HERITAGE IMPACT ASSESSMENT

(REQUIRED UNDER SECTION 38(8) OF THE NHRA (No. 25 OF 1999)

FOR THE PROPOSED PROSPECTING APPLICATION ON 66 107.1283 ha HECTARES IN THE NORTHERN CAPE

Type of development:

Prospecting Application

Client:

Greenmined Environmental (Pty) Ltd

Applicant:

Strata Africa Exploration (Pty) Ltd

Report Prepared by:

Beyond Heritage
Private Bag X 1049
Suite 34
Modimolle
0510
Tel: 082 373 8491
Fax: 086 691 6461
E-Mail: jaco@heritageconsultants.co.za

Report Author:
Ms. L. Kraljević

Project Reference:
Project number 24230

Report date:
April 2024

APPROVAL PAGE

Project Name	Prospecting Application
Report Title	Heritage Impact Assessment for the Prospecting Application on 66 107.1283 Hectares in the Northern Cape
Authority Reference Number	TBC
Report Status	Draft Report
Applicant Name	Strata Africa Exploration (Pty) Ltd

Responsibility	Name	Qualifications and Certifications	Date
Report writing and archaeological support	Lara Kraljević - Archaeologist	MA Archaeology ASAPA #661	April 2024
Palaeontological Report	Prof Marion Bamford	PhD Palaeobotany	April 2024

DOCUMENT PROGRESS

Distribution List

Date	Report Reference Number	Document Distribution	Number of Copies
29 April 2024	24230	Greenmined Environmental (Pty) Ltd	Electronic Copy
2 May 2024	24230	Greenmined Environmental (Pty) Ltd	Electronic Copy

Amendments on Document

Date	Report Reference Number	Description of Amendment

INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. Beyond Heritage reserves the right to modify aspects of the report including the recommendations if and when new information becomes available from ongoing research or further work in this field or pertaining to this investigation.

Although Beyond Heritage exercises due care and diligence in rendering services and preparing documents Beyond Heritage accepts no liability, and the client, by receiving this document, indemnifies Beyond Heritage against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Beyond Heritage and by the use of the information contained in this document.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

COPYRIGHT

REPORT OUTLINE

Appendix 6 of the GNR 326 EIA Regulations published on 7 April 2017 provides the requirements for specialist reports undertaken as part of the Environmental Authorisation process. In line with this, Table 1 provides an overview of Appendix 6 together with information on how these requirements have been met.

Table 1. Specialist Report Requirements.

Requirement from Appendix 6 of GN 326 EIA Regulation 2017	Chapter
(a) Details of - (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.	Section a
(b) Declaration that the specialist is independent in a form as may be specified by the competent authority.	*Declaration of Independence*
(c) Indication of the scope of, and the purpose for which, the report was prepared.	Section 1
(cA) An indication of the quality and age of base data used for the specialist report.	Section 3.4.
(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change.	Section 9
(d) Duration, Date and season of the site investigation and the relevance of the season to the outcome of the assessment.	Section 3.4
(e) Description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used.	Section 3
(f) Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of site plan identifying site alternatives.	Section 7, 8 and 9
(g) Identification of any areas to be avoided, including buffers.	Section 7,8 and 9
(h) Map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.	Section 8
(I) Description of any assumptions made and any uncertainties or gaps in knowledge.	Section 3.7
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity including identified alternatives on the environment or activities.	Section 1.3
(k) Mitigation measures for inclusion in the EMPr.	Section 9.1 and 9.5
(l) Conditions for inclusion in the environmental authorisation.	Section 9. 1 and 9.5
(m) Monitoring requirements for inclusion in the EMPr or environmental authorisation.	Section 9.6
(n) Reasoned opinion - (i) As to whether the proposed activity, activities or portions thereof should be authorised; (iA) Regarding the acceptability of the proposed activity or activities; and (ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan.	Section 9.3
(o) Description of any consultation process that was undertaken during the course of preparing the specialist report.	Section 5
(p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto.	Refer to the BAR report
(q) Any other information requested by the competent authority.	No other information requested at this time

Executive Summary

The proposed prospecting application is located on a Portion of Lower Kuruman Native Reserve No 219, Remaining Extent of the farm Edgehill No 194, Remaining Extent of the farm Alphen No 442, Remaining Extent of the farm Boland No 133, Farm Boland 133, Remaining Extent of the farm Seduall 124, Remaining Extent of the farm Mora Schuba 201, Remaining Extent of the farm Kungkung No 123, Remaining Extent of the farm Mahura Muthla No 198, Remaining Extent of Farm No 123, Farm Brandziekfontein No 124, Farm Helvetia No 126, Remaining Extent of the farm Hartebeesdale No 564, Remaining Extent of the farm Kogelbeen No 44, and Remaining Extent of the farm Banghoek No 17.

