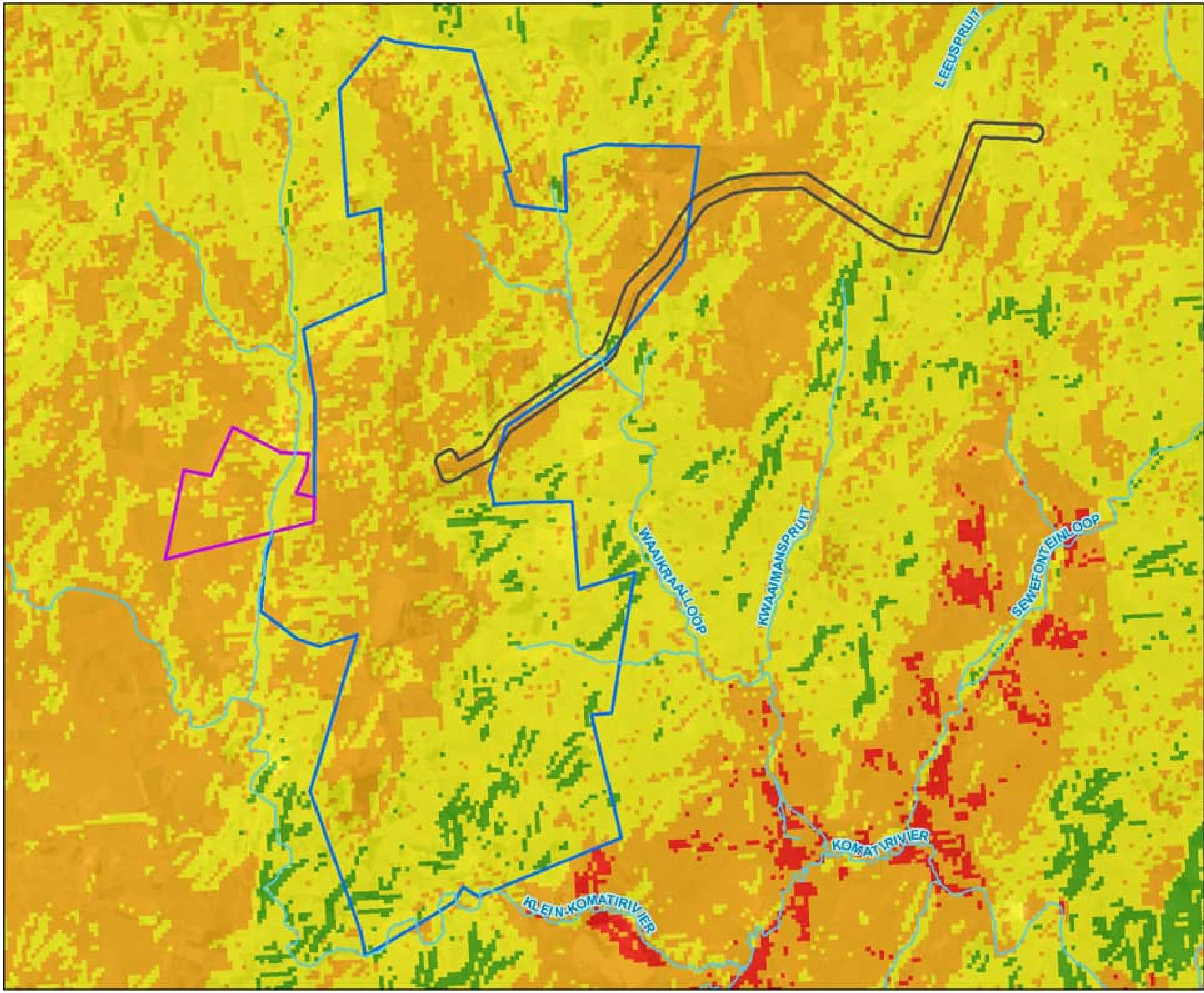
5.1. AGRICULTURAL SENSITIVITY

The Project site areas were allocated agricultural sensitivities in accordance with Table 5-1. The identified 'No-Go' areas include the rivers running through the site (typically underlain by Katspruit soils), wetlands (WSP, 2022a) and associated 50m buffers. The areas around the watercourses were assigned a 50m buffer – as opposed to a more typical 100m buffer – as the terrestrial soils appear to start close to the edges of the watercourses in the area (see Figure 5-1). The DFFE 2021 land sensitivity database shows that the Dalmanutha site comprises mainly a combination of high and medium agricultural sensitivity areas, with small areas of low sensitivity (see Figure 5-2). For the purposes of this study, the areas of the site underlain by arable soils (Shortlands and Clovelly) and those that have been cultivated have been considered high sensitivity areas (see Figures 5-3 and 5-4). Very limited development is typically allowed on agricultural land as the major agricultural concern for any development is the loss of high potential agricultural land and there is already a shortage of arable land available in South Africa. What is available is under threat from competing land uses, leading to a cumulative loss of arable land. Subdivision of land may create portions that are too small to be economically viable. The Department of Agriculture, Forestry and Fisheries (DAFF) thus limits the portion of agricultural land that can be utilised for renewable energy development to 10%. In the case of wind energy there is often overlap between where high wind energy resources and high potential agricultural land occur. Wind and agricultural farming can often exist on the same piece of land as the disturbance footprint of a wind farm is typically small (CSIR, 2015). At Dalmanutha this is also the case for solar infrastructure. The remainder of the site has been considered low sensitivity areas, underlain by the very shallow Glenrosa and Mispah soils and the duplex Valsrivier soils. Again the soils information has been augmented with vegetation information (WSP, 2022b) such that the rocky grassland, alien trees, transformed land and infrastructure areas are also considered low sensitivity areas.

Table 5-1 – Sensitivity Classes

SENSITIVITY	AREAS	PERMITTED
NO GO	Wetlands and buffers	Turbines and hardstanding are not allowed. Linear infrastructure such as cabling and powerlines may traverse the areas if essential.
HIGH	Cultivated areas	Linear infrastructure such as cabling and powerlines are allowed. Turbines and hardstanding are not allowed unless mitigation measures are correctly implemented, and the area of arable land used for the development is 10% or less and stakeholder engagement is undertaken to compensate farmers for crop field land areas. Roads must be avoided where they divide fields that could be cultivated.
LOW	Non-arable soils	Turbine, solar PV, hardstanding and road development

Figure 5-1 - Red Soils Near Riverbed



DALMANUTHA WIND (PTY) LTD

AGRICULTURAL SENSITIVITY

Legend

Rivers - Perennial

Site Boundaries

Dalmanutha 132kV Grid Connection

Dalmanutha West

Dalmanutha Wind Energy Facility

Agricultural Sensitivity (DAFF, 2016)

1. Low
2. Medium
3. High
4. Very High

N

0 890 1,780 2,670 3,560

Metres

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PROJECT TITLE
DALMANUTHA WEF

