SMEC
South Africa
Member of the Surbana Jurong Group

SMEC INTERNAL REF. 23GP03/2023/04/2881

Geotechnical Desktop Study Report

Loxton Wind Energy Cluster, Northern Cape

Project Reference No. 23GP03

Prepared for Loxton Wind Facility 1 (Pty) Ltd, Loxton Wind Facility 2 (Pty) Ltd, and Loxton Wind Facility 3 (Pty) Ltd

25 April 2023

Document Control

Project Name	Loxton Wind Energy Cluster, Northern Cape
Document Name	Geotechnical Desktop Study Report
Report Number	23GP03/2023/04/2881
Revision Number	B

Revision History

Revision No.	Date	Prepared By	Reviewed By	Approved for Issue By
A	28/02/2023	B. Magwaza	R. Roberts	C. Warren-Codrington
B	25/04/2023	B. Magwaza	R. Roberts	C. Warren-Codrington

Issue Register

Distribution List	Date Issued	Number of Copies
Loxton Wind Facility 1 (Pty) Ltd, Loxton Wind Facility 2 (Pty) Ltd, and Loxton Wind Facility 3 (Pty) Ltd	25/04/2023	1 Electronic

SMEC Company Details

Approved by	Charles Warren-Codrington Pr Eng		
Address	SMEC South Africa (Pty) Ltd.		
	65 Riebeek Street		
	Cape Town	South Africa	8001
Telephone	+27 21 417 2900	**Website**	www.smec.com
Email	charles.warren-codrington@smec.com		
Signature			

The information within this document is and shall remain the property of: Loxton Wind Facility 1 (Pty) Ltd, Loxton Wind Facility 2 (Pty) Ltd, and Loxton Wind Facility 3 (Pty) Ltd.

Important Notice

This report is confidential and is provided solely for the purposes of providing Loxton Wind Facility 1 (Pty) Ltd, Loxton Wind Facility 2 (Pty) Ltd, and Loxton Wind Facility 3 (Pty) Ltd with a geotechnical desktop study for the Loxton Wind Energy Facility (WEF) located east of Loxton, Northern Cape. This report is provided pursuant to a Consultancy Agreement between SMEC South Africa (Pty) Ltd ("SMEC") and Loxton Wind Facility 1 (Pty) Ltd, Loxton Wind Facility 2 (Pty) Ltd, and Loxton Wind Facility 3 (Pty) Ltd, under which SMEC undertook to perform a specific and limited task for Loxton Wind Facility 1 (Pty) Ltd, Loxton Wind Facility 2 (Pty) Ltd, and Loxton Wind Facility 3 (Pty) Ltd This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications, and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications, and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

This report must be read as a whole. Any subsequent report must be read in conjunction with this report.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents, or which come to light after the date of the report. SMEC is not obliged to inform you of any such event, transaction, or matter nor to update the report for anything that occurs, or of which SMEC becomes aware, after the date of this report.

Unless expressly agreed otherwise in writing, SMEC does not accept a duty of care or any other legal responsibility whatsoever in relation to this report, or any related enquiries, advice or other work, nor does SMEC make any representation in connection with this report, to any person other than Loxton Wind Facility 1 (Pty) Ltd, Loxton Wind Facility 2 (Pty) Ltd, and Loxton Wind Facility 3 (Pty) Ltd Any other person who receives a draft or a copy of this report (or any part of it) or discusses it (or any part of it) or any related matter with SMEC, does so on the basis that he or she acknowledges and accepts that he or she may not rely on this report nor on any related information or advice given by SMEC for any purpose whatsoever.

Table of Contents

1 Introduction 1
1.1 Background and Project Description 1
1.2 Terms of Reference 1
1.3 Objectives 1
1.4 Methodology 1
1.5 Codes of Practices and Standards 2
1.6 Limitations of Assessment 2
2 Site Dictates 3
2.1 Location 3
2.2 Climate 3
2.3 Topography, Drainage and Vegetation 6
2.4 Regional Geology 6
2.5 Regional Hydrogeology 6
2.6 Seismicity 10
3 Geotechnical Evaluation 12
3.1 Proposed Development 12
3.2 Conceptual Geological Profile 12
3.3 Geotechnical Risks 13
4 Recommendations 14
4.1 Geotechnical Feasibility of Project 14
4.2 Geotechnical Investigations 14
4.2.1 Preliminary Geotechnical Investigations 14
4.2.2 Detailed Geotechnical Investigations 15
5 Conclusion 16
6 Closing 17
7 References 18

List of Figures

Figure 2-1: Summary of Climatic Data in Loxton (after World Weather Online, 2022) 3
Figure 2-2: Site Location 4
Figure 2-3: Site Layout Plan 5
Figure 2-4: Topography and Drainage of the Study Area 7
Figure 2-5: Abstract of 3122 Victoria West, 1:250 000 Geological Map Series Showing the Geology Underlying the Study Area 8
Figure 2-6: Abstract of 3122 Beaufort West, 1:500 000 Hydrogeological Map Series Showing Groundwater Aquifers Characterising the Study Area 9
Figure 2-7: Seismic Hazards Map of South Africa (Council for Geoscience, 2003) 10
Figure 2-8: Seismic Activity Recorded (SANSN, 2009) 11

1 Introduction

1.1 Background and Project Description

Loxton Wind Facility 1 (Pty) Ltd, Loxton Wind Facility 2 (Pty) Ltd, and Loxton Wind Facility 3 (Pty) Ltd ("The Applicant") propose constructing a wind energy facility (WEF) on a site located approximately 30 km North of Loxton within the Ubuntu Local Municipality, Pixley Ka Seme District Municipality, Northern Cape Province. The site is subdivided into three areas designated Loxton 1, 2 and 3. The development details at each WEF are indicated below:

- The Loxton WEF 1 project site covers approximately 7 200 ha and shall comprise up to 42 turbines producing up to 240 MW with a permanent footprint of 65 ha.
- Loxton WEF 2 covers an area of approximately 15 000 ha and shall comprise up to 62 turbines producing up to 480 MW with a permanent footing of 110 ha.
- Loxton WEF 3 covers an area of approximately 12 500 ha and shall comprise up to 38 turbines producing up to 240 MW with a permanent footprint of 65 ha.

Each WEF includes associated access roads, laydown areas, auxiliary buildings and substations. Full information on these and the turbine footprint area is attached in Appendix A of this report.

1.2 Terms of Reference

SMEC South Africa (Pty) Ltd. ("SMEC") was appointed on 13 February 2023 by the Applicant to carry out a desktop review of the site concerning geological and geotechnical aspects thereof.

1.3 Objectives

This desktop study aims to provide high-level geological and geotechnical information for the proposed Loxton WEF so that the Applicant can provide stakeholders with baseline geological and geotechnical information for planning purposes. The tasks required to fulfil this objective are as follows:

Identification of documented regional and local geological conditions;

Review site topography and climate and their influence on rock decomposition and subsequent soil formation;

Review geohydrological information at a desktop level (viz. groundwater levels, flow direction, etc.);

Provide insight into the perceived geotechnical conditions of the site (viz. foreseeable soil formations, depth, and quality of underlying rock masses); and

Comment on the geotechnical feasibility of the WEFs.

1.4 Methodology

The following methodology was adopted to realise the objective of the desktop study:

Review available geological records, including 3122 Victoria West, 1: 250 000 Geological Series;

Review of 3122 Beaufort West, 1:500 000 Hydrogeological Map Series;

Review of site topography via Digital Elevation Model (DEM)-sourced elevation data; and

Evaluation of SMEC's geotechnical database of projects conducted near the project area and within similar geotechnical and geological zonation/ sequences.

1.5 Codes of Practices and Standards

SMEC used the following standards and guideline documents in performing this study:

- Site Investigation Code of Practice. SAICE Geotechnical Division (2010); and
- Basis of structural design and actions for buildings and industrial buildings. Part 5: Basis for geotechnical design and actions. SANS 10160-5 (2010).

1.6 Limitations of Assessment

The services performed by SMEC were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical profession practising under similar conditions for the requirements of a geotechnical feasibility study (SAICE, 2010). This geotechnical desktop study report is based on data from a limited number of sources, including geological records, topographic maps, aerial imagery, and geotechnical and geological literature available for the greater Loxton region.

The nature of geotechnical engineering is such that variations in soil and rock conditions may occur even where sites seem consistent. Variations in what is reported here will become evident during the later project phases of site investigation and construction.

On a conceptual basis, the current project phase may be considered a Category 1 geotechnical project (SANS 10160-5, 2010), requiring desktop study equivalent information to determine the project feasibility.