The Project areas are situated in Joe Morolong Local Municipality, Ga-Segonyana Local Municipality, Dikgatlong Local Municipality, Tsantsabane Local Municipality, and Siyancuma Local Municipality, Northern Cape. Greenmined Environmental has been appointed as the independent environmental assessment practitioner (EAP) to apply for the environmental authorisation for the Project. Beyond Heritage was appointed to conduct a Heritage Impact Assessment (HIA) for the project and the study area was assessed through a desktop assessment. Key findings of the assessment include:

- The scope of work is to conduct a heritage desktop report for a large prospecting right area comprising approximately 66 107.1283 ha;
- It was deemed not feasible to conduct fieldwork at this stage of the process due to the following reasons:
    - The extensive geographical size of the exploration application and the fact that the exact locations of drill sites or number of drill holes to be dug is not available at this point;
    - No intrusive activities will occur at this point of the application;
    - Limited site access;
- This desktop study is informed by available data for the proposed project area derived from several large-scale heritage surveys conducted for mining projects in the area as well as extensive archaeological studies at Kathu Complex and Kuruman, and including the fact that the archaeological character of the region is now well described (e.g., Beaumont 1990; 2007; 2008, Morris 2005; 2008, Huffman 2001, Fourie and van der Walt 2006, Webley and Halkett 2008);
- The prospecting areas are within an archaeologically rich landscape especially in relation to the Stone Age with significant sites such as the Kathu Complex and the National heritage sites of Wonderwerk Cave, and Kathu Townlands and the natural heritage site, the Kogelbeen Caves, found in this region;
- Stone Age artefacts can be expected throughout the landscape ranging from low-density scatters to significant sites which are more focal to topographical features such as rocky outcrops, hills, drainage lines, pans, and confluences of rivers and streams;
- Burial sites can occur anywhere on the landscape. A memorial site occurs at 27˚33’32.4”S; 23˚29’39.3”E, at Edgehill 194/5.
- According to the SAHRA Paleontological sensitivity map the study areas are of low, moderate, high, and very high sensitivity and an independent study was commissioned for this aspect.

The impact on heritage resources is expected to be low, and the Project can be authorised provided that the recommendations in this report are adhered to and based on the SAHRA's approval.

Recommendations:

The following recommendations for Environmental Authorisation apply and the Project may only proceed after receiving comment from SAHRA:

- Once the drill sites have been confirmed these areas have to be subjected to a heritage walk down, this should be conducted prior to the commencement of invasive prospecting activities;
- Drill sites must be kept as close as possible to existing roads in order to minimise the impact on the landscape;
- Focal points on the landscape like rocky outcrops, caves (including the Kogelbeen caves) or pans must be avoided as far as possible as these areas could be sensitive from a heritage point of view;
- Burial sites, memorials and graves should be avoided with a 30 m buffer zone;
- Monitoring of the Project area by the ECO during the exploration phase for heritage and palaeontology chance finds, if chance finds are encountered to implement the Chance Find Procedure for the Project as outlined in Section 9.

Declaration of Independence

Specialist Name	Lara Lucija Kraljević
Declaration of Independence	I declare, as a specialist appointed in terms of the National Environmental Management Act (Act No 107 of 1998) and the associated 2014 Environmental Impact Assessment (EIA) Regulations (as amended), that I: • I act as an 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 49 A of the Act.
Signature	
Date	25/04/2024

a) Expertise of the specialist

Lara Kraljević completed her masters in archaeology at the University of Pretoria specialising in chemical and mineralogical studies of Iron Age ceramics. Lara is an accredited member of the Association of South African Professional Archaeologists (ASAPA) (#661). She has co-authored over 100 impact assessments in Gauteng, Limpopo, Mpumalanga, Northern Cape, Eastern Cape, and North West Provinces in South Africa.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