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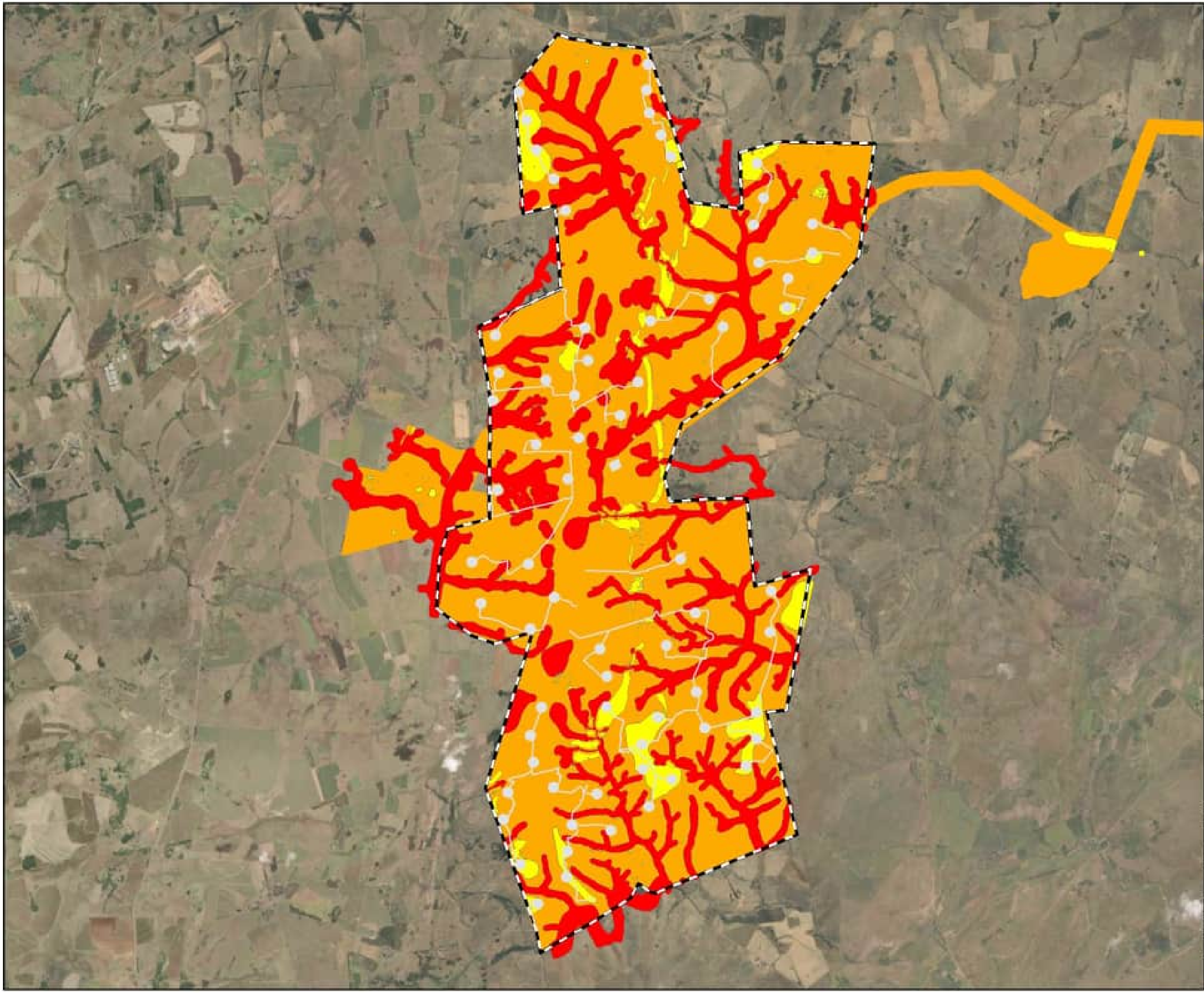
FIGURE NO: 5-2	PROJECT NO: 41103723	REV


DALMANUTHA WIND (PTY) LTD
SOIL
IMPACT ASSESSMENT
Legend
Proposed infrastructure
Proposed access roads
Proposed substations
Site Boundaries
Soil Sensitivity
No-Go Area
High
Low
N
0
890
1,780
2,670
3,560
Metres
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PROJECT TITLE
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SCALE
DRAWN BY: TS
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REVIEWED BY: KK
FIGURE NO
PROJECT NO
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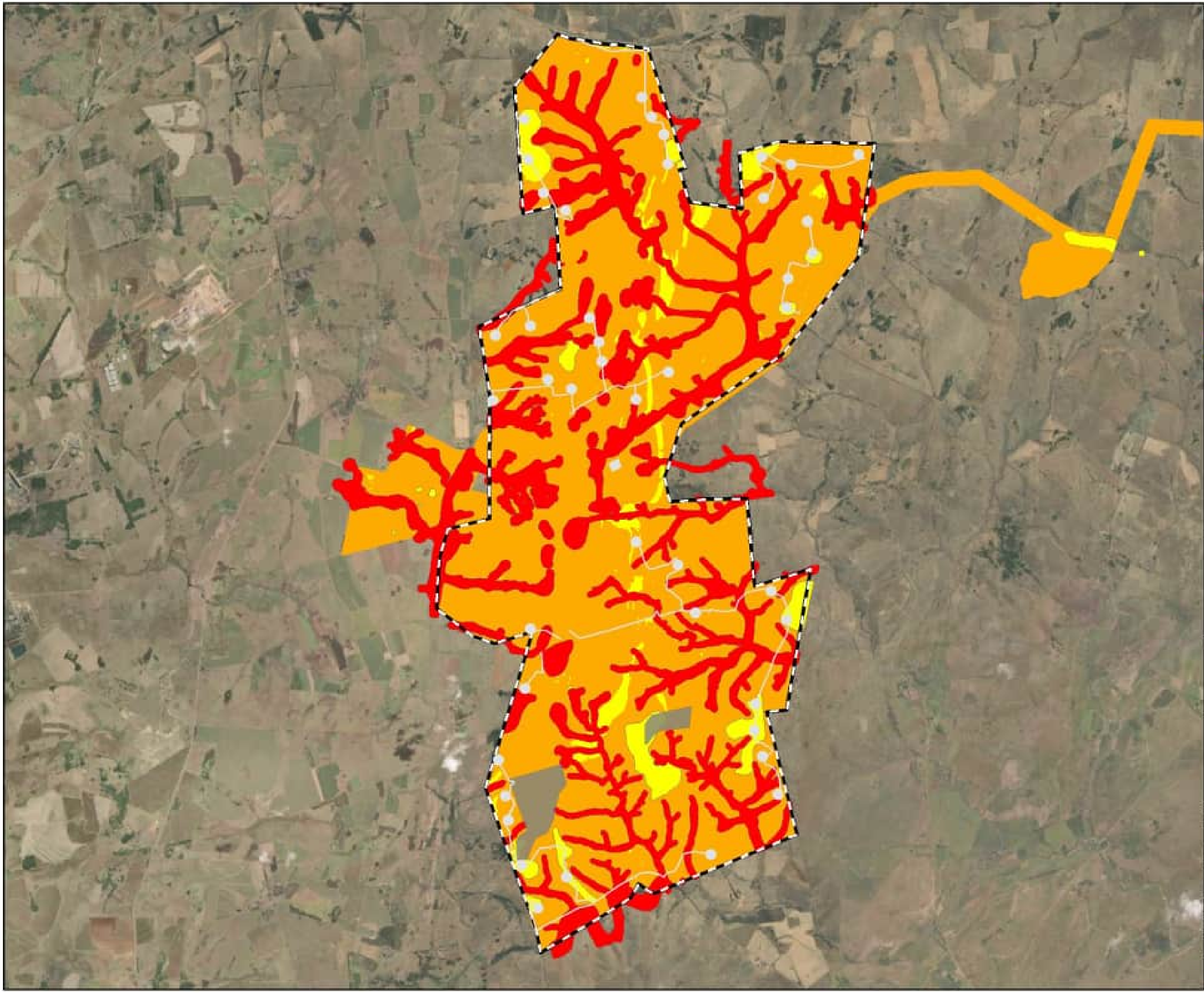

DALMANUTHA WIND (PTY) LTD

SOIL IMPACT ASSESSMENT

Legend

Proposed infrastructure

Proposed access roads

Proposed substations

Solar footprint

Site Boundaries

Soil Sensitivity

No-Go Area

High

Low

N

0 890 1,780 2,670 3,560

Metres

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PROJECT TITLE

DALMANUTHA WEF

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DATE: 2023-05-17	REVIEWED BY: KK

FIGURE NO: 5-4	PROJECT NO: 41103723	REV

5.2. POTENTIAL IMPACTS

The impacts of the potential development have been assessed for both the wind only alternative (Alternative 1) that includes 70 wind turbines, and for the combined wind and solar alternative (Alternative 2) that includes 44 turbines and two solar fields, for the construction, operational and decommissioning phases and for cumulative impacts. While Alternative 2 is likely to impact a smaller physical area and the chosen positions for the solar fields appear to be in a higher-lying area so are more likely to be underlain by shallower, less arable soils; using the methodology described in Section 2, the Impact Extent criterion rating of both alternatives is 1 (site only extent), thus the potential impact rating of the alternatives is the same.

The greatest impacts to soil are typically felt during the site preparation and construction phase of development as a result of vehicular movement, the removal of vegetation within the development footprint and associated disturbances to soil, and access to the site. Site preparation is followed by earthworks required for establishment of structures, leading to stockpiling and exposure of loose soils, as well as movement of construction equipment and personnel within the project area. Based on the information available, the following potential negative impacts of the proposed development were considered and evaluated (see Tables 5-2 to 5-5).

5.2.1. CUMULATIVE IMPACTS

As highlighted previously, sheep, dairy, maize, potato and timber farming take place in the area, the project site vegetation includes maize, grasses and trees in the main, and coal and back granite are mined in the area.

There are three approved projects in the Mpumalanga Province within 40 km of the Dalmanutha Project site. These are:

- The 14MW Machadodorp PV 1 solar energy facility on portion 8 of the farm De Kroon 363, 11 km northeast of the site,
- The Haverfontein wind energy facility near Carolina, 9 km south of the site, and
- The Eskom Arnot PV Facility at the Arnot Power Station on the Remainder of Portion 24 of Reitkuil 491 JS near Middleburg, 31km southwest of the site.