However, once the project progresses to the preliminary and detailed design stages, it will require more detailed geotechnical input. Thus, to lower the probability of failure of the final designed structures and avoid over-design, a detailed geotechnical investigation of each turbine structure - and supporting infrastructure thereof - must be considered mandatory as the project approaches detailed design status. Thus, this report will culminate with recommendations for further geotechnical investigations that will provide the engineer with the necessary parameters for further design stages. It must be noted that any founding recommendation(s) provided in this report is conceptual and that this report does not present a design for the proposed foundation support solution(s). Referral to a design solution is conceptual, and the design process, as per the latest version of SANS 10160 in general and specifically SANS 10160-5, must be undertaken under a separate appointment.

2 Site Dictates

2.1 Location

The site is approximately 30 km north of Loxton and 92 km north of Beaufort West. It is assumed that Loxton WEF 1 and Loxton WEF 2 can be accessible via unnamed roads joining from the R63. Loxton WEF 3 can be accessed directly via the R63, which intersects this facility to the north. Within the site boundary, numerous gravel tracks are discernible from the Google Earth satellite image. The site location and layout plan are illustrated in Figure 2-2 and Figure 2-3, respectively.

2.2 Climate

Loxton experiences arid climate conditions, with a Thornthwaite's Moisture Index of less than -40 (Emery, 1988). Climatic data (World Weather Online, 2023) indicates that the mean annual temperature in this region is 15.9°C. The average maximum daily temperatures vary from 30.1°C in January to 14.4°C in June-July. Corresponding minimum temperatures for these months are 14.6°C and 2.5°C, respectively. The mean annual precipitation is approximately 263 mm, falling mainly during summer. Precipitation is the lowest in September, with an average of 10 mm. The greatest amount of precipitation occurs in March, with an average of 37 mm. The average monthly temperature and rainfall distribution are illustrated in Figure 2-1.

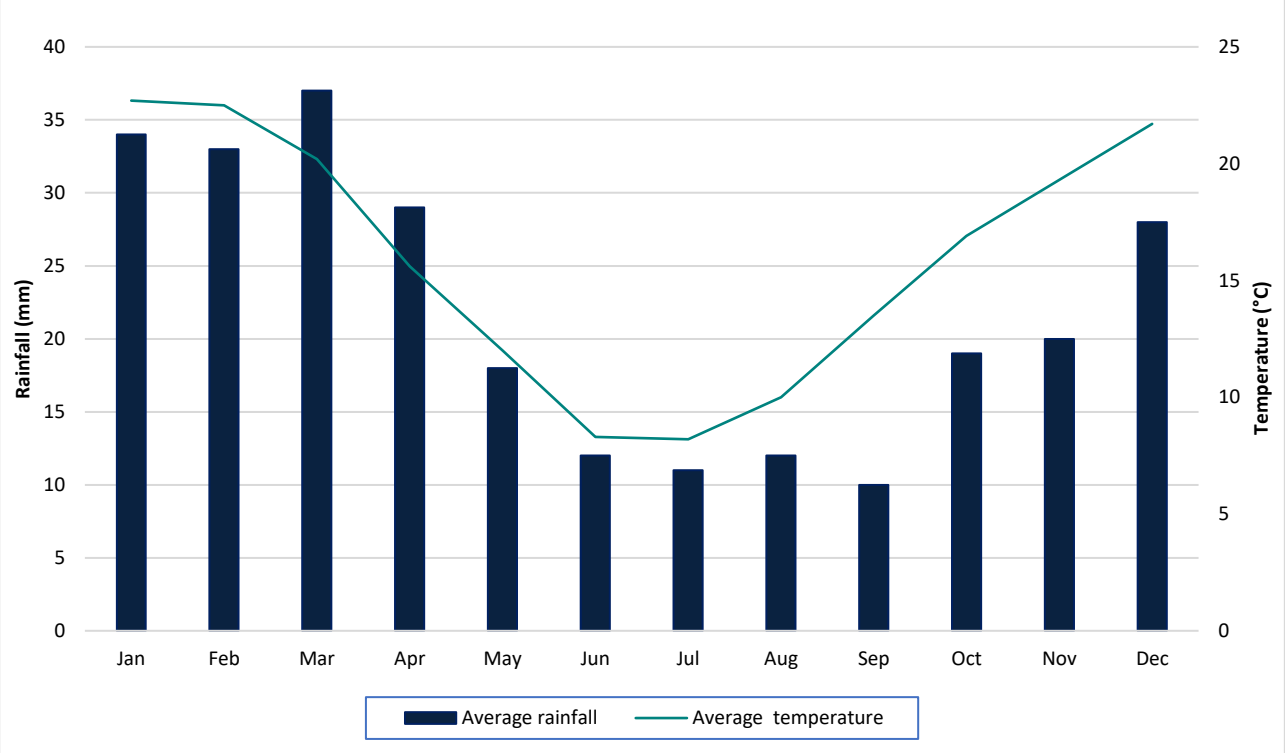

Figure 2-1: Summary of Climatic Data in Loxton (after World Weather Online, 2022)

The climate is a pivotal factor for geotechnical considerations as it determines the mode and rate of rock mass weathering and, thus, the formation of soils. Weinert (1980) developed the N-Value to differentiate between regions of similar weathering characteristics. The N-value for the Loxton region is approximately 18, indicating that disintegration will be the predominant type of weathering, resulting in less-developed residual soil horizons and shallow bedrock conditions. However, based on the previous studies conducted near the site, thick transported soils may occur.