ASAPA	Association of South African Professional Archaeologists
BGG	Burial Ground and Graves
CFPs	Chance Find Procedures
CMP	Conservation Management Plan
CoGHSTA	Co-operative Governance, Human Settlements and Traditional Affairs
CRR	Comments and Response Report
CRM	Cultural Resource Management
DFFE	Department of Fisheries, Forestry and Environment,
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment*
EIA	Early Iron Age*
EAP	Environmental Assessment Practitioner
EMPr	Environmental Management Programme
ESA	Early Stone Age
ESIA	Environmental and Social Impact Assessment
GIS	Geographical Information System
GPS	Global Positioning System
GRP	Grave Relocation Plan
HIA	Heritage Impact Assessment
LIA	Late Iron Age
LSA	Late Stone Age
MEC	Member of the Executive Council
MIA	Middle Iron Age
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MSA	Middle Stone Age
NCHM	National Cultural History Museum
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NHRA	National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NID	Notification of Intent to Develop
NoK	Next-of-Kin
PRHA	Provincial Heritage Resource Agency
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

**Although EIA refers to both Environmental Impact Assessment and the Early Iron Age both are internationally accepted abbreviations and must be read and interpreted in the context it is used.*

GLOSSARY

Archaeological site	Remains of human activity over 100 years old
Earlier Stone Age	~ 2.6 million to 250 000 years ago
Middle Stone Age	~ 250 000 to 40-25 000 years ago
Later Stone Age	~ 40-25 000, to the historic period
The Iron Age	~ AD 400 to 1840
Historic	~ AD 1840 to 1950
Historic building	Over 60 years old

1 Introduction

Beyond Heritage was appointed to conduct a desk based Heritage Impact Assessment (HIA) for the proposed prospecting application that is located on Portion of Lower Kuruman Native Reserve No 219, Remaining Extent of the farm Edgehill No 194, Remaining Extent of the farm Alphen No 442, Remaining Extent of the farm Boland No 133, Remaining Extent of the farm Seduall 124, Remaining Extent of the farm Mora Schuba 201, Remaining Extent of the farm Kungkung No 123, Remaining Extent of the farm Mahura Muthla No 198, Remaining Extent of Farm No 123, Farm Brandziekfontein No 124, Farm Helvetia No 126, Remaining Extent of the farm Hartebeesdale No 564, Remaining Extent of the farm Kogelbeen No 44, and Remaining Extent of the farm Banghoek No 17. The Project areas are situated in Joe Morolong Local Municipality, Ga-Segonyana Local Municipality, Dikgatlong Local Municipality, Tsantsabane Local Municipality, and Siyancuma Local Municipality, Northern Cape (Figure 1.1 to 1.3). The report forms part of the Basic Assessment environmental authorisation process for the project.

The aim of the study is to assess the proposed development footprint on a desktop level to understand the cultural layering of the study area. It serves to assess the potential impact of the proposed project on non-renewable heritage resources, and to submit appropriate recommendations about the responsible cultural resources management measures required. It is also conducted to protect such resources within the framework provided by the National Heritage Resources Act of 1999 (Act No 25 of 1999) (NHRA). The report outlines the approach and methodology utilized, which includes review of relevant literature; desktop assessment of the study area; reporting the outcome of the study.

At this stage of the project, it is impossible to define the exact locations of drill sites or number of drill holes to be dug and a heritage walk down can be conducted once this is confirmed. Possible impacts were identified, and mitigation measures are proposed in this report. The South African Heritage Resources Agency (SAHRA) as a commenting authority under section 38(8) of NHRA requires all environmental documents, compiled in support of an Environmental Authorisation application as defined by National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations section 40 (1) and (2), to be submitted to SAHRA for commenting. Upon submission to SAHRA the project will be automatically given a case number as reference. As such the Basic Assessment (BA) report and its appendices must be submitted to the case as well as the EMPr, once it's completed by the Environmental Assessment Practitioner (EAP).

.