These sites are too far from the Dalmanutha Project site to have a cumulative effect on soil compaction, erosion and contamination at this stage. As the previous sub-sections highlight, however, the potential impacts centre on a loss of agriculture. Figure 4-10 shows that there is still a large amount of agricultural land around the project site. Having said this, a very recent (late 2022) coal prospecting right application was submitted on all portions of the Farm Berg-en dal (see Figure 1-1), potentially reducing the agricultural land on these portions significantly. Should both the Dalmanutha energy project and the prospecting project go ahead, construction and operation of another site in the immediate vicinity of the proposed wind farm will lead to cumulative agricultural land loss, soil erosion and contamination impacts. The cumulative impact significance ratings have been calculated assuming this prospecting project does go ahead.

5.2.2. IMPACT 1: LOSS OF SOIL

The stripping of soil, especially topsoil, ahead of the development of roads and the platforms sited on arable soil, will lead to a loss of usable soil if not undertaken correctly. The soil horizons need to be separately stripped, stockpiled and reused to rehabilitate the disturbed footprint.

In the cases of Alternatives 1 and 2, the disturbed footprint (the turbine foundation, solar PV and immediate surroundings) is likely to be relatively small and will not result in a significant loss of soil and agricultural potential. Post construction rehabilitation in the form of shaping and grassing of all disturbed areas in veld or in pastures should be undertaken, however, in order to stabilise loose soil and reduce erosion losses. Using the impact assessment methodology described in Section 2, the impact significance for Alternatives 1 and 2 are as follows:

- Construction Phase: Moderate without mitigation and Low with mitigation.
- Operational Phase: Low without mitigation and Very Low with mitigation,
- Decommissioning Phase: Low without mitigation and Very Low with mitigation, and
- Cumulative Impacts: High without mitigation and Moderate with mitigation.

Recommended mitigation measures are as follows:

- Strip and stockpile all useable soil material.
- Soil stockpiles should be kept low (below 3m tall).
- Irrespective of where soil is stockpiled, it should be vegetated as soon as possible to protect against erosion, discourage weeds and maintain active soil microbes.
- The Shortlands and Clovelly topsoil should be stripped to a depth of 30 cm and subsoils to a depth of 80cm. All stripping and stockpiling should be undertaken according to the guidelines below.
  - Demarcate the area to be stripped clearly, so that the contractor does not strip beyond the demarcated boundary.
  - The stripped soil should be relocated by truck along set removal paths.
  - The area to be stripped requires storm water management and the in-flow of water should be prevented with suitable structures.
  - Prepare the haul routes prior to stripping.
  - Stripping should not be undertaken in wet conditions.

5.2.3. IMPACT 2: LOSS OF AGRICULTURAL LAND

There exists the potential for loss of agricultural land owing to direct occupation of the footprint of the energy facility infrastructure and the fragmentation of agricultural land. Cultivated land currently makes up 16% of the Project area. The movement of vehicles and equipment is very likely to result in compaction, disturbance and possible sterilization of soils and associated change in land capability.

The more clay-rich soils identified on site (such as the Valsrivier soils and the Shortlands that dominate the site) will be more vulnerable to compaction than the sandier soils will. Soil compaction reduces the pore space available for air and water within soil, reducing soil arability and increasing the risk of soil erosion. Soil compaction cannot be fully mitigated against as compacted soil cannot regain its original structure.

In the case of this proposed project, using the impact assessment methodology described in Section 2, the impact significance of Alternatives 1 and 2 are as follows:

- Construction Phase: High without mitigation and Moderate with mitigation.
- Operational Phase: Moderate with and without mitigation,
- Decommissioning Phase: Very Low with and without mitigation, and
- Cumulative Impacts: High without mitigation and Moderate with mitigation.

Mitigation measures that should be considered include:

- Limiting vehicle routes on site by demarcating traffic areas.
- Limiting site vehicle access.
- Reuse of existing roads will prevent additional areas from becoming compacted.
- Stripping soils when they are dry.
- Compacted soils can be ripped to make them more suitable for cultivation.

5.2.4. IMPACT 3: DISTURBANCE TO AGRICULTURAL PRACTICES

Construction activities, division of fields and prevention of aerial crop spraying owing to wind turbines can disturb agricultural practices (CSIR, 2015).

In the case of both alternatives, as both include wind turbines, using the impact assessment methodology described in Section 2, the impact significance is as follows:

- Construction Phase: Moderate with and without mitigation,
- Operational Phase: Moderate without mitigation and Very Low with mitigation,
- Decommissioning Phase: Very Low with and without mitigation, and
- Cumulative Impacts: High without mitigation and Moderate with mitigation.

Recommended mitigation measures are as follows:

- Construction activities should be planned in such a way that they work around farming schedules.
- Final siting of the turbines should avoid dividing fields into sections that are too small to be agriculturally viable and should take into account any aerial crop spraying activities that might be undertaken. Turbines should be sited out of cultivated areas where possible. If avoidance is not possible, stakeholder engagement must be undertaken to fairly compensate landowners for crop field land.

5.2.5. IMPACT 4: EROSION AND SEDIMENTATION

Soil stripping, clearing of vegetation, movement of vehicles and earthworks are very likely to result in increased loose material being exposed and consequent erosion. Some erosion will occur wherever soils are disturbed, especially if mitigation measures are not correctly put in place. The thin, hilltop soils (Mispah and Glenrosa) and the less structured soils (Clovelly) will be more vulnerable to erosion than the more clay-rich soils (Valsrivier, Shortlands and Katspruit). Soil erosion can lead to sedimentation of the watercourses that cross the site, and to the loss of valuable topsoil that is essential for agricultural and rehabilitation purposes.

Although the magnitude and extent of erosion and sedimentation are likely to be limited if the recommended mitigation measures are properly implemented, some erosion is inevitable when clearing an area, and erosion and sedimentation are not easily reversible.

In the case of Alternatives 1 and 2, using the impact assessment methodology described in Section 2, the impact significance is as follows:

- Construction Phase: Moderate without mitigation and Low with mitigation.
- Operational Phase: Moderate without mitigation and Low with mitigation.
- Decommissioning Phase: Moderate without mitigation and Low with mitigation, and
- Cumulative Impacts: High without mitigation and Moderate with mitigation.

Recommended mitigation measures are as follows:

- Limit earthworks and vehicle movement to demarcated paths and areas.
- Limit the duration of construction activities, especially those involving earthworks / excavations.
- Access roads associated with the development should have gradients or surface treatment to limit erosion, and road drainage systems should be accounted for.
- Existing roads should be used and regraded instead of creating new roads wherever possible.
- Removal of vegetation must be avoided until such time as soil stripping is required and similarly exposed surfaces and soil stockpiles should be re-vegetated or stabilised as soon as is practically possible.
- A construction phase-specific storm water management plan should be designed for the site and adhered-to.
- During periods of strong winds, stockpiles that have not yet been vegetated should be covered with appropriate material.

5.2.6. IMPACT 5: SOIL CONTAMINATION

- Movement of vehicles and plant / equipment on site could result in leaks and spills of hazardous materials including hydrocarbons. Contaminated soil is expensive to rehabilitate and contamination entering the soils of the project area will infiltrate into the ground as well as migrate from site during rainfall events. The more clay-rich soils identified on site will be more vulnerable to contamination than the sandier soils will, as the more clay-rich soils are more chemically active and will interact with the contaminants. All soils will be at risk of contamination especially during the construction phase.

In the case of Alternatives 1 and 2, using the impact assessment methodology described in Section 2, the impact significance is as follows:

- Construction Phase: High without mitigation and Low with mitigation.
- Operational Phase: Moderate without mitigation and Low with mitigation.
- Decommissioning Phase: Low with and without mitigation.
- Cumulative Impacts: High without mitigation and Moderate with mitigation.

The following mitigation measures are recommended:

- On-site vehicles should be well-maintained,
- Drip trays should be placed under vehicles;
- On-site pollutants/hazardous materials should be contained in a bunded area and on an impermeable surface;
- Ensure proper control of dangerous substances entering the site, and
  Adequate disposal facilities should be provided.