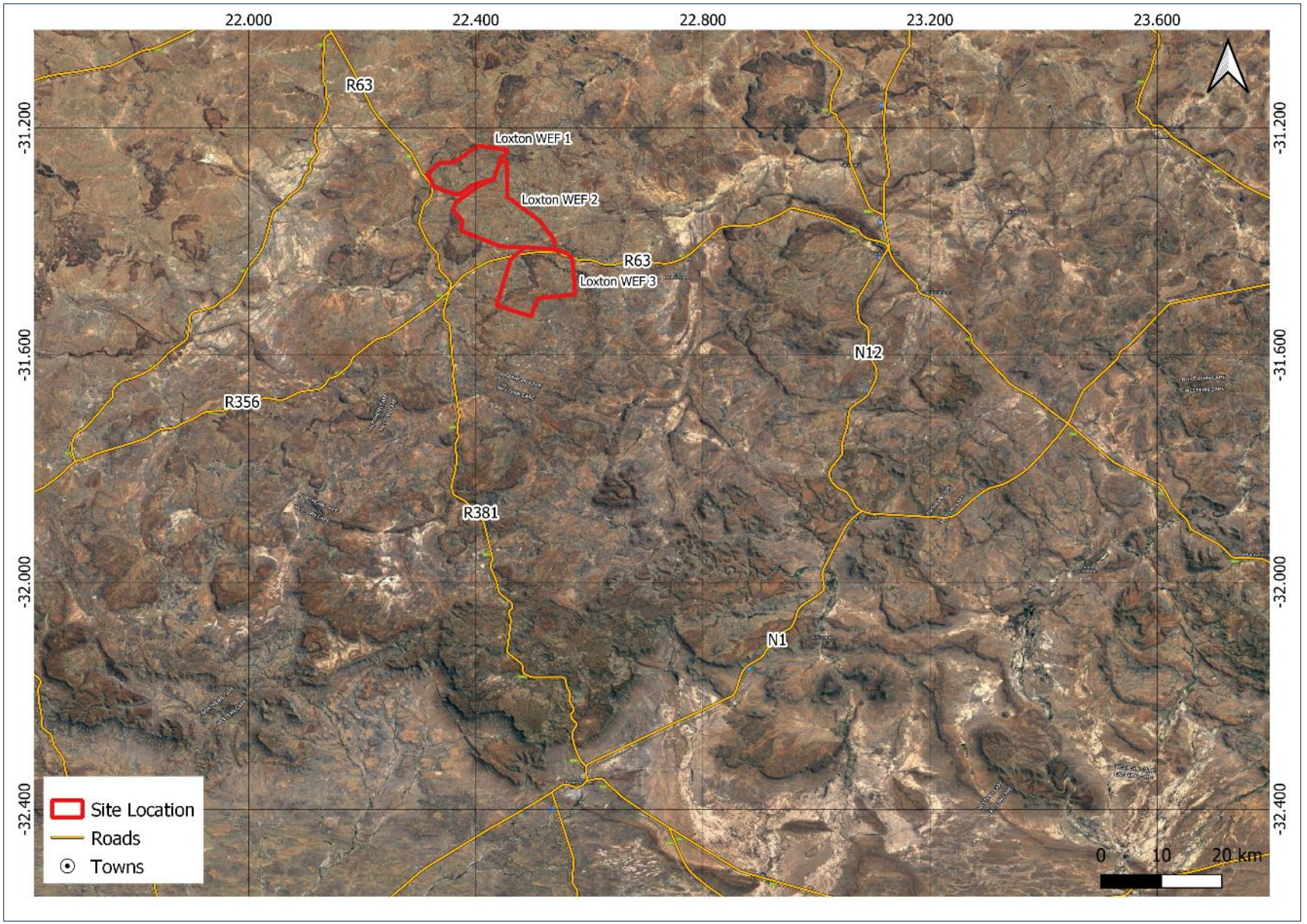

Figure 2-2: Site Location

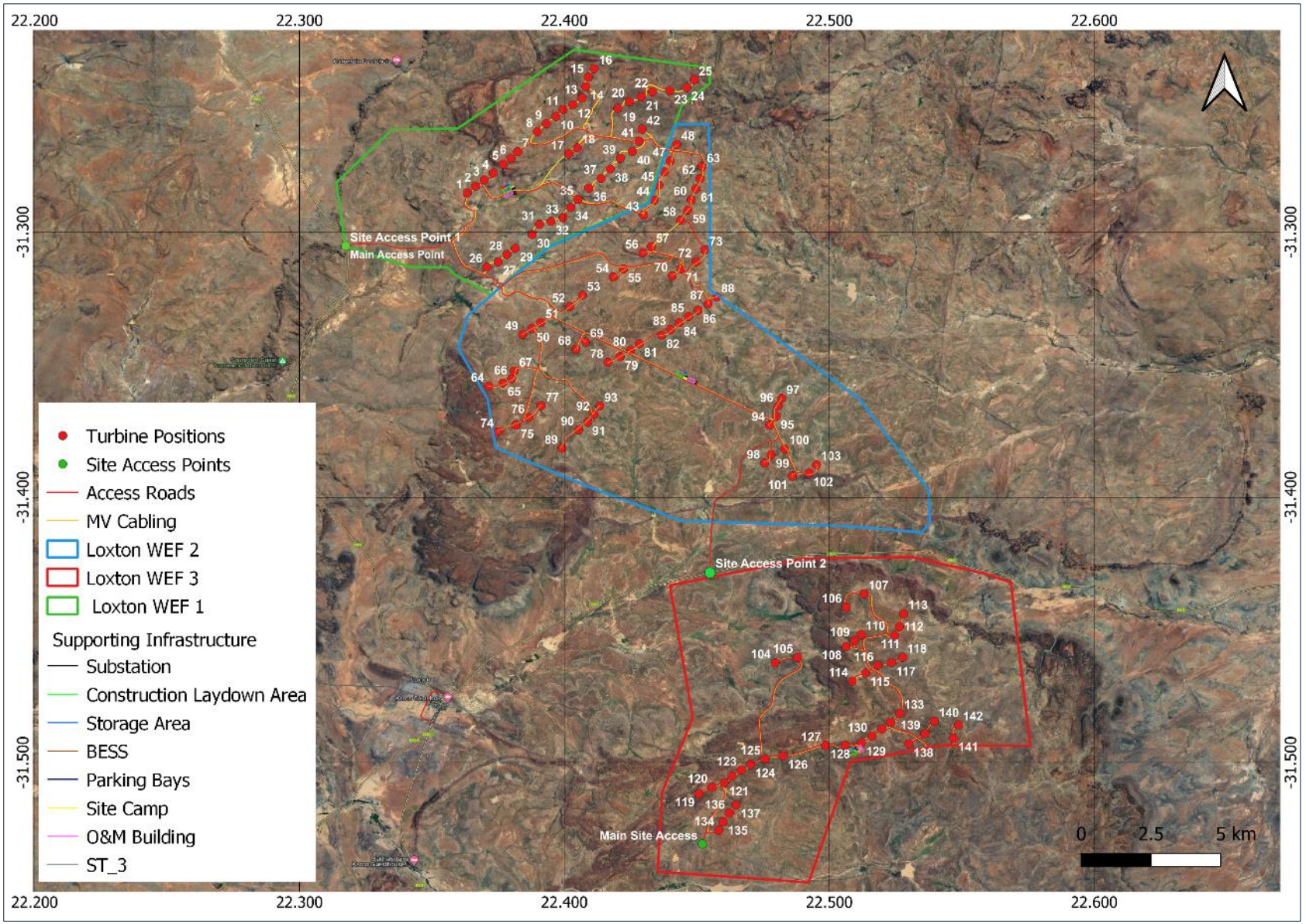

Figure 2-3: Site Layout Plan

2.3 Topography, Drainage and Vegetation

The regional topography generally slopes northward at an average slope of 2.2%. An irregular topography characterises the site with minor elevation differences; dolerite hills form topographical highs in the study area. The minimum and maximum elevation points are approximately 1 420 and 1 560 m above mean sea level, respectively. Elevation profiles estimated from Google Earth indicate an elevation gain/ loss of 525 m at an average gradient of 2.5% across the three WEFs.

The site is bounded east and west by the north-easterly flowing Klein Brak River and the north-westerly draining Brak River, respectively (Figure 2-4). Their unnamed ephemeral tributaries intersect the site at numerous points, and several farm dams are also noted along these tributaries.

According to the 1:1 000 000 SANBI vegetation map (2018), the study area is regionally characterised by the Upper Nama Karoo vegetation comprising stunted shrubs and thornveld.

2.4 Regional Geology

A review of 3122 Victoria West, 1:250 000 Geological Series indicates that the Loxton WEF site is underlain by the sedimentary rocks belonging to Abrahamskraal and Teekloof formations of the Adelaide Subgroup, Karoo Sequence.

The Abrahamskraal Formation, which underlies most of the site, forms the lower part of the Adelaide Subgroup and comprises up to 2 500 m thick fining upward succession (Woodford and Chevallier, 2002). It comprises grey to green mudstone interlayered with fine to medium-grained sandstone, with the mudstone sandstone ratio of 4:1 (Johnson et al. 1996).

Over 40% of the Loxton WEF 3 is underlain by the younger Teekloof Formation, comprising up to 1 000 m thick interlayered fining upward succession. This sequence is dominated by grey mudrock with thin feldspathic sandstone bodies deposited in a fluvial environment (Johnson et al. 1996).

The sedimentary sequence is intruded by a series of dolerite sills which form ridges and is regionally covered by Quaternary alluvial sand deposits occurring along the drainage lines (Figure 2-5).

2.5 Regional Hydrogeology

The groundwater environment characterising the site comprises two aquifers, the Karoo sediments and the intruding dolerites, classified as intergranular and fractured aquifers. The borehole yielding potential within the intergranular and fractured aquifers ranges between 0.1 L/s and 2 L/s. Higher yields (>5 L/s) in intergranular and fractured aquifers are limited to geological structures which act as groundwater conduits within these aquifer types.

The alluvial sand deposits developed along major drainage lines are classified as Quaternary unconfined aquifers. Quaternary aquifers often have high porosity and hydraulic conductivity, allowing for the free flow of water, and hence are expected to be high yielding.

Several boreholes exist within the site boundaries. The depth to groundwater obtained from the existing registered borehole database (National Groundwater Archive) on the site indicates groundwater levels between ~7 m and 33 m below ground level within the intergranular and fractured aquifers. Groundwater levels within the Quaternary aquifers are expected to be shallow, from < 1 m below ground level (see Figure 2-6).