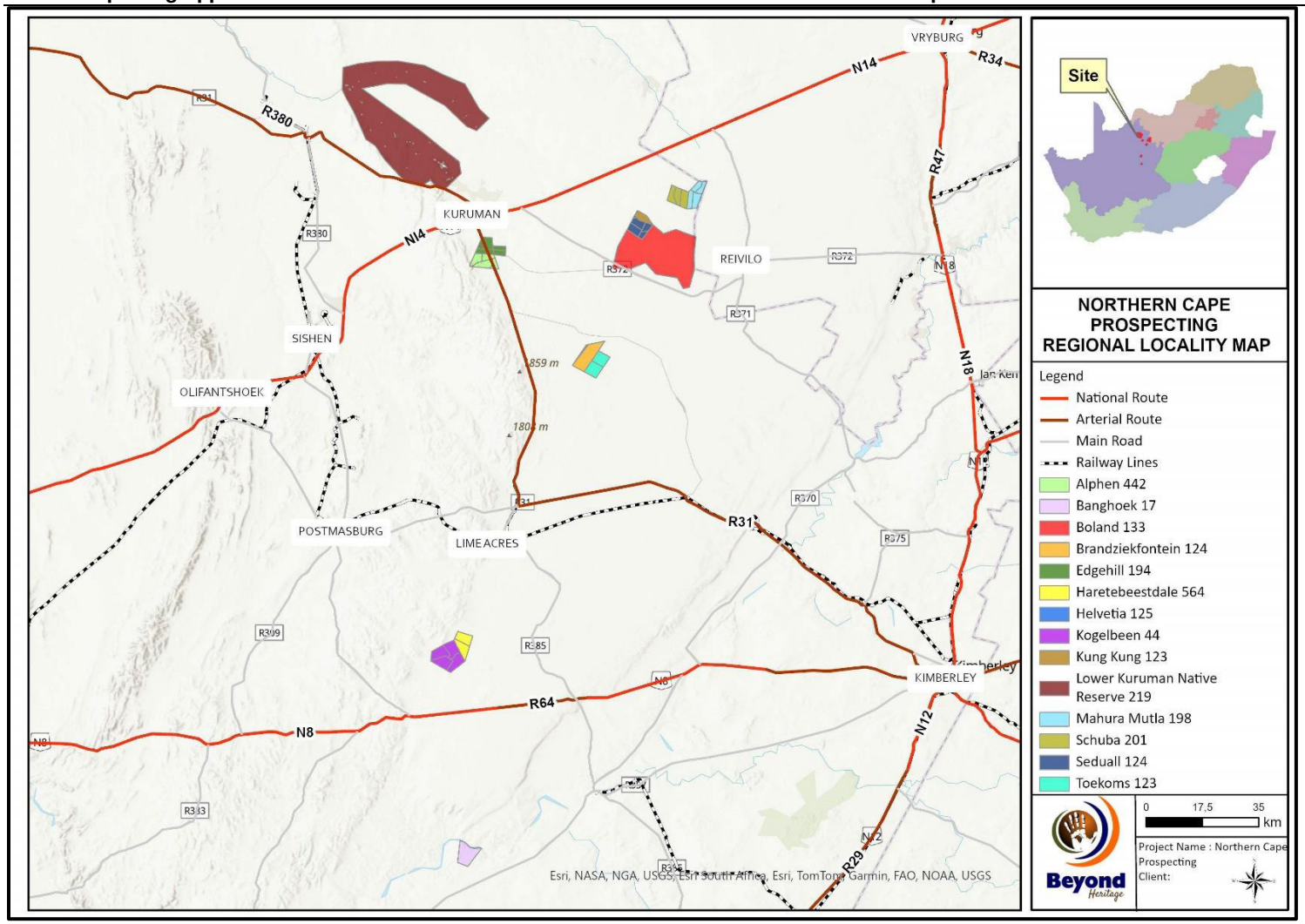


Figure 1.1. Regional setting of the Project (Extract of the 2723, 2724, 2923, 2823 1: 250 000 topographical map).