Table 5-2 - Impact Assessment for Alternatives 1 and 2 – Construction Phase

Impact Number	Impact	Mitigation Measures (With / Without)	Nature of Impact (Negative / Positive)	Magnitude (5)	Extent (5)	Reversibility (5)	Duration (5)	Probability (5)	Significance (100)	Significance rating
1	Loss of Soil	Without	N	4	1	3	4	5	60	Moderate
		With	N	3	1	3	4	2	22	**Low**
2	Loss of Arable Land	Without	N	5	1	3	4	5	65	High
		With	N	4	1	3	4	5	60	**Moderate**
3	Disturbance to Agricultural Practices	Without	N	2	1	3	4	5	50	Moderate
		With	N	1	1	3	4	3	27	**Low**
4	Erosion and Sedimentation	Without	N	4	1	3	4	5	60	Moderate
		With	N	2	1	3	4	3	30	**Low**
5	Contamination	Without	N	4	2	3	5	5	70	High
		With	N	3	1	3	4	2	22	**Low**

Table 5-3 - Impact Assessment for Alternatives 1 and 2 – Operational Phase

Impact Number	Impact	Mitigation Measures (With / Without)	Nature of Impact (Negative / Positive)	Magnitude (5)	Extent (5)	Reversibility (5)	Duration (5)	Probability (5)	Significance (100)	Significance rating
1	Loss of Soil	Without	N	1	1	3	4	5	45	Moderate
		With	N	1	1	3	4	1	9	**Very Low**
2	Loss of Arable Land	Without	N	2	1	3	4	5	50	Moderate
		With	N	1	1	3	4	1	45	**Moderate**
3	Disturbance to Agricultural Practices	Without	N	2	1	3	4	5	50	Moderate
		With	N	1	1	3	4	1	9	**Very Low**
4	Erosion and Sedimentation	Without	N	2	1	3	4	5	50	Moderate
		With	N	1	1	3	4	2	18	**Low**
5	Contamination	Without	N	2	2	3	5	5	60	Moderate
		With	N	2	1	3	4	3	30	**Low**

Table 5-4 - Impact Assessment for Alternatives 1 and 2 – Decommissioning Phase

Impact Number	Impact	Mitigation Measures (With / Without)	Nature of Impact (Negative / Positive)	Magnitude (5)	Extent (5)	Reversibility (5)	Duration (5)	Probability (5)	Significance (100)	Significance rating
1	Loss of Soil	Without	N	1	1	3	4	3	27	Low
		With	N	1	1	3	4	1	9	Very Low
2	Loss of Arable Land	Without	N	1	1	3	4	1	9	Very Low
		With	N	1	1	3	4	1	9	Very Low
3	Disturbance to Agricultural Practices	Without	N	1	1	3	4	1	9	Very Low
		With	N	1	1	3	4	1	9	Very Low
4	Erosion and Sedimentation	Without	N	3	1	3	4	5	55	Moderate
		With	N	2	1	3	4	2	20	Low
5	Contamination	Without	N	2	1	3	5	2	22	Low
		With	N	1	1	3	4	2	18	Low

Table 5-5 - Impact Assessment for Alternatives 1 and 2 – Cumulative Impacts

Impact Number	Impact	Mitigation Measures (With / Without)	Nature of Impact (Negative / Positive)	Magnitude (5)	Extent (5)	Reversibility (5)	Duration (5)	Probability (5)	Significance (100)	Significance rating
1	Loss of Soil	Without	N	5	3	3	5	5	80	High
		With	N	3	3	3	4	4	52	**Moderate**
2	Loss of Arable Land	Without	N	5	3	3	5	5	80	High
		With	N	3	3	3	4	4	52	**Moderate**
3	Disturbance to Agricultural Practices	Without	N	5	3	3	5	5	80	High
		With	N	3	3	3	4	3	39	**Moderate**
4	Erosion and Sedimentation	Without	N	4	3	3	5	5	75	High
		With	N	2	3	3	4	5	60	**Moderate**
5	Contamination	Without	N	4	3	3	5	5	75	High
		With	N	2	3	3	4	5	60	**Moderate**

5.3. MONITORING REQUIREMENTS

Should the project go ahead, the following aspects should be monitored visually by the ECO during the construction phase.

- Ensure that all operations are restricted to the areas demarcated as construction areas and not move outside of those areas.
- Ensure that the topsoil is stripped ahead of deeper excavations for the turbine foundations.
- Monitor the vegetative cover of the soil stockpiles.
- Monitor signs of erosion and consequent sedimentation.
- Monitor signs of contamination of soils, especially where vehicles and equipment are present.
- Monitor rehabilitation progress at the locations where the turbines are situated in the grasslands and where vegetation is needed to stabilize soils.

6. IMPACT STATEMENT

The potential impacts of Alternatives 1 and 2 of the proposed Dalmanutha energy development centre on a loss of agriculture and include a loss of arable soils, loss of agricultural land, interference with agricultural practices, soil erosion and consequent sedimentation and soil contamination. If the recommended mitigation measures are correctly implemented and appropriate monitoring is undertaken, all the potential impacts can be reduced to Low except for the potential loss of agricultural land as a result of permanent project infrastructure. The small footprints of the turbines would not significantly reduce the area available for cropping or cutting and baling.

It is highly recommended that additional micro-siting soil surveys be undertaken for any infrastructure that is repositioned when the solar PV and/or wind turbine layout plan is finalised in order to establish with certainty the soil forms and characteristics underlying the solar PV infrastructure, wind turbine hardstanding, access roads, buildings and all related infrastructure. It is also recommended that infrastructure be sited away from agricultural land wherever possible – such as on the high points underlain by Glenrosa and Mispah soils.

7. REFERENCES

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- WSP, 2022a. Dalmanutha Wind Energy Facility Wetlands Study EIA Report. Enertrag South Africa.
- WSP, 2022b. Dalmanutha Wind Energy Facility Vegetation Study EIA Report. Enertrag South Africa.

A SPECIALIST CV

KAREN KING, M.Sc., Pr.Sci.Nat.

Senior Associate (Hydrologist & Soil Scientist), Environment & Energy

Years with the firm

5.5

Years of experience

16.5

Professional qualifications

Pri.Sci.Nat (Earth Science)

Areas of expertise

Soil Science

Hydrology

Languages

English

Afrikaans

Italian (learning)

CAREER SUMMARY

Ms King is a professional soil scientist and hydrologist (Pr.Sci.Nat, M.Sc.) with WSP Engineering and Environmental Consultants in Johannesburg. She has 16+ years' work experience and specialises in local and international soil classification systems, soil capability and suitability assessments, land use assessments and associated risk and mitigation assessments and monitoring plans, as well as agricultural studies. She also specialises in mining/development hydrology, water resources planning, catchment-scale hydrological modelling, flood studies, storm water management planning, wetland delineation, water research, and related risk assessments and management plans. She has been primarily involved in the environmental and engineering hydrology and soil science fields, initially as a soil science lecturer at UKZN for 3 years, and then as a soil scientist and hydrologist in various engineering and environmental consultancies both in South Africa and in the United Kingdom.

EDUCATION

Master of Science, University of KwaZulu-Natal, South Africa	2004
Bachelor of Science (Honours), University of Natal, South Africa	2002
Bachelor of Science, Hydrology and Soil Science, University of Natal, South Africa	2001

SELECTIONS AND AWARDS

Golder Technical Conference Abstract Selection	2022
WSP Group Unity Award	2019
WSP Environmental Collaboration Award	2018
Golden Key Honour Society Selection	2002
A series of academic and sports scholarships	1994-2003

PROFESSIONAL MEMBERSHIPS

South African Council for Scientific Professions – Professional Natural Scientist (Earth Scientist) (Reg. No. 400035/11)	SACNASP
Water Institute of South Africa (member 23404)	WISA
The Golden Key Honour Society (member 1264480)	-
International Water Association (member 01053990)	IWA

MODEL PROFICIENCY

SAPWAT Crop Irrigation Model

HYDRUS Soil-Water Interaction Model

Agricultural Catchments Research Unit (ACRU) Model

Pitman Water Resources Assessment Model

SOIL SCIENCE PROFESSIONAL EXPERIENCE

— Richbay Chemicals South Africa Extension Project – Soils Study (2021-2022). Project Director. Client: Richbay Chemicals.

Assessment of any potential agricultural and social uses of an area of land earmarked for industry extension in a light industrial/residential area of KwaZulu-Natal.

— Ghana Genser Power Project – Soils Study (2021-2022). Project Soils Specialist. Client: Genser Power.

Agricultural Soils Classification, Capability and Impacts Assessment, and Mitigation Measures Recommendations for a Power Plant and Pipeline in Ghana.

— Liberia Gold Mine Biomass Project – Soils Study (2021-2022). Project Soils Specialist. Lient: MNG Lebetse Gold Mine.

Agricultural Soils Classification, Capability and Impacts Assessment, and Mitigation Measures Recommendations for a proposed biomass project in Liberia.

— Guinea Project – Interdisciplinary Soils Study (2021-2022). Project Soils Specialist. Client: Confidential.

Multidisciplinary Potential Impacts and Mitigation Measures Assessment under very difficult conditions

— Lebombo Cape Soils Study. Soils Compliance Study for Fruit Export – Physical and Chemical Assessments (2021-2022). Project Director. Client: Lebombo Cape.