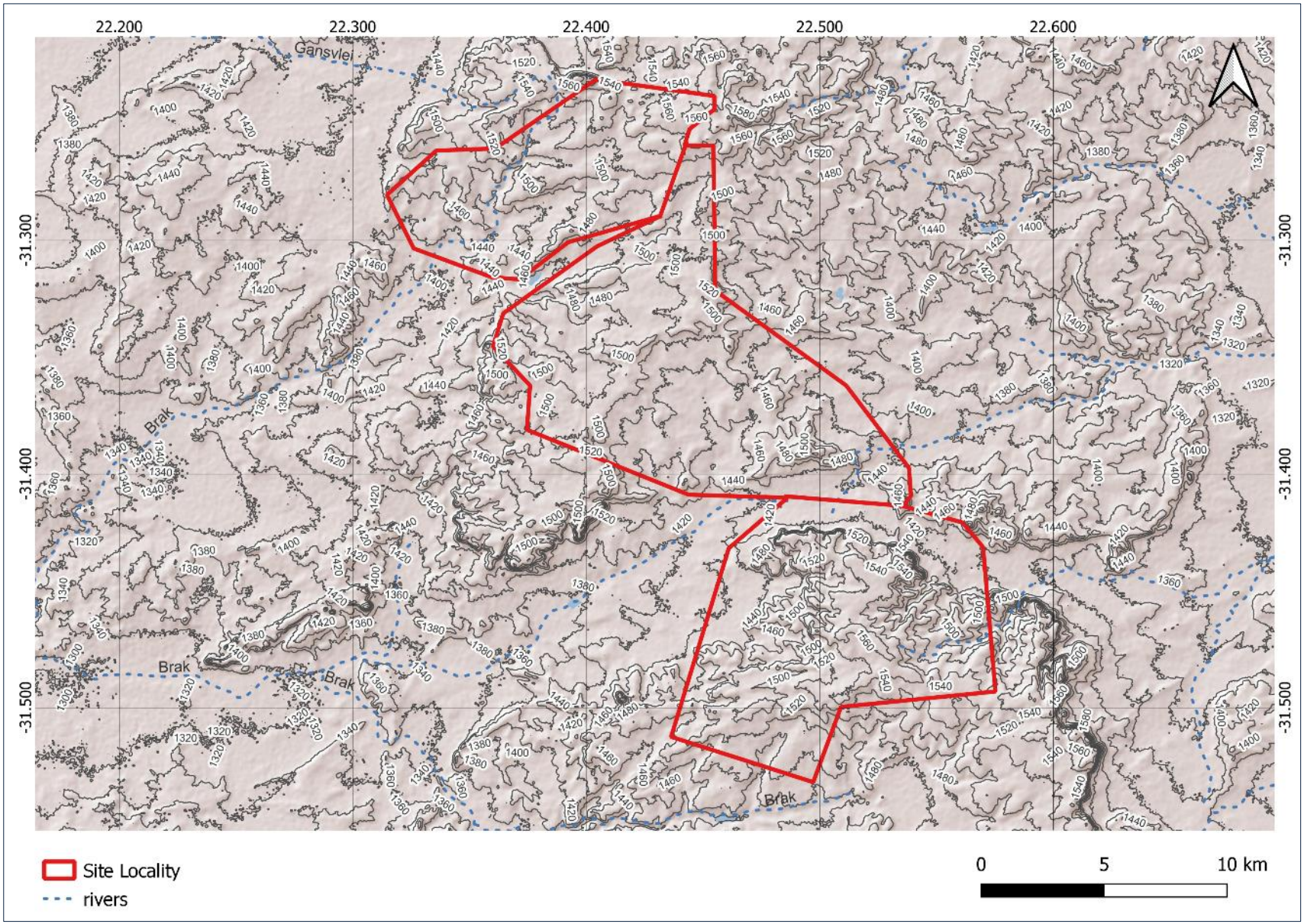

Figure 2-4: Topography and Drainage of the Study Area

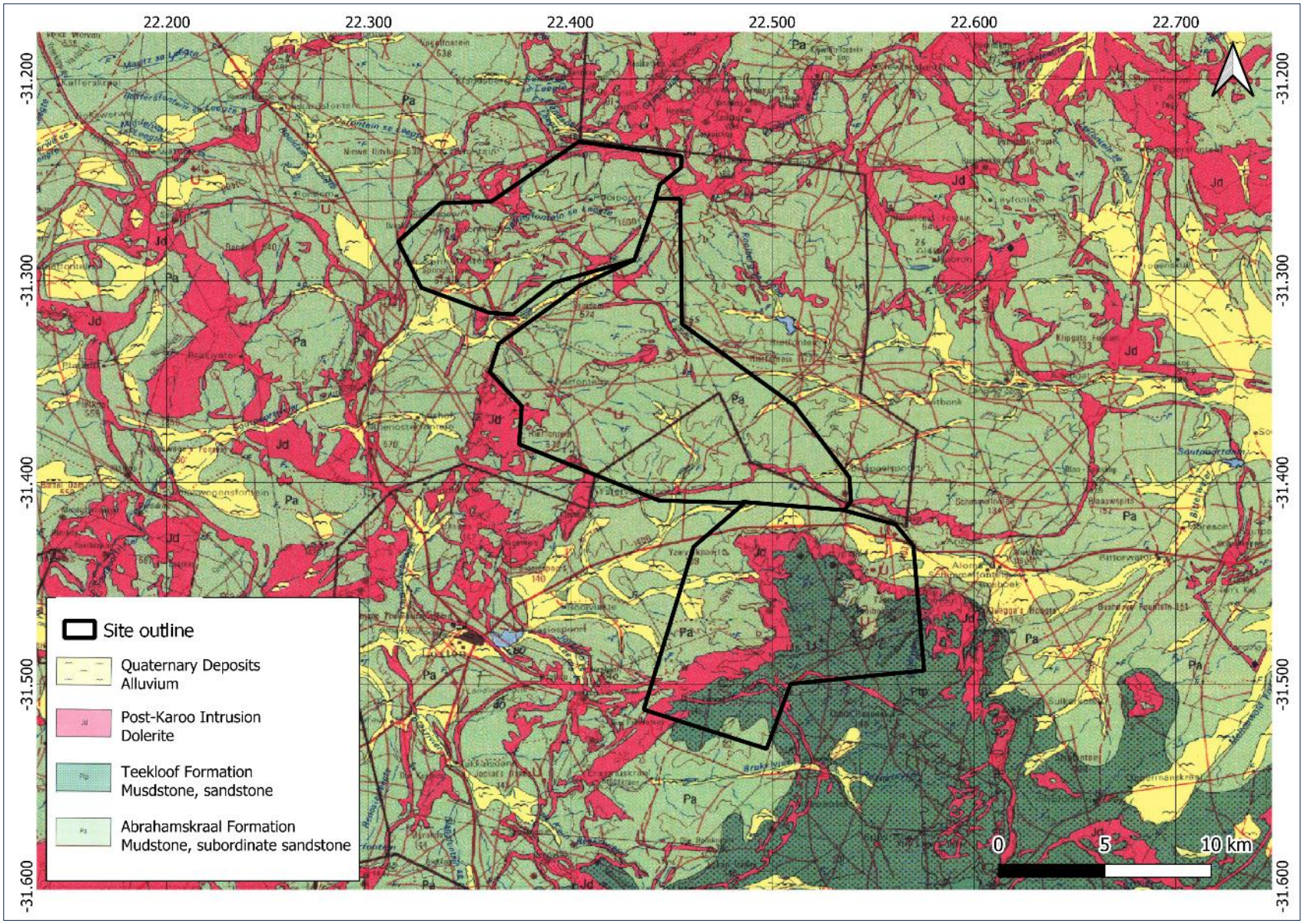

Figure 2-5: Abstract of 3122 Victoria West, 1:250 000 Geological Map Series Showing the Geology Underlying the Study Area