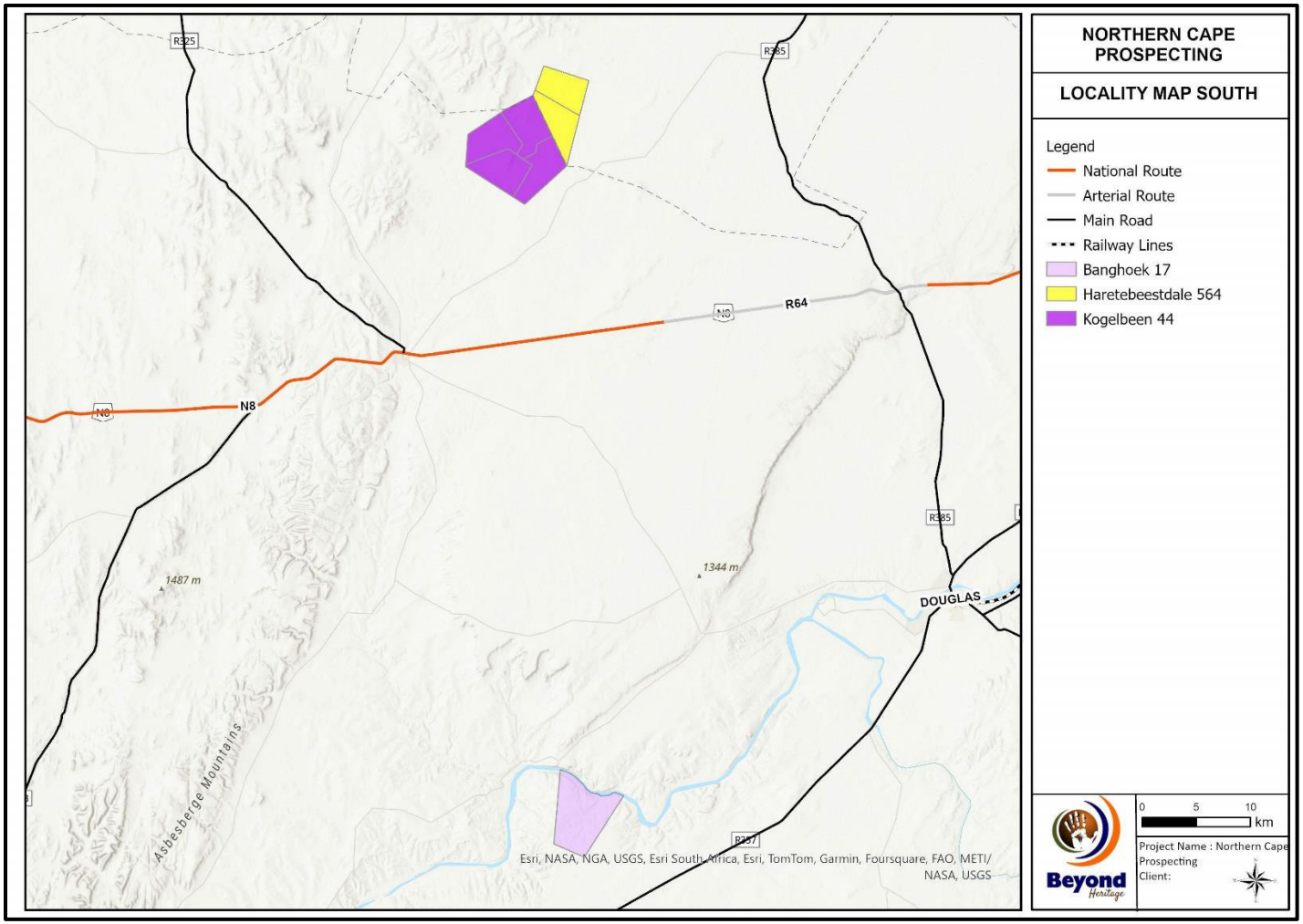


Figure 1.2. Local setting of the southern section of the Project area.