Classification of soil forms according to the South African taxonomic system, soil capability and impact assessment, and mitigation recommendations.

— DRC Kamoa Copper Mine ESIA – Soils Study (2021). Project Soils Specialist. Client: Ivanhoe Mines.

Agricultural soils study according to IFC standards that involved World Resource Base classification of lateritic and non-lateritic soils across developed and undeveloped areas of Kamoa Copper Mine. The soil agricultural capability and suitability were assessed and management plans for top- and sub-soil stripping and for soil erosion were developed.

— Etihad Rail Saudi Arabia to Oman Rail - Desert Soils Study (2020-2021). Project Director. Client: Etihad Rail.

Soils study centred on the establishment of soil properties and thus Curve Numbers to inform desert soil hydropedological processes.

— Swaziland Nondvo Dam Morphodynamic and River Basin Specialist Studies – (2018-2021): Project Director and Reviewer. Client: Swaziland DWS

Soil-centred studies that assessed the potential for landscape changes due to soil erosion and sedimentation associated with the development and raising of dam walls in Swaziland.

— Calodex Soils and Hydropedological Assessments (2021). Project Director. Client: Calodex.

Soils study centred on the agricultural classification of a number of local soils. Potential effects of soil-water movement on local wetlands was established.

— Jet Park Soils and Hydropedological Assessment (2021). Project Director. Client: Abbeydale Construction.

Soils study centred on the agricultural classification of a number of local soils. Potential effects of soil-water movement on local wetlands was established.

- Sasol Soils and Hydropedological Study (2021). Project Director. Client: Sasol.

  Soils study centred on the agricultural classification of a number of local soils. Potential effects of soil-water movement on local wetlands was established.

- Sapref Soils and Hydropedological Study (2019-2020). Project Manager. Client: Sapref.

  Soils study centred on the agricultural classification of a number of local soils. Potential effects of soil-water movement on local wetlands was established.

- Ethiopia Agri-Industrial Zone ESIA. Soils Classification, Land Use, Land Capability, Risk Assessment and Management Plan Study (2017-2018). Client: UNOPS.

  Agricultural soils study according to IFC standards that involved World Resource Base classification of a wide range of soil forms. Agricultural soil capability and suitability was established, an impact assessment was undertaken and mitigation and management plans recommended.

- Richards Bay Minerals Sokhulu Remediation Plan, South Africa (2017). Soil Assessment. Client: Rio Tinto

  Soils were classified by form according to a local agricultural taxonomic system.

- Zambia Olam Soils Study (2016): Project Manager. Soil Classification, Land Use and Land Capability Study. Client: NCCL.

  Agricultural soils study according to IFC standards that involved World Resource Base classification of a range of soil forms. Land capabilities were established.

- Glisa Soils Study, Gauteng, South Africa (2015): Project Manager. Soil Classification, Land Use and Land Capability and Suitability Study. Client: Exxaro Resources.

- Philippi Sand Mine Soils Study, Western Cape, South Africa (2015): Project Manager. Hydrology, Storm Water Management Plan, Risk Assessment, Reporting and Project Management. Client: Consol Glass.

- Madagascar Molo Graphite Mine Soils Study. (2014): Project Manager. Soil Classification, Land Use and Land Capability Study with Management Plan and Staff Capability Outputs. Client: Energiser Resources.

- Wits Gold Mine Soils Study, Gauteng, South Africa (2014): Project Manager. Soil Classification, Land Use and Land Capability Study. Client: Wits Gold.

- Soil Monitoring Study, Gauteng, South Africa (2013-2014). Project Manager. Client: Total Coal South Africa.

- Kangra Coal specialist input – soils. (2013). Project Manager. Soil Classification, Land Use and Land Capability and Suitability Study. Client: Kangra Coal.

- Two Rivers Platinum EIA specialist input – soils. (2012). Project Manager. Soil Classification, Land Use and Land Capability and Suitability Study. Client: Two Rivers Platinum.

- Witkop EIA specialist input – soils. Witkop Exploration and Mining (2012). Project Manager. Soil Classification, Land Use and Land Capability and Suitability Study. Client: Witkop Mine.

- Matimba EIA specialist input – soils. (2012). Project Manager. Soil Classification, Land Use and Land Capability and Suitability Study. Client: SiVest.

- Sasol Fuel Department Due Diligence (2011). Project Manager. Establishing whether the soil in one of Sasol's tank farms was contaminated. This required soil sampling and analysis, as well as report writing. Client: Exxaro Coal.

HYDROLOGY PROFESSIONAL EXPERIENCE

- Lebombo Cape Water Study. Surface Water Fruit Export Compliance Assessment (2021-2022). Project Director. Client: Lebombo Cape.
- Etihad Rail Saudi Arabia to Oman Railway Line - Desert Hydrology Study (2020-2021). Project Director. Client: Etihad Rail.
- De Wittekrans WULA, IWWMP and specialist studies (2019). Project Director. Client: Canyon Coal.
- Trans-Alloys WULA, IWWMP and specialist studies (2019). Project Director and Reviewer. Client: Eskom.
- Eskom Lethabo WULA and IWWMP Amendment (2019). Project Director and Reviewer. Client: Eskom.
- Kimberly Clark WULA (2019). Project Director. Kimberly Clark.
- Sappi Ngodwana WULA Advisory Services (2019). Project Director. Client: Sappi.
- Sapref WULA, IWWMP and specialist studies including Storm Water Management Plan, Groundwater and wetland studies (2019). Project Director and Reviewer. Client: Sapref.
- Southern Cross Foundry WULA, IWWMP and specialist studies including a Storm Water Management Plan and Groundwater Study (2018-2019). Project Director and Reviewer. Client: Southern Cross.
- Nondvo Dam Morphodynamic and River Basin Specialist Studies – Swaziland (2018-2019): Project Director and Reviewer. Client: Swaziland DWS
- Transnet Monthly Surface Water Monitoring (2018-2019). Project Director and Reviewer. Client: TPT
- AMSA Stormwater Dam Complex Assessment (2018-2019). Report Reviewer. Client: Arcelor Mittal SA
- Alliance Mining Commodities Guinea Mine Water Study (2018-2019): Report Reviewer. Client: AMC.
- Yanfolila Mali Gold Mine Water Study (2018-2019): Project Reviewer. Client: Hummingbird Resources.
- Thabametsi Coal-fired power station water study (2017-2019). Water Use License Application and Storm Water Management Planning specialist advisors. Client: Marubeni.
- Turfontein Underground Mine WULA and IWWMP (2017-2019). Project Manager and Reviewer. Client: Samancor Chrome.
- Kalgold Mine Surface Water Assessment (2018): Project Director. Client: EIMS
- Tau Lekoa Gold Mine Surface Water Assessment (2018): Project Director. Client: EIMS
- Sappi Ngodwana WUL and IWWMP study (2018). Project Reviewer. Client: Sappi.
- Agriprotein Storm Water Management Plan (2018): Project Reviewer. Client: Agriprotein Industries.
- Sundumbili Wastewater Treatment Works upgrade potential water quality changes calculations (2018). Project Reviewer. Client: RHDHV.

- Glendale Distillery Water Use License Application study (2017 - 2018). Project Reviewer. Client: Illovo.
- GDC Wastewater Treatment Works Water Use License Application study (2017). Project Reviewer. Client: Illovo.
- Hwange District Plant Drain System Study, Zimbabwe (2017): Project Manager. Water Balance and Storm Water Management Plan review and recommendations. Client: ZimPower and the African Development Bank.
- Ethiopia Agri-Industrial Zone ESIA (2017): Project Manager, reviewer and soil scientist. Surface and groundwater, wetlands and soils assessment and risk and mitigation assessment. Client: UNOPS.
- Zambia Coal-fired power station Water Assessment (2017): Project Reviewer. Water Availability Assessment. Client: Black Rhino.
- Richards Bay Water Quality Monitoring Study (2017): Report reviewer. Compliance assessment. Client: Transnet Port Terminals.
- Oranjemund Mine Conjunctive Water Use Study (2016): Project Manager. Strategic Surface Water and Groundwater Assessment, Desalination, Project Management. Client: Freedthinkers.
- SKA Antennae Extensive Flood Lines Assessment (2016): Project Reviewer. Client: SKA.
- Avondale Housing Estate Hydrology and Flood Lines (2016): Project Reviewer. Client: Triplo4.
- Avon Power Plant Surface Water Assessment (2016): Project Reviewer. Client: Triplo4.
- Molopo Gas Study (2016): Project Reviewer. Sensitivity Assessment, Risk Assessment, Surface Water Assessment and Project Management. Client: EIMS.
- City of Johannesburg Open Spaces Study (2016): Project Reviewer. An assessment of any potential risks to and from surface water and offering general advice about maintenance of Johannesburg's open spaces. Client: CoJ.
- Open Spaces Study, Johannesburg, Gauteng, South Africa (2015): Project Manager. General Hydrological Risks Assessment. Client: CoJ.
- Philippi Sand Mine Surface Water Study, Western Cape, South Africa (2015): Project Manager. Hydrology, Storm Water Management Plan, Risk Assessment, Reporting and Project Management. Client: Consol Glass.
- Glisa Mine Surface Water Study, Gauteng, South Africa (2015): Project Manager. Hydrology, Storm Water Management Plan, Risk Assessment, Water and Salt Balance, Reporting and Project Management. Client: Exxaro Resources.
- Surface Water Assessment, Richards Bay, KwaZulu-Natal, South Africa (2015): Project Manager. Flood Lines and Project Management. Client: GIBB.
- Unconventional Gas Study, Gauteng, South Africa (2015). Flood Lines, Storm Water Management Plan, Water Balance, Review, Project Management. Client: RHDHV.
- Pumpi Mine Integrated Water Management Study, Mozambique (2015): Project Manager: Flood Lines, Storm Water Management Plan, Review, Project Management. Client: Lamikal.
- Molo Graphite Mine Surface Water Study, Madagascar (2014). Project Manager. Hydrology, Yield Analysis, Storm Water Management Plan, Water Quality Assessment, Risk Assessment, Water and Salt Balance, Reporting and Project Management with Management Plan and Staff Capability Outputs. Client: Energizer Resources.