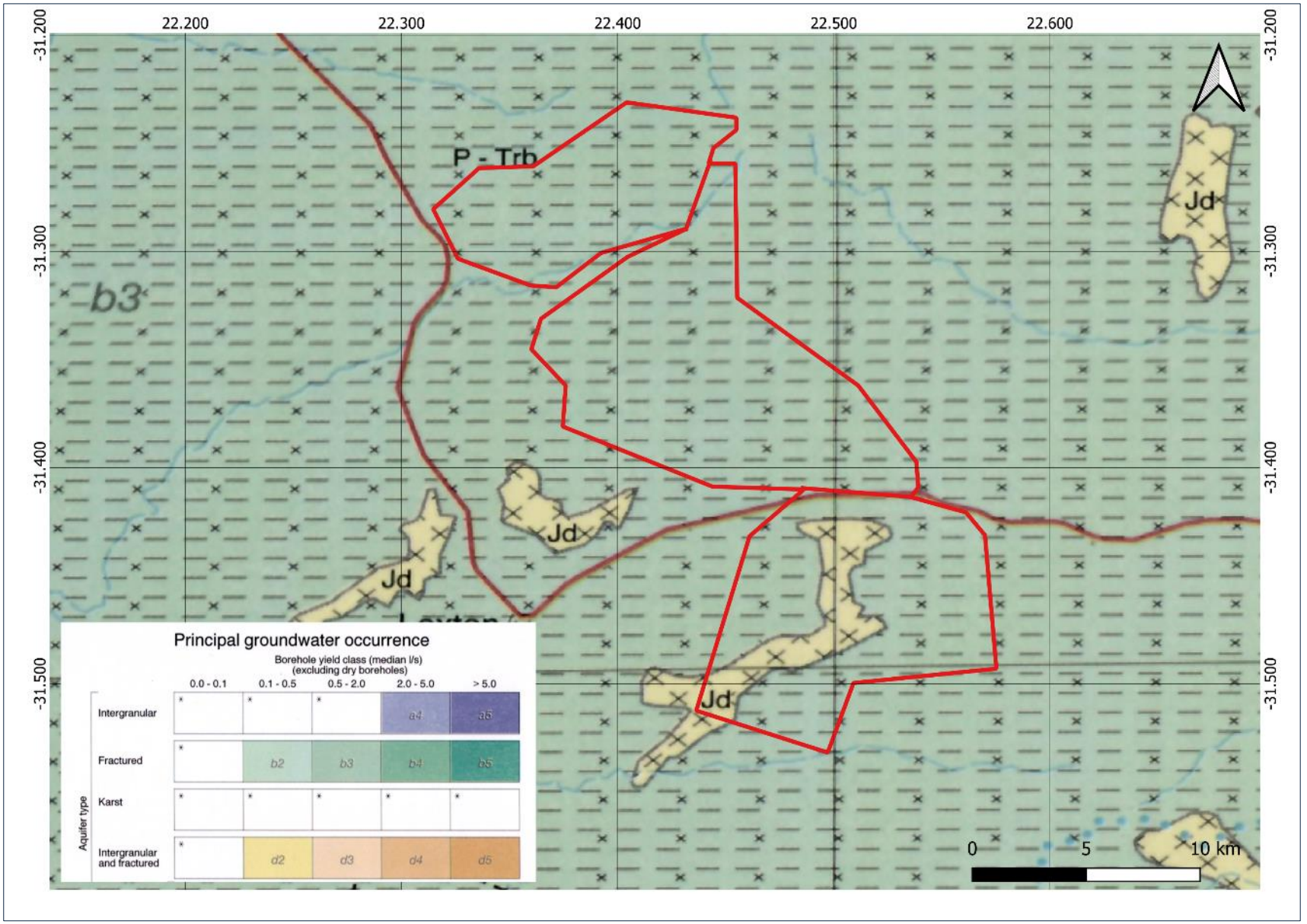

Figure 2-6: Abstract of 3122 Beaufort West, 1:500 000 Hydrogeological Map Series Showing Groundwater Aquifers Characterising the Study Area

2.6 Seismicity

The study area is situated in a relatively stable plate with low degrees of movement compared to other tectonic plates. Therefore, much of the African Plate – except the East African Rift Zone and localities of intensive underground mining – can be considered a zone of low tectonic activity. This does not suggest that no seismic activity occurs but that the probability and magnitude are lower. Seismic hazard is represented by the peak ground acceleration (PGA) of any area for a prescribed return period and the probability of exceedance. From Figure 2-7, the relevant range of PGA values applicable to the project site - to a 10% probability of exceedance over 50 years is in the range of 0.08 g and 0.1 g.

The South African Loading Code SANS 10160 (Part 4 Seismic Actions for Buildings) requires "ordinary buildings" to be designed for seismic or mining-induced seismic activity where PGA exceeds 0.1g. PGA in the study area is ≤0.1; therefore, the above-mentioned design conditions are not applicable.

In addition to this rating, the South African National Seismic Network (SANSN), a division of the Council for Geoscience, has recorded seismic events across South Africa. For completeness and to give a complete overview of the seismic setting of the site, this is presented in Figure 2-8.

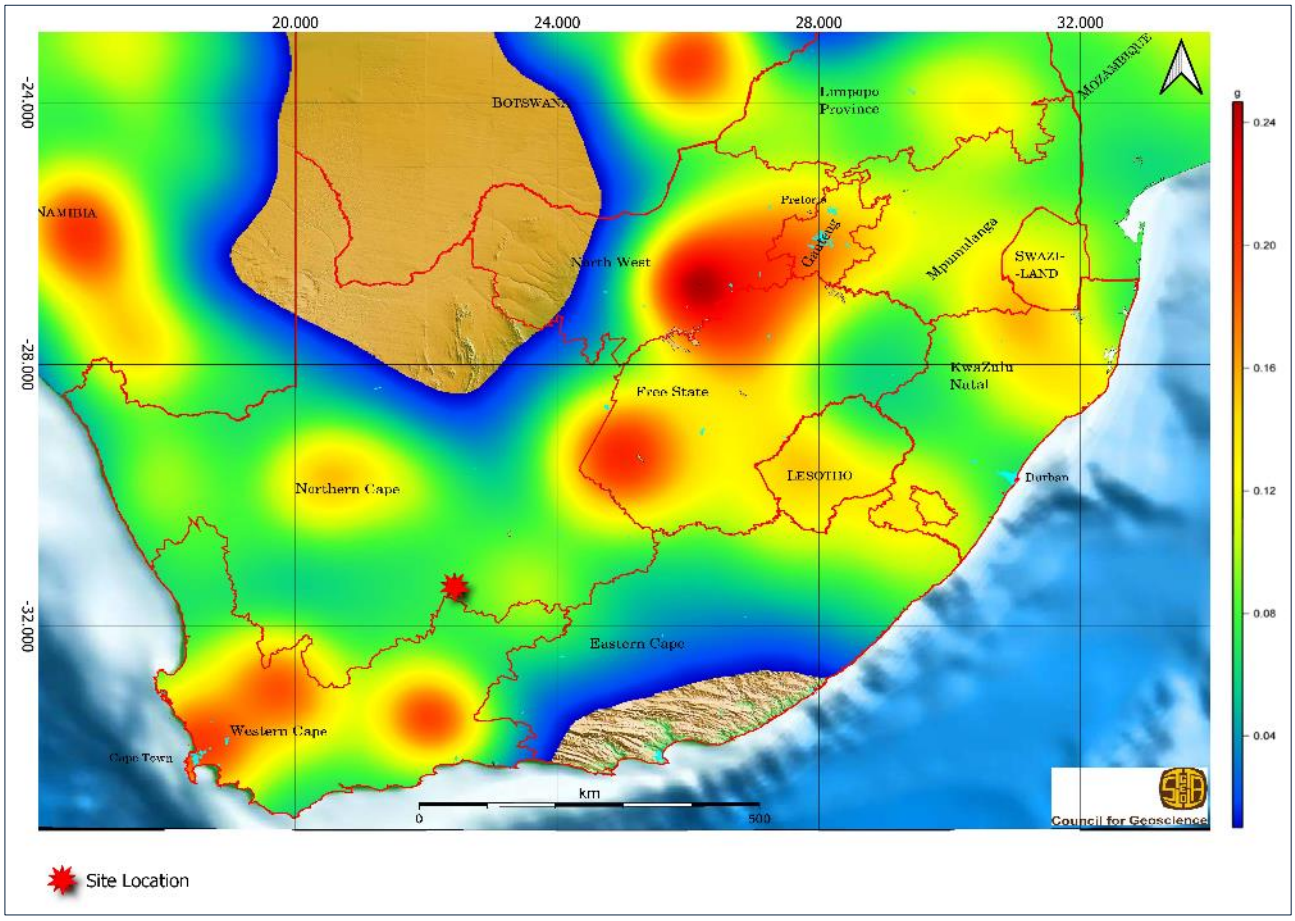

Figure 2-7: Seismic Hazards Map of South Africa (Council for Geoscience, 2003)