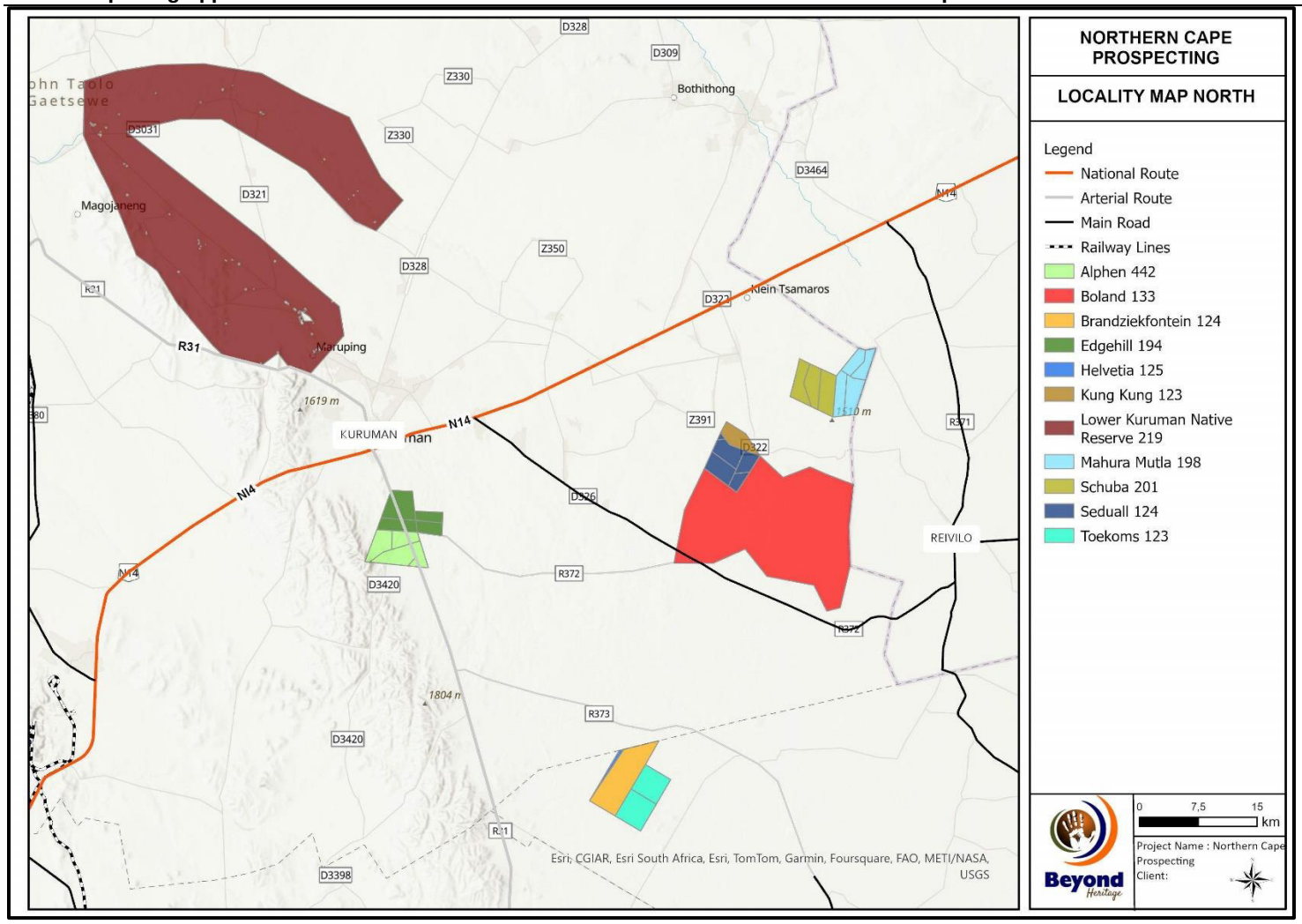


Figure 1.3. Local setting of the southern section of the Project area.