- De Wittekrans Surface Water Study, Mpumalanga, South Africa, (2014): Project Manager. Hydrology, Storm Water Management Plan, Risk Assessment, Reporting and Project Management. Client: EIMS.
- Wits Gold Mine Surface Water Study, Gauteng, South Africa (2014): Project Manager. Hydrology, SWMP, Water Balance, Reporting, Project Management. Client: Wits Gold.
- Olam Zambia Surface Water Study, Zambia. (2014): Project Manager. Hydrology, Water Availability Assessment, Water Quality, Water resource Planning, Reporting, Project Management. Client: NCCL.
- Angola AEMR Area 5 Surface Water Study, Angola. (2014): Project Manager. Hydrology, Yield Analysis, Storm Water Management Plan, Water Balance, Reporting and Project Management. Client: Tenova Bateman.
- EnviroServ Water Facility Integrated Water Resources Study (2013). Project Manager. Hydrology, Water Balance, Salt Dilution Recommendations, Project Management. Client: EnviroServ.
- Surface Water Quantity and Quality Management Planning Study, King Shaka Airport, Durban, South Africa (2013-2016). Project Manager: Hydrology, SWMP, Water Quality Assessment, Bio-monitoring, Water Quality Monitoring Planning, Reporting, Project Management. Client: ACSA.
- Kangra Coal specialist input – hydrology. (2013). Project Manager. Hydrology, Storm Water Management Plan, Flood Lines, Water Quality Assessment, Water Balance, Monitoring Programme, Reporting and Project Management. Client: Kangra Coal.
- Angola AEMR Areas 2 and 3 Surface Water Study, Angola (2013). Project Manager. Hydrology, Yield Analysis, Storm Water Management Plan, Water Balance, Reporting and Project Management. Client: SMP.
- Kakanda-Luita Mine Project (2012). Project Manager. Hydrological modelling of mine areas to determine peak flows at various points, preparation of water balances for the respective mines and a flood line report. Client: ENRC Management South Africa (Pty) Ltd.
- Marikana Water Balance (2012). Hydrologist. An Excel-based process flow diagram and water balance was set up and verified for the mine. Client: Marikana Platinum Mine.
- Volspruit Platinum Mine Flood line calculations and berm design (2012). Project Manager. 1:50- and 1:100-year flood lines were calculated using Hec-RAS software for the watercourses running through the mine and flood protection berms were designed for these return periods. Client: Pan Palladium (Pty) Ltd.
- Marula Platinum Mine Flood Lines Project. (2012). Project Manager. 1:50- and 1:100-year flood lines were calculated using Hec-RAS software for the watercourses running through the mine and the risks associated with flooding identified. Client: Marula Platinum Mine.
- Marampa Iron Ore Flood Line Project (2012). Project Manager. 1:50- and 1:100-year flood lines were calculated using Hec-RAS software for the watercourses running through the mine and the risks associated with flooding identified. Client: Marula Platinum Mine.
- Two Rivers Platinum EIA specialist input – hydrology (2012). Project Manager. Hydrology, Storm Water Management Plan, Flood Lines, Water Quality Assessment, Risk Assessment, Water and Salt Balance, Monitoring Programme, Reporting and Project Management. Client: Two Rivers Platinum.
- Witkop EIA specialist input – hydrology. (2012). Project Manager. Hydrology, Storm Water Management Plan, Flood Lines, Water Quality Assessment, Risk

Assessment, Water and Salt Balance, Monitoring Programme, Reporting and Project Management. Client: Witkop Exploration and Mining.

- Matimba EIA specialist input – hydrology (2012). Project Manager. Hydrology, Storm Water Management Plan, Flood Lines, Water Quality Assessment, Risk Assessment, Water and Salt Balance, Monitoring Programme, Reporting and Project Management. Client: SiVest.
- Mulepe Diamond Mine Project (2011). Project Manager. Flood Lines Calculation and reporting study. Client: De Beers Anglo Prospecting.
- Impala Tailings Dam Weirs (2011). Project Manager. PH and EC monitoring equipment were investigated and the best of these was recommended to the client. Client: Impala Platinum.
- New Clydesdale Coal Water Balance Study (2011). Project Manager. An Excel-based process flow diagram and water and salt balance was calculated for the mine. Client: Exxaro Coal.
- Nkomati Integrated Water and Waste Management Plan. (2012). Hydrologist. Client: African Rainbow Minerals Limited.
- Rus Ter Vaal Residential Development (2012). Project Manager. Water resources Availability Study, Water Balance and Project Management. Client: Arengo 6.
- Progressive Realisation of the IncoMaputo Agreement (PRIMA) Study. Tripartite Permanent Technical Committee (TPTC) between Mozambique, Swaziland and South Africa (2011). Developing and running a model to determine the water availability in the Maputo and Incomati catchments and their sub-catchments for a range of scenarios. Writing reports and giving presentations based on these findings at international meetings. Hydrologist. Client: PRIMA.
- Development of a Reconciliation Strategy for the Olifants River Water Supply System. (2011). Hydrologist. Client: DWA.
- Projected Impacts of Climate Change on water quality and quantity in the Mngeni Catchment (2011). Hydrologist. Client: The Water Research Commission.
- CSIR Regional Water infrastructure Project (2011). Hydrologist. Client: CSIR.
- uMgungundlovu Municipality Integrated Waste Management Plan (2010). Collection and analysis of solid waste collection, removal and disposal data for the 7 local municipalities making up uMgungundlovu District Municipality, and writing an integrated waste management plan for the area, based on this data. Client: uMgungundlovu District Municipality.
- Ugu District Municipality Disaster Management Plan. (2010). Hydrologist. Writing methodologies for air, soil and water pollution disaster mitigation and calculating preliminary timeframes and budgets for overall disaster management in the district. Client: Ugu District Municipality.
- eThekwini District Municipality Sandton Sanitation Project (2010). Hydrologist. Writing reports at various stages explaining what work has been done and what was still due to be done, on an area-by-area basis. Client: eThekwini District Municipality.
- SADC Climate Change Study. (2009). Hydrologist. Setting up the HEC-HMS modeling system to run various hydrological scenarios. Client: Pegasus.
- Bitou Stormwater and Flood Study. (2009). Hydrologist. Hydrological and hydraulic model development, flood hazard mapping and dam break analysis. Client: Bitou Local Municipality.
- SANRAL Bridge Study. (2009). Running the HDYP01 and HEC-HMS models and reporting on the findings. Client: Pegasus.