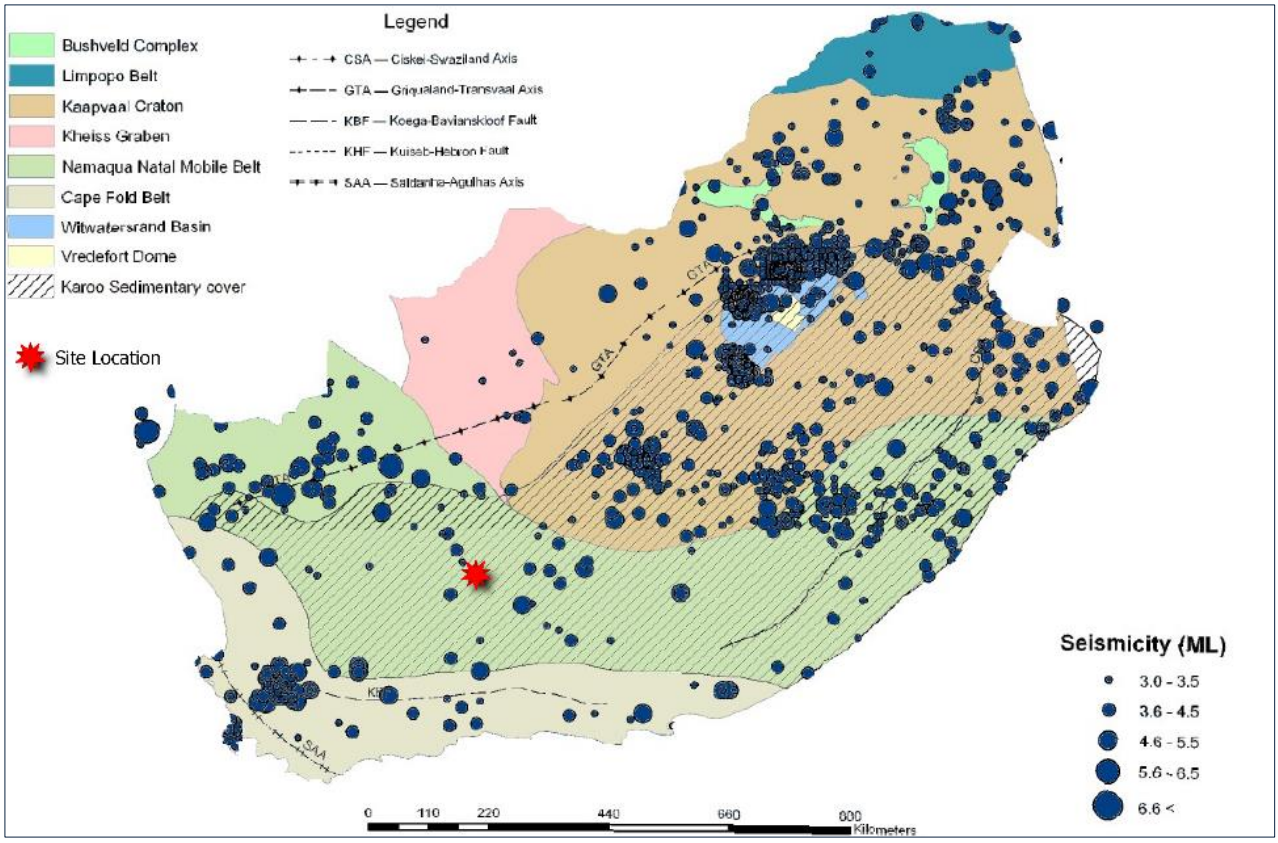

Figure 2-8: Seismic Activity Recorded (SANSN, 2009)

3 Geotechnical Evaluation

3.1 Proposed Development

The Applicant provided SMEC with a site layout plan showing anticipated turbine positions, with associated construction laydown areas, substations, operations, and maintenance buildings. From the desktop assessment of the site and the surroundings, the rock mass is anticipated at a shallow depth, hence, founding of wind turbines on shallow rock mass is considered likely.

In areas characterised by thickly developed transported sand, the wind turbine structures may require piles socketed into the bedrock below the alluvium layers. However, these deposits characterise low-lying areas or drainage lines, and it is unlikely that the placement of turbines at those locales will be practical for optimum wind exposure.

3.2 Conceptual Geological Profile

Based on data gathered from the desktop review of regional geology and historical borehole data, it is foreseeable that the site will primarily be underlain by mudrock and sandstone, which are expected at shallow depths in most parts of the site. Dolerite outcropping to the surface and at shallow depth is expected to be more dominant in Loxton WEF 1 and 3 than in Loxton WEF 2. Previous studies near the site also indicate that thick transported soils up to 3 m below ground level are expected along shallow depressions. Additionally, dolerite gravel, cobbles, and boulders are anticipated along the hill slopes, especially around dolerite occurrences.

Based on the information gathered and evaluation thereof, the following conceptual geological profile is envisioned for wind turbine foundations:

0 to ≥ 3m: Alluvium: silty sandy gravel/ sandy, clayey silt sand deposits are expected to occur across the site. Thicker sand deposits greater than 2.6 m in thickness are expected in areas along the drainage lines and shallow depressions.

Thin residual clayey or silty sand is expected to occasionally occur on the surface or below the transported sand up to depths of 3 m below ground level.

The bedrock profile in the study area is expected to comprise an upper weathered profile either outcropping to the surface or underlying the thin residual and transported soil profiles reaching up to 3 m below ground level, then progressing to an unweathered rock profile.

The region's climate promotes mechanical weathering, suggesting typically thinly developed residual soil. The project area is located in an irregular topography; during high rainfall periods, the transported soils may be susceptible to seasonal flooding resulting in weathered to fresh rock mass generally being exposed at shallow depths in most parts of the site.

Based on the regional climatic conditions, the dolerite, which occupies about 20% of the site, is expected to be more weather-resistant and typically has a good rock quality. Mudstone and sandstone, when unweathered, are typically classified as fair to good quality rocks (Class III to Class II), being medium-hard to hard rock in strength. These rocks provide a suitable base for founding wind turbine structures. However, weathering of these sedimentary rocks can significantly reduce their quality and strength and should be protected soon after excavation with the placement of blinding concrete.

Variations to the above conceptual geological profile and strength index will manifest through on-site geological mapping and geotechnical investigations.

3.3 Geotechnical Risks

Conceivable geotechnical risks towards the proposed development of the Loxton WEF are provided hereunder. These risks should form part of the objective of geotechnical investigations for the preliminary and detailed design of the proposed infrastructure.

Undefined rock mass competence laterally and with depth at the planned turbine locations.

Hard to very hard rock conditions for areas, particularly those underlain by dolerite, requiring hard excavation techniques (blasting) to excavate foundations and construct access roads;

Irregular topography and local steep slopes with considerable elevation differences across dolerite ridges;

Sourcing of suitable construction materials (specifically for concrete aggregate and surfacing of gravel roads);

Unquantified durability of mudstone upon exposure to atmosphere and moisture;

Localised perched groundwater table; and

Undefined depth to permanent groundwater table and whether this is suitable for use during construction.

4 Recommendations

4.1 Geotechnical Feasibility of Project

Based on the geological and geotechnical information obtained for the Loxton WEF and interpretation thereof, there appears to be no geotechnical reason for the project's development not to proceed beyond the pre-feasibility stage.

Foundation solutions appropriate for the anticipated geotechnical conditions can be conceptualised and provided. SMEC cannot comment on the overall feasibility of the project. However, from a geotechnical point of view, the project can surpass the feasibility stage and move to preliminary and detailed design-level geotechnical investigations.

4.2 Geotechnical Investigations

This desktop study has been compiled for feasibility purposes only; thus, the information presented here will not be suitable for designing Category 3 structures (SANS 10160-5, 2010), as anticipated for this project. Thus, for economic design and to reduce the probability of failure of the proposed development, site mapping, geotechnical field investigations, and laboratory work will be required for engineering design. Each geotechnical investigation will elevate the project to a higher confidence level. Based on information obtained from this feasibility study, SMEC has recommended the following further geotechnical investigations as per guidelines offered by SAICE (2010).

4.2.1 Preliminary Geotechnical Investigations

The following scope of work is recommended for preliminary geotechnical investigations which must be undertaken, as part of a phased investigation approach, prior to construction:

Machine excavation of test pits across the site where development is anticipated to facilitate recovery of bulk material samples. Test pits are to be excavated using a tractor loader backhoe (TLB) to a refusal depth or the machine's reach.

Rotary core drilling at least 20% of turbine locations per Wind Energy Facility to determine the rock mass competence. Boreholes should be drilled to at least 25 m depth or shallower if at least 10 m of continuous, competent rock mass is intersected.

Installation of groundwater standpipes for the long-term observation of groundwater levels.

Profiling of soil and rock horizons by a registered professional Engineering Geologist or Geotechnical Engineer.

Field mapping across the site of rock mass outcrops at planned turbine locations (or clusters thereof) by a registered professional Engineering Geologist or Geotechnical Engineer and derivation of Geological Strength Indices.

Retrieval of soil and rock samples for determination of index and engineering properties including, but not limited to:

- Foundation Indicator tests, including determination of Atterberg limits, grading and hydrometer analyses to determine clay content and activity.
- Modified AASTHO/ CBR and compactability tests to determine the utilisation of in situ material in new construction activities.
- Moisture content and chemical analysis tests on soil samples to determine aggressiveness towards buried ferrous services and foundations.

- Uniaxial Compressive strength with strain measurements (UCM) on rock core samples to approximate rock mass properties.

Compile a comprehensive interpretive geotechnical report with recommendations, inter alia, on the following:

- Foundation options;
- Site development and excavatability; and
- Material utilisation.

4.2.2 Detailed Geotechnical Investigations

The following broad scope of work should be considered a minimum for detailed geotechnical investigations for the Loxton WEF. Below is a high-level summary of the investigations envisioned to facilitate detailed engineering design. Quantities are not made explicit as these will rely on the preliminary geotechnical investigation results and final project design layouts.

Additional test pits and dynamic probing (if thicker soil horizons are intersected) will further quantify the ground conditions and build a robust geological cross-section for the planned infrastructure. Additional test pits will be required for all infrastructure not previously investigated in the preliminary geotechnical study, such as access roads, overhead transmission lines, laydown areas and other supporting facilities. Furthermore, test pits will be required to establish excavatability for buried cable trenches.

Additional rotary core turbine positions at all confirmed turbine locations to facilitate detailed rock mass evaluation and design parameters.

Installation of groundwater standpipes for the long-term observation of groundwater levels. The existing borehole may also be used for groundwater monitoring.

Multi-channel Analysis of Surface Waves (MASW) in combination with seismic refraction geophysical surveys to establish rock mass properties such as:

- Bulk modulus;
- Shear modulus;
- Young's Modulus;
- Poisson's Ratio; and
- Shear and primary wave velocities (Vs and Vp, respectively).