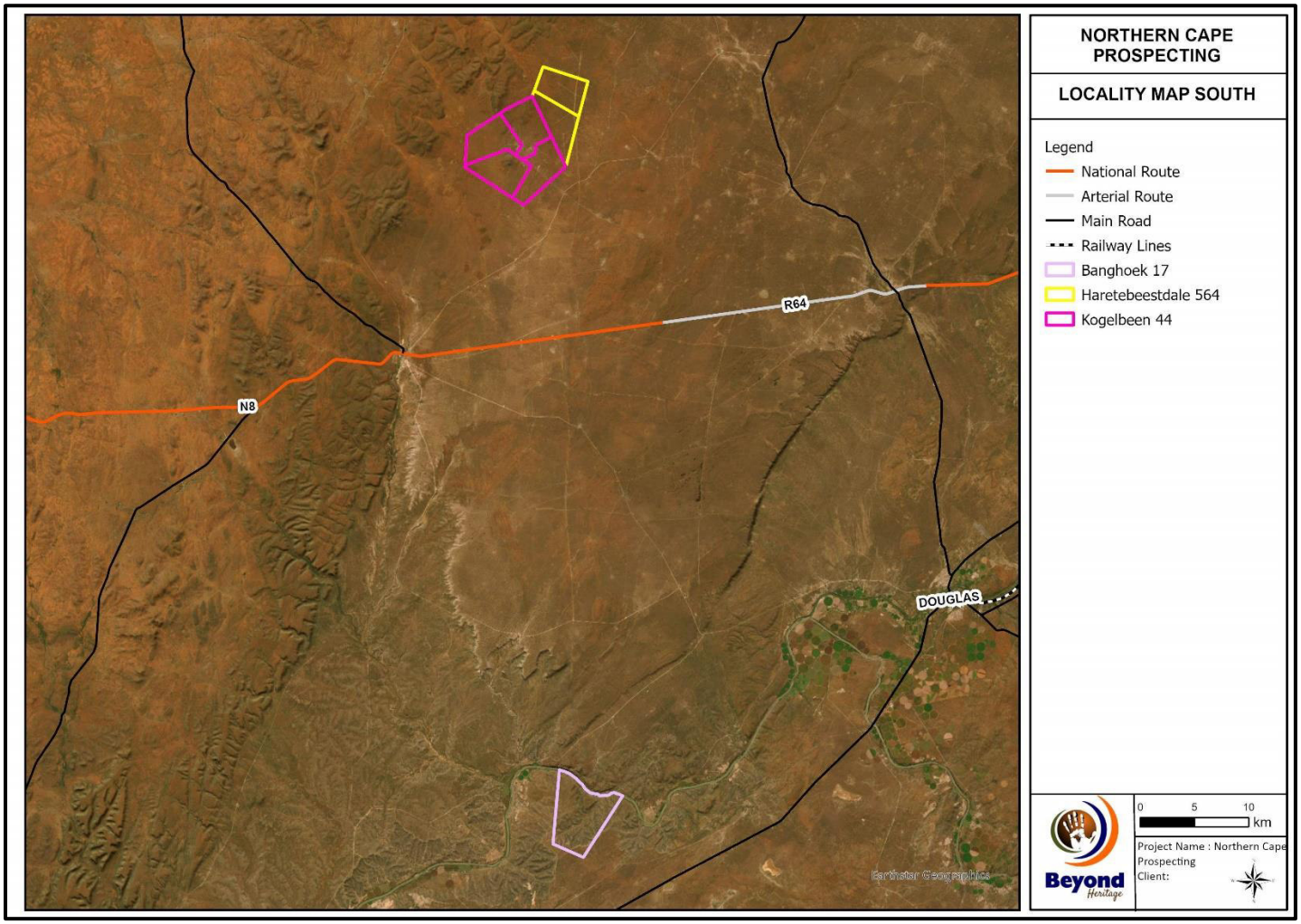


Figure 1.4. Aerial image of the southern part of the Project area and surrounds.