- EA Toddbrook Reservoir Rapid Impact Assessment. (2008). Hydrologist. Reports based on Toddbrook Reservoir were used in conjunction with a risk assessment modelling tool to produce a rapid impact assessment of the potential damage caused by a dam break at Toddbrook Reservoir. Client: The Environment Agency.
- SEW Ouse Cuckmere Control Lines. (2008). Flood control lines were produced using 1996 and 2005 simulation results and these were compared to identify how and why they differ. Client: South East Water.
- SEW NR09 Northern Region Development Options. (2007-2008). Hydrologist. The potential yield at these sites was assessed at various storage and pumping levels, and the sites were evaluated based on their potential yields and positions. Client: South East Water.
- West Sussex Strategic Flood Risk Assessment. (2006-2007). Hydrologist. Flood Risk mapping according to local climatic conditions, soils and populations, as well as surface water flood risk report writing. Client: The Environment Agency.
- Water Resources of South Africa, 2005 Study (2005). Hydrologist. The Water Research Commission. Setting up, simulating and calibrating water resources networks, including climatic, soils and vegetation data, and running scenarios for the whole of the Orange catchment, plus testing of the WRSM2005 model used for this exercise. Client: WRC.
- Assessment of Water Availability in the Olifants Catchments, South Africa. (2005). Hydrologist. Water resources Modelling. Client: SATAC.
- Development of a Reconciliation Strategy for the Amatole Bulk Water Supply Systems, South Africa. (2005). Hydrologist. Climate change and desalination studies made up a part of the project. Client: DWAF.
- Feasibility Study of Utilisation of the Low Level Storage at Vanderkloof Dam. (2005). Hydrologist. A feasibility study into utilisation of low level dam storage, accounting for the hydrological, economic, sociological, soils and environmental aspects thereof. Client: DWAF.

PUBLICATIONS AND PRESENTATIONS

Publications

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B SITE NOTES

APPENDIX: SOIL CLASSIFICATION POINTS

Classification Point: 1

Coordinates: 25°48'55.59S 30°06'03.70''E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Clay Loam 27.5-40%

Depth: 0.7m

Photograph(s):

Classification Point: 2

Coordinates: 25°48'29.66"S 30° 5'43.91"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Clay Loam 27.5-40%

Depth: 0.8m

Photograph(s):

Classification Point: 3

Coordinates: 25°48'28.94"S 30° 5'23.51"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Clay Loam 27.5-40%

Depth: 0.9m

Photograph(s):

Classification Point: 4

Coordinates: 25°48'24.96"S 30° 5'7.88"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay Loam 20-35%

Depth: 0.8m

Photograph(s):

Classification Point: 5

Coordinates: 25°48'26.17"S 30° 4'54.86"E

Soil Form: Shortlands

Catena Position: Valley

Clay Percentage: Sandy Clay 35-55%

Depth: 0.8m

Photograph(s):

Classification Point: 6

Coordinates: 25°48'26.17"S 25°48'26.17"S

Soil Form: Katspruit

Catena Position: Valley

Clay Percentage: Silty Clay 40-60%

Depth: 1.2m+

Photograph(s):

Classification Point: 7

Coordinates: 25°46'36.55"S 30° 8'44.18"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 1m

Photograph(s):

Classification Point: 8

Coordinates: 25°46'21.71"S 30° 9'3.20"E

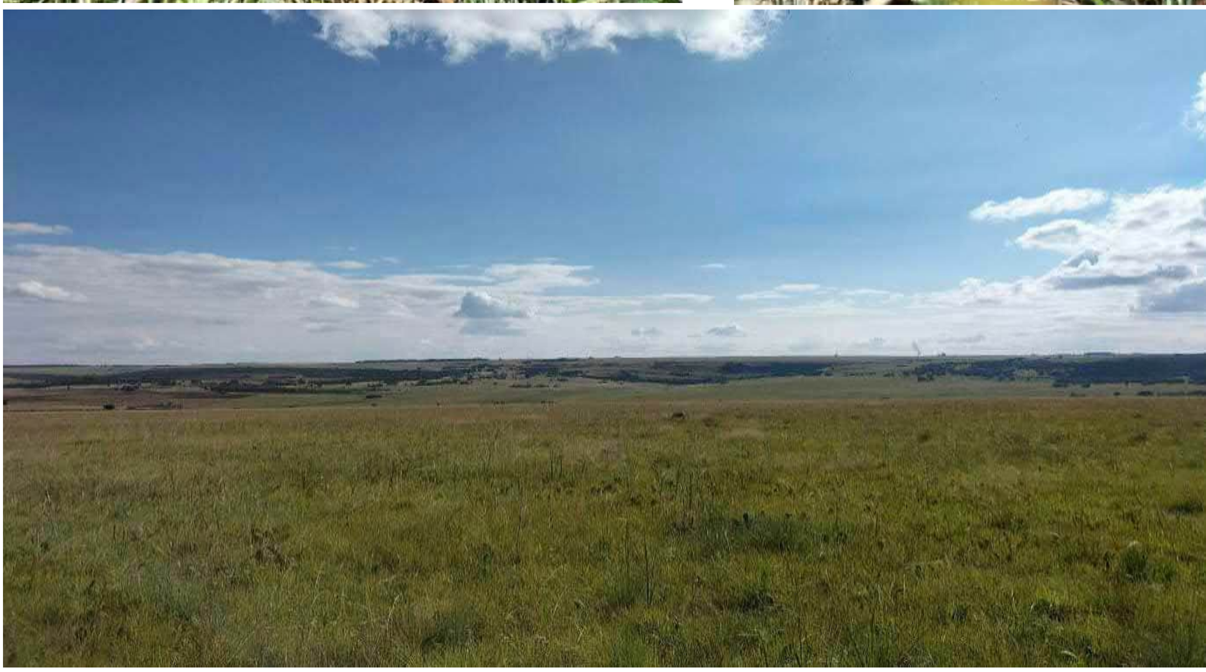
Soil Form: Valsrivier

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 0.4m

Photograph(s):



Classification Point: 9

Coordinates: 25°46'53.50"S 30° 8'45.24"E

Soil Form: Valsrivier

Catena Position: Mid-slope

Clay Percentage: Sandy Clay Loam 20-35%

Depth: 0.4m

Photograph(s):

Classification Point: 10

Coordinates: 25°44'30.88"S 30° 5'28.11"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Silty Clay Loam 27.5-40%

Depth: 1m

Photograph(s):

Classification Point: 11

Coordinates: 25°44'57.61"S 30° 5'31.15"E

Soil Form: Valsrivier

Catena Position: Mid-slope

Clay Percentage: Clay Loam 27.5-40%

Depth: 0.8m

Photograph(s):

Classification Point: 12

Coordinates: 25°45'20.91"S 30° 5'43.32"E

Soil Form: Valsrivier

Catena Position: Mid-slope

Clay Percentage: Clay Loam 27.5-40%

Depth: 0.7m

Photograph(s):

Classification Point: 13

Coordinates: 25°45'36.68"S 30° 5'50.93"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 0.7m

Photograph(s):

Classification Point: 14

Coordinates: 25°45'58.61"S 30° 5'58.54"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 0.9m

Photograph(s):

Classification Point: 15

Coordinates: 25°46'16.09"S 30° 5'59.68"E

Soil Form: Shortlands

Catena Position: Hilltop

Clay Percentage: Sandy Clay 35-55%

Depth: 0.6m

Photograph(s):

Classification Point: 16

Coordinates: 25°47'16.15"S 30° 6'7.07"E

Soil Form: Valsrivier

Catena Position: Mid-slope

Clay Percentage: Silty Clay Loam 40-60%

Depth: 1m

Photograph(s):

Classification Point: 17

Coordinates: 25°47'31.54"S 30° 6'4.15"E

Soil Form: Valsrivier

Catena Position: Mid-slope

Clay Percentage: Silty Clay 40-60%

Depth: 0.9m

Photograph(s):

Classification Point: 18

Coordinates: 25°47'42.34"S 30° 6'3.28"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Clay Loam 27.5-40%

Depth: 0.7m

Photograph(s):

Classification Point: 19

Coordinates: 25°48'51.42"S 30° 4'15.80"E

Soil Form: Glenrosa

Catena Position: Hilltop

Clay Percentage: Sandy 0-10%

Depth: 0.1m

Photograph(s):

Classification Point: 20

Coordinates: 25°49'2.15"S 30° 4'13.42"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.1m

Photograph(s):

Classification Point: 21

Coordinates: 25°48'17.96"S 30° 5'11.27"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Clay Loam 27.5-40%

Depth: 0.8m

Photograph(s):

Classification Point: 22

Coordinates: 25°48'1.61"S 30° 5'11.17"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Clay Loam 27.5-40%

Depth: 0.8m

Photograph(s):

Classification Point: 23

Coordinates: 25°44'15.27"S 30° 7'0.62"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Silty Clay Loam 27.5-40%

Depth: 0.6m

Photograph(s):

Classification Point: 24

Coordinates: 25°44'23.46"S 30° 7'2.46"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay Loam 20-35%

Depth: 0.5m

Photograph(s):

Classification Point: 25

Coordinates: 25°44'29.72"S 30° 7'5.72"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay Loam 20-35%

Depth: 0.6m

Photograph(s):

Classification Point: 26

Coordinates: 25°44'59.56"S 30° 7'19.63"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay Loam 20-35%

Depth: 0.6m

Photograph(s):