Additional laboratory testing if justified by the preliminary investigation.

Electrical resistivity tomography (ERT) geophysical survey across substation footprints to establish design parameters for earth mat design.

The geotechnical design of turbine foundations and verification procedures for foundations specific to the geological conditions of each turbine site.

Compilation of a comprehensive interpretive geotechnical report providing firm recommendations for project development and detailed engineering design.

5 Conclusion

This geotechnical desktop study report highlights the anticipated geological and subsequent ground conditions expected at the Loxton Wind Energy Facility.

Based on a desktop study, a basic geological profile has been conceptualised for the project site. The primary geotechnical conditions to be expected during construction activities and their variability across the site and associated characteristic geotechnical issues are discussed based on this conceptual profile.

Briefly, soft to hard rock mudstone interlayered with sandstone is anticipated to be the dominant geological profile at the site, underlying about 80% of the site. About 20% of the site is expected to be underlain by medium-hard to very hard rock dolerite. Alluvium sand deposits are expected to cover the lithology in most parts of the site with variable thicknesses ranging from 0 – 3.0 m (±0.2).

Generally, the planned turbine positions are on the hilltops, with a few located along the hill slopes. A site walkover will aid in determining if any slope instabilities may exist during construction. Several tributaries characterise the site and the surroundings; it is recommended that the structures are placed at least 100 meters from a 1:100-year flood line.

Shallow groundwater levels (from 1 m below ground level) are anticipated within Quaternary aquifers along drainage lines. A seasonal perched groundwater table is also anticipated across the site. Therefore, it is recommended that the groundwater level be monitored at the existing and future boreholes at the turbine positions.

The main concerns regarding development of the project sites and which will need to be determined via on-site investigations are:

- Undefined rock mass competence laterally and with depth at the planned turbine locations.
- Potentially hard to very hard rock conditions, particularly for areas underlain by dolerite, requiring hard excavation techniques (blasting) to excavate foundations and construct access roads.
- Irregular topography and instabilities thereof.
- Unquantified durability of mudrock upon exposure.
- Undefined depth to permanent groundwater table and whether this is suitable for use during construction.

SMEC is of the opinion that the project meets feasibility criteria and may move to preliminary and detailed design-level investigations, which will assist in defining and quantifying the geotechnical risks to development and choosing the most appropriate founding solution.

6 Closing

Based on the desktop study there are no fatal flaws in terms of the project progress.

This report acts merely to aid in the feasibility determination of the project, and it is imperative that geotechnical investigations of the site be undertaken should the development move forward. SMEC has undertaken several investigations for similar developments and highlighted the minimum requirements for preliminary and detailed geotechnical investigations to inform the respective engineering design. Undertaking geotechnical investigations will generate the necessary geomechanical design parameters of the soils and rock mass that will mitigate the risk of failure of the proposed structures and unforeseen geotechnical issues across the site.

It must be noted that the information and recommendations given in this desktop study report are generalised and based on limited data for the Loxton area and surroundings. Inconsistencies from what is reported here may likely be observed during the later investigation phases.

Furthermore, all recommendations this report makes serve as guidelines for the Client's consideration. Anticipated founding conditions and conceptual solutions, as described herein, must be proven before design and construction to ensure the proper economic viability of the proposed project.

We trust that this report will be found to be complete and adequate for your consideration. Should further elaboration be required for any portion of this project, we would be pleased to assist.

SMEC appreciates the opportunity to provide our services on this project and hopes to provide preliminary and detailed geotechnical investigations in future.

7 References

1. Engineering Geology of Southern Africa, Volumes 1-3. A. B. A Brink, 1979-1995.
2. Geotechnical Division Site Investigation Code of Practice. SAICE, 2010.
3. Monitoring Soil Erosion in South Africa at a Regional Scale. ARC-ISCW report no GW/A/2011/23 Project GW 59/004 Task 50. JJ Le Roux, 2011.
4. National Groundwater Archive (Department of Water and Sanitation). Accessed February 2023.
5. Regional characterisation and mapping of Karoo fractured aquifer systems. An integrated approach using a Geographical Information System and digital Image processing. Water Research Commission Report 653/1/02, 220pp. A. Woodford and L. Chevallier, 2002.
6. Seismic Hazard in South Africa. Council for Geoscience. M. Brandt, 2011.
7. Terminology for Soil Erosion and Conservation. ISSS, ITC, ISRIC. Bergsma E, Charman P, Gibbons F, Hurni H, Moldenhauer WC, Panichapong S. 1996.
8. The Prediction of Moisture Content in Untreated Pavement Layers and the Application to Design in Southern Africa. CSIR (DRTT Bulletin 20). S.J. Emery (1988).
9. Sedimentary Rocks of the Karoo Supergroup. In: Johnson, M.R., Annhaeusser, C.R. Thomas, R.J. (Eds.). The Geology of South Africa. Geol. Society of South Africa, pp. 237–260 (Chapter 10). Eriksson P.G, 2006.
10. The Vegetation of South Africa, Lesotho, and Swaziland. *Strelitzia 19*. South African National Biodiversity Institute (SANBI), Pretoria. L. Mucina & M.C. Rutherford, 2006.
11. World Weather Online (WWO). Climatic Data for Loxton District. Site Accessed February 2023.
12. The Natural Road Construction Materials of Southern Africa. H. H. WeineArt, 1980.

Appendix A Project Description

Loxton Wind Energy Facility 1, Northern Cape Province – Project Description

Note to specialist: Kindly make use of the project description included below as part of the specialist report. Please also ensure that the name of the project (Loxton WEF 1) and the applicant (i.e. Loxton Wind 1 (Pty) Ltd) is used for the report and is consistent throughout.

The applicant **Loxton Wind Facility 1** (Pty) Ltd is proposing the development of a commercial Wind Energy Facility (WEF) and associated infrastructure on a site located approximately 30 km North of Loxton within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province.

Two additional WEF's are concurrently being considered on the surrounding properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained in Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Loxton WEF 2 and Loxton WEF 3.

A preferred project site with an extent of approximately 58 000 ha has been identified as a technically suitable area for the development of the three WEF projects. Loxton WEF 1 will comprise of up to 42 turbines, Loxton WEF 2 up to 62 turbines and Loxton WEF 3 up to 38 turbines. Loxton WEF 1 and Loxton WEF 3 will each have a contracted capacity of up to 240MW with a permanent footprint of up to 65 ha, whereas Loxton WEF 2 will comprise of up to 63 turbines with a contracted capacity of up to 480 MW and permeant footprint of up to 110 ha.

The Loxton WEF 1 project site covers approximately 7 200 ha and comprises the following farm portions:

- Portion 12 of the Farm Rietfontein 572;
- Remaining Extent of Farm 582
- Remaining Extent of the Farm Saaidam No. 574;
- Remaining Extent of the Farm Springfontein No. 573

The Loxton WEF 1 project site is proposed to accommodate the following infrastructure, which will enable the wind farm to supply a contracted capacity of up to 240 MW:

- Up to 42 wind turbines with a maximum hub height of up to 160 m and a rotor diameter of up to 200 m;
- A transformer at the base of each turbine;
- Concrete turbine foundations with a permanent footprint 5.5 ha;
- Each turbine will have a crane hardstand of 70 m x 45 m. The permanent footprint for turbine hardstands will be up to 12ha.
- Each turbine will have a temporary blade hardstand of 80 m x 45 m. The temporary footprint for blade hardstands will be up to 14 ha.
- Temporary laydown areas (with a combined footprint of up to 23 ha) which will accommodate the boom erection, storage and assembly area;
- Battery Energy Storage System (with a footprint of up to 5 ha);
- Medium voltage (33 kV) cables/powerlines running from wind turbines to the facility substations. The routing will follow existing/proposed access roads and will be buried where possible.
- One on-site substations of up to 2 ha in extent to facilitate the connection between the wind farm and the electricity grid;
- Access roads to the site and between project components inclusive of stormwater infrastructure. A 15 m road corridor may be temporarily impacted upon during construction and rehabilitated to 6m wide after construction. The WEF will have a total road network of up to 50 km.
- A temporary site camp establishment and concrete batching plants (with a combined footprint of up to 2 ha); and
- Operation and Maintenance buildings (with a combined footprint of up to 2 ha) including a gate house, security building, control centre, offices, warehouses, parking bays, a workshop and a storage area.

The Electrical Grid Infrastructure (EGI) associated with the Loxton WEF considers a 300m wide corridor route from the Loxton Switching Station/Collector Station to the Gamma MTS. The EGI is located within the Central Strategic Powerline Corridor and therefore subject to a Basic Assessment process in accordance with GN 113 of 16 February 2018 listed under NEMA, 1998.

Loxton Wind Energy Facility 2, Northern Cape Province – Project Description

Note to specialist: Kindly make use of the project description included below as part of the specialist report. Please also ensure that the name of the project (Loxton WEF 2) and the applicant (i.e. Loxton Wind 2 (Pty) Ltd) is used for the report and is consistent throughout.

The applicant **Loxton Wind Facility 2**(Pty) Ltd is proposing the development of a commercial Wind Energy Facility (WEF) and associated infrastructure on a site located approximately 17 km North East of Loxton within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province.

Two additional WEF's are concurrently being considered on the surrounding properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained in Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Loxton WEF 1 and Loxton WEF 3.

A preferred project site with an extent of approximately 58 000 ha has been identified as a technically suitable area for the development of the three WEF projects. Loxton WEF 2 will have a contracted capacity of up to 480 MW with a permanent footprint of up to 110 ha, whereas Loxton WEF 1 and Loxton WEF 3 will comprise of up to 38 and 41 turbines respectively, each with a contracted capacity of up to 240 MW and permanent footprint of up to 65 ha.

The Loxton WEF 2 project site covers approximately 15 000 ha and comprises the following farm portions:

- Portion 4 of the Farm Rietfontein No. 572;
- Portion 12 of the Farm Rietfontein No. 572;
- Portion 11 of the Farm Rietfontein No.572;
- Remaining Extent of Farm Rietfontein No.572;
- Remaining Extent of the Farm Saaidam No. 574;
- Remaining Extent of the Farm Yzervarkspoort No. 139;
- Portion 2 of the Farm Yzervarkspoort No. 139;
- Remaining Extent of the Farm Springfontein No. 573
- Remaining Extent of Farm 582

The Loxton WEF 2 project site is proposed to accommodate the following infrastructure, which will enable the wind farm to supply a contracted capacity of up to 480 MW:

- Up to 62 wind turbines with a maximum hub height of up to 160 m and a rotor diameter of up to 200 m;
- A transformer at the base of each turbine;
- Concrete turbine foundations with a permanent footprint of approximately 9.1 ha;
- Each turbine will have a crane hardstand of 70 m x 45 m. The permanent footprint for turbine hardstands will be up to approximately 20 ha.
- Each turbine will have a temporary blade hardstand of 80 m x 45 m. The temporary footprint for blade hardstands will be up to approximately 23 ha.
- Temporary laydown areas (with a combined footprint of up to approximately 38 ha) which will accommodate the boom erection, storage and assembly area;
- Battery Energy Storage System (with a footprint of up to 5ha);
- One construction period laydown areas (temporary) up to 6 ha each;
- Medium voltage (33 kV) cables/powerlines running from wind turbines to the facility substations. The routing will follow existing/proposed access roads and will be buried where possible.
- One on-site substations up to 4 ha in extent to facilitate the connection between the wind farm and the electricity grid;

- Access roads to the site and between project components inclusive of stormwater infrastructure. A 15 m road corridor may be temporarily impacted upon during construction and rehabilitated to 6m wide after construction. The WEF will have a total road network of up to 100 km.
- One temporary site camp establishment and concrete batching plant (each with a combined footprint of up to 2 ha); and
- Operation and Maintenance buildings (each with a combined footprint of up to 2 ha) including a gate house, security building, control centre, offices, warehouses, parking bays, storage facility and a workshop.

The Electrical Grid Infrastructure (EGI) associated with the Loxton WEF considers a 300m wide corridor route from the Loxton Switching Station/Collector Station to the Gamma MTS. The EGI is located within the Central Strategic Powerline Corridor and therefore subject to a Basic Assessment process in accordance with GN 113 of 16 February 2018 listed under NEMA, 1998.

Loxton Wind Energy Facility 3, Northern Cape Province – Project Description

Note to specialist: Kindly make use of the project description included below as part of the specialist report. Please also ensure that the name of the project (Loxton WEF 3) and the applicant (i.e. Loxton Wind 3 (Pty) Ltd) is used for the report and is consistent throughout.

The applicant **Loxton Wind Facility 3** (Pty) Ltd is proposing the development of a commercial Wind Energy Facility (WEF) and associated infrastructure on a site located approximately 15 km East of Loxton within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province.

Two additional WEF's are concurrently being considered on the surrounding properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained in Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Loxton WEF 1 and Loxton WEF 2.

A preferred project site with an extent of approximately 58 000 ha has been identified as a technically suitable area for the development of the three WEF projects. Loxton WEF 1 & Loxton WEF 2 comprise of 38 and 42 turbines, each with a contracted capacity of up to 240 MW and a permanent footprint of up to 65 ha each. Whereas Loxton WEF 2 will have up to 62 turbines, with a contracted capacity of up to 480 MW and permanent footprint of up to 110 ha.

The Loxton WEF 3 project site covers approximately 12 500 ha and comprises the following farm portions:

- Remaining Extent of the Farm Yzervarkspoort No. 139;
- Portion 1 of the Farm Yzervarkspoort No. 139;
- Remaining Extent of Farm 273
- Remaining Extent of the Farm No. 262;
- Remaining Extent of the Farm Erasmuskraal No. 269;

The Loxton WEF 3 project site is proposed to accommodate the following infrastructure, which will enable the wind farm to supply a contracted capacity of up to 240 MW:

- Up to 38 wind turbines with a maximum hub height of up to 160 m and a rotor diameter of up to 200 m;
- A transformer at the base of each turbine;
- Concrete turbine foundations with a permanent footprint of approximately 6 ha;
- Each turbine will have a crane hardstand of 70 m x 45 m. The permanent footprint for turbine hardstands will be up to approximately 13 ha.
- Each turbine will have a temporary blade hardstand of 80 m x 45 m. The temporary footprint for blade hardstands will be up to approximately 15 ha.
- Temporary laydown areas (with a combined footprint of up to 25 ha) which will accommodate the boom erection, storage and assembly area;
- Battery Energy Storage System (with a footprint of up to approximately 5 ha);

- Medium voltage (33 kV) cables/powerlines running from wind turbines to the facility substations. The routing will follow existing/proposed access roads and will be buried where possible.
- One on-site substations up to 4 ha in extent to facilitate the connection between the wind farm and the electricity grid;
- Construction period laydown areas (temporary) up to 6 ha;
- Access roads to the site and between project components inclusive of stormwater infrastructure. A 15 m road corridor may be temporarily impacted upon during construction and rehabilitated to 6m wide after construction. The WEF will have a total road network of up to 50 km.
- A temporary site camp establishment and concrete batching plants (with a combined footprint of up to 2ha); and
- Operation and Maintenance buildings (with a combined footprint of up to 2 ha) including a gate house, security building, control centre, offices, warehouses, a workshop, parking bays and a storage area.

The Electrical Grid Infrastructure (EGI) associated with the Loxton WEF considers a 300m wide corridor route from the Loxton Switching Station/Collector Station to the Gamma MTS. The EGI is located within the Central Strategic Powerline Corridor and therefore subject to a Basic Assessment process in accordance with GN 113 of 16 February 2018 listed under NEMA, 1998.

SMEC
South Africa
Member of the Surbana Jurong Group

Redefining exceptional

Through our specialist expertise, we're challenging boundaries to deliver advanced infrastructure solutions.

www.smec.com

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PROPOSED LOXTON CLUSTER WEF, NORTHERN CAPE PROVINCE

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	SMEC SOUTH AFRICA (PTY) LTD.			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	1	Percentage Procurement recognition	
Specialist name:	MR. CHARLES WARREN-COLLINGTON.			
Specialist Qualifications:	MSc (ENG) ; BSc (ENG).			
Professional affiliation/registration:	PrEng (ECSA) ; PMP (PROJECT MANAGEMENT INSTITUTE)			
Physical address:	65 RIEBEEK ST., CAPE TOWN.			
Postal address:	-			
Postal code:	8001	Cell:	084 636 7186	
Telephone:	021 4172700	Fax:	-	
E-mail:	CHARLES.WARREN-COLLINGTON@SMEC.COM.			

2. DECLARATION BY THE SPECIALIST

I, C. WARREN-COLLINGTON, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

SMEC SOUTH AFRICA (PTY) LTD.

Name of Company:

2023/04/26.

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, C. WARREN-GOBRINGTON; swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

SMEC SOUTH AFRICA (PTY) LTD.

Name of Company

2023/04/26.

Date

Signature of the Commissioner of Oaths

2023/04/26

Date

SUSANNA ELIZABETH MADER
COMMISSIONER OF OATHS R.S.A.
Ex Officio
Professional Accountant (SA)
Membership Number: 30820
577 31st Avenue, Villieria, Pretoria, 0186
Cell: 082 552 0823