Classification Point: 27

Coordinates: 25°45'8.56"S 30° 7'21.47"E

Soil Form: Valsrivier

Catena Position: Mid-slope

Clay Percentage: Clay Loam 27.5-40%

Depth: 0.5m

Photograph(s):

Classification Point: 28

Coordinates: 25°45'19.79"S 30° 7'25.63"E

Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 29

Coordinates: 25°53'27.36"S 30° 5'40.42"E

Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 30

Coordinates: 25°53'7.00"S 30° 5'34.62"E

Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 31

Coordinates: 25°50'12"S 30° 5'34.21.77"E

Soil Form: Clovelly

Catena Position: Mid-slope

Clay Percentage: Loam 7.5-27.5%

Depth: 0.6m

Photograph(s):

Classification Point: 32

Coordinates: 25°50'13.90"S 30° 5'35.74"E

Soil Form: Clovelly

Catena Position: Mid-slope

Clay Percentage: Loam 7.5-27.5%

Depth: 0.7m

Photograph(s):

Classification Point: 33

Coordinates: 25°50'22.79"S 30° 5'40.24"E

Soil Form: Clovelly

Catena Position: Mid-slope

Clay Percentage: Loam 7.5-27.5%

Depth: 0.8m

Photograph(s):

Classification Point: 34

Coordinates: 25°53'37.93"S 30° 5'55.88"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Clay Loam 27.5-40%

Depth: 0.6m

Photograph(s):

Classification Point: 35

Coordinates: 25°53'39.72"S 30° 6'09.84"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay Loam 20-35%

Depth: 0.8m

Photograph(s):

Classification Point: 36

Coordinates: 25°53'32.12"S 30° 6'42.61"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy Loam 15-20%

Depth: 0.1m

Photograph(s):

Classification Point: 37

Coordinates: 25°53'30.19"S 30° 6'44.19"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy Loam 15-20%

Depth: 0.1m

Photograph(s):

Classification Point: 38

Coordinates: 25°53'11.60"S 30° 6'12.89"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy Loam 15-20%

Depth: 0.1m

Photograph(s):

Classification Point: 39

Coordinates: 25°53'6.47"S 30° 6'15.22"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 0.8m

Photograph(s):

Classification Point: 40

Coordinates: 25°52'55.20"S 30° 6'14.90"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy Loam 15-20%

Depth: 0.1m

Photograph(s):

Classification Point: 41

Coordinates: 25°52'35.96"S 30° 6'11.31"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 0.9m

Photograph(s):

Classification Point: 42

Coordinates: 25°53'7.00"S 30° 5'34.62"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 0.9m

Photograph(s):

Classification Point: 43

Coordinates: 25°52'34.67"S 30° 6'12.41"E

Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 44

Coordinates: 25°51'41.29"S 30° 8'24.24"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy Loam 15-20%

Depth: 0.1m

Photograph(s):

Classification Point: 45

Coordinates: 25°52'3.99"S 30° 8'27.78"E

Soil Form: Mispah

Catena Position: Hilltop

Clay Percentage: Sandy 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 46

Coordinates: 25°53'7.00"S 30° 5'34.62"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Silty Clay 40-60%

Depth: 0.9m

Photograph(s):

Classification Point: 47

Coordinates: 25°52'38.09"S 30° 8'43.12"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Silty Clay 40-60%

Depth: 0.8m

Photograph(s):

Classification Point: 48

Coordinates: 25°52'50.84"S 30° 8'00.46"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Silty Clay 40-60%

Depth: 0.6m

Photograph(s):

Classification Point: 49

Coordinates: 25°52'32.27"S 30° 8'00.61"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 0.9m

Photograph(s):

Classification Point: 50

Coordinates: 25°52'27.09"S 30° 8'00.28"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 0.9m

Photograph(s):

Classification Point: 51

Coordinates: 25°52'4.45"S 30° 7'26.96"E

Soil Form: Mispah

Catena Position: Hilltop

Clay Percentage: Sand 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 52

Coordinates: 25°51'58.25"S 30° 7'30.77"E

Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sand 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 53

Coordinates: 25°52'1.13"S 30° 7'36.50"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 1m

Photograph(s):

Classification Point: 54

Coordinates: 25°52'2.01"S 30° 7'35.00"E

Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sand 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 55

Coordinates: 25°52'00.32"S 30° 7'17.12"E

Soil Form: Mispah

Catena Position: Hilltop

Clay Percentage: Sand 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 56

Coordinates: 25°51'45.24"S 30° 7'10.79"E

Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 57

Coordinates: 25°44'5.06"S 30° 15'49.62"E

Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 58

Coordinates: 25°45'36.21"S 30° 15'10.45"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sand 0-10%

Depth: 0.1m

Photograph(s):

Classification Point: 59

Coordinates: 25°46'51.81"S 30° 12'32.18"E

Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 60

Coordinates: 25°46'43.71"S 30° 12'28.83"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay Loam 20-35%

Depth: 0.7m

Photograph(s):

Classification Point: 61

Coordinates: 25°46'32.32"S 30° 12'34.37"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 20-35-55%

Depth: 0.9m

Photograph(s):

Classification Point: 62

Coordinates: 25°46'26.37"S 30° 12'31.50"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 1.1m

Photograph(s):

Classification Point: 63

Coordinates: 25°46'48.80"S 30° 14'12.28"E

Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.01m

Photograph(s):

Classification Point: 64

Coordinates: 25°46'57.52"S 30° 14'19.90"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.1m

Photograph(s):

Classification Point: 65

Coordinates: 25°46'20.69"S 30° 13'16.10"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.1m

Photograph(s):

Classification Point: 66

Coordinates: 25°46'23.10"S 30° 12'59.68"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.1m

Photograph(s):

Classification Point: 67

Coordinates: 25°51'9.29"S 30° 6'27.23"E

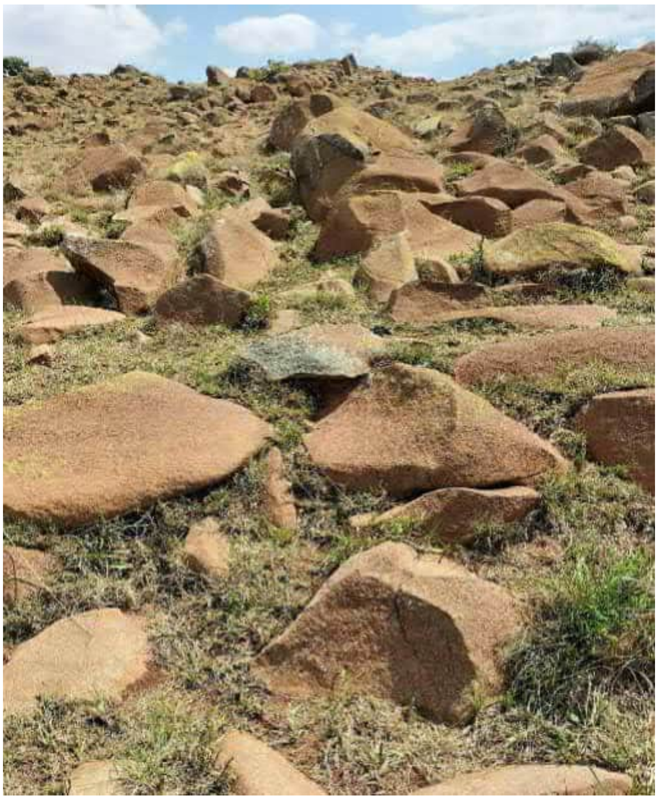
Soil Form: Mispah

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.01m

Photograph(s):



Classification Point: 68

Coordinates: 25°50'7.50"S 30° 5'04.61"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.1m

Photograph(s):

Classification Point: 69

Coordinates: 25°50'22.58"S 30° 8'54.82"E

Soil Form: Glenrosa

Catena Position: Mid-slope

Clay Percentage: Sandy 0-10%

Depth: 0.1m

Photograph(s):

Classification Point: 70

Coordinates: 25°49'45.28"S 30° 8'04.64"E

Soil Form: Glenrosa

Catena Position: Lower slope

Clay Percentage: Sandy 0-10%

Depth: 0.1m

Photograph(s):

Classification Point: 71

Coordinates: 25°47'8.15"S 30° 8'24.01"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 0.9m

Photograph(s):

Classification Point: 72

Coordinates: 25°46'27.81"S 30° 8'45.53"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 1.1m

Photograph(s):

Classification Point: 73

Coordinates: 25°47'00.95"S 30° 8'31.02"E

Soil Form: Shortlands

Catena Position: Mid-slope

Clay Percentage: Sandy Clay 35-55%

Depth: 1.2m

Photograph(s):

Building 1, Maxwell Office Park
Magwa Crescent West, Waterfall City
Midrand, 1685
South Africa

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