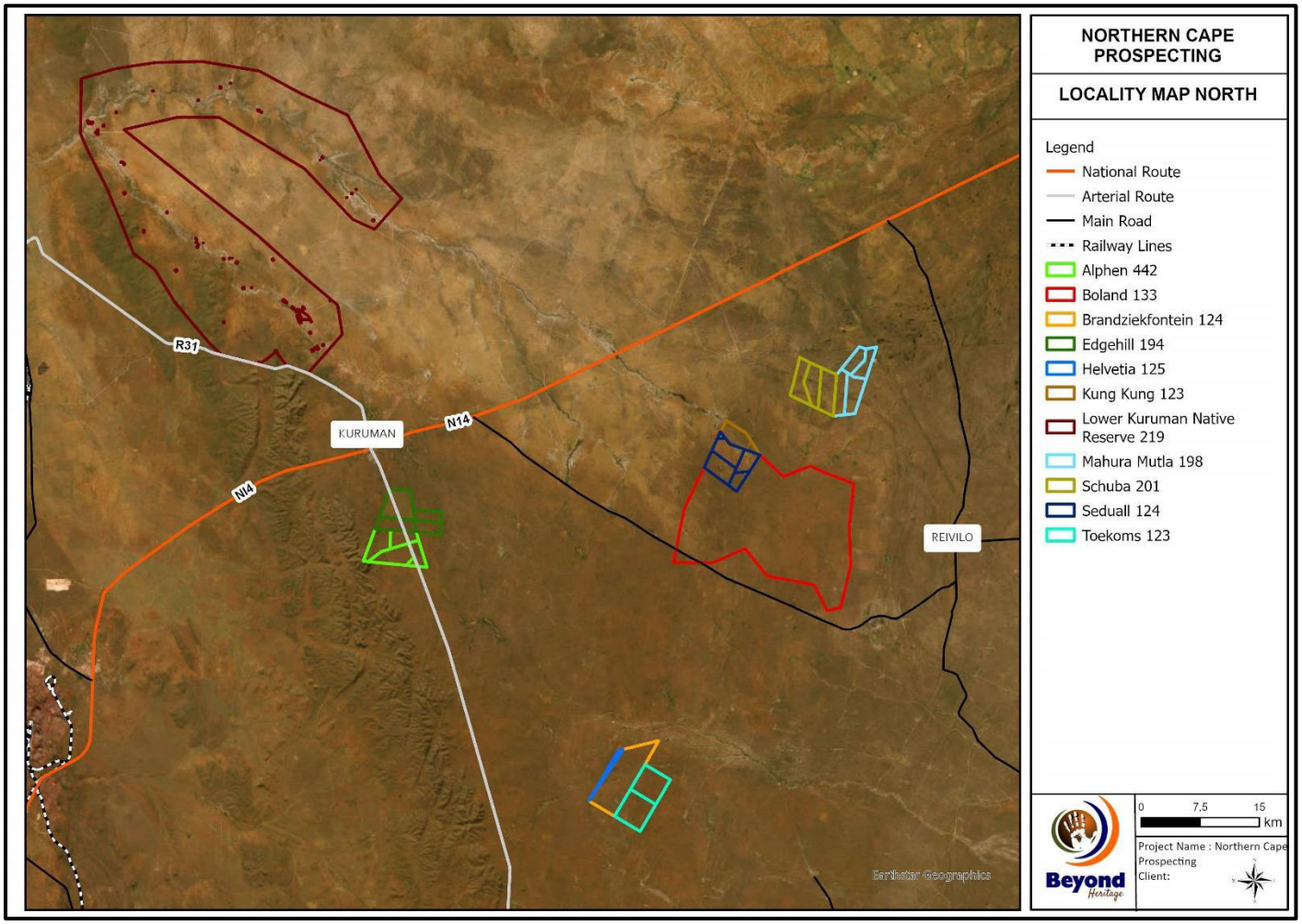


Figure 1.5. Aerial image of the northern part of the of the Project area.

1.1 Terms of Reference

The main aim of this desktop report is to determine if any known heritage resources occur within the project site. The objectives of the desktop report were to:

- Conduct a desktop study:
  - Review available literature, previous heritage studies and other relevant information sources to obtain a thorough understanding of the archaeological and cultural heritage conditions of the area;
  - Identify known and recorded archaeological and cultural sites; and
  - Determine whether the area is renowned for any cultural and heritage resources, such as Stone Age sites, informal graveyards or historical homesteads.
- Compile a specialist Heritage Desktop Report in line with the requirements of the EIA Regulations, 2014, as amended on 07 April 2017.

The reporting is based on the results and findings of a desktop study, wherein potential issues associated with the proposed project will be identified. Reporting will aim to identify the anticipated impacts, as well as cumulative impacts, of the operational units of the proposed project activity on the identified heritage resources for all 3 development stages of the project, i.e. construction, operation and decommissioning. Reporting will also consider alternatives should any significant sites be impacted on by the proposed project. This is done to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve and develop them within the framework provided by Heritage Legislation.

When the localities of the invasive prospecting activities are fixed, the following terms will apply:

Field study (Walkdown)

Conduct a field study to: (a) locate, identify, record, photograph and describe sites of archaeological, historical or cultural interest; b) record GPS points of sites/areas identified as significant areas; c) determine the levels of significance of the various types of heritage resources affected by the proposed development

Reporting

Report on the identification of anticipated and cumulative impacts the operational units of the proposed project activity may have on the identified heritage resources for all 3 phases of the project; i.e., construction, operation and decommissioning phases. Consider alternatives, should any significant sites be impacted adversely by the proposed project. Ensure that all studies and results comply with the relevant legislation, SAHRA minimum standards and the code of ethics and guidelines of ASAPA.

To assist the developer in managing the discovered heritage resources in a responsible manner, and to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act No 25 of 1999).

1.2 Project Description

Project components and the location of the Project are outlined in Tables 2 and 3.

Table 2: Project Description

Magisterial Districts	Joe Morolong Local Municipality, Ga-Segonyana Local Municipality, within the John Taolo Gaetsewe District Municipality; Dikgatlong Local Municipality within the Frances Baard District Municipality; Tsantsabane Local Municipality within the Z F Mgcawu District Municipality; and Siyancuma Local Municipality within the Pixley ka Seme District Municipality
Central co-ordinates of the development	27° 4'28.60"S; 23° 7'34.53"E 27°33'59.74"S; 23°27'39.00"E 27°24'5.46"S; 24° 1'39.76"E 27°33'13.19"S; 23°57'49.66"E 27°51'25.16"S; 23°45'43.26"E 28°40'34.38"S; 23°22'20.37"E 29°14'18.05"S; 23°24'47.82"E
1:50 000 Topographic Map Number	2723 AA, AB, AC, AD, CB, DA, BD, DB, DC, DD 2724 AC, CA 2923AB, AD 2823 CB
Farm Name:	1. Portion of Lower Kuruman Native Reserve No 219 (Farm No 219) 2. Remaining Extent of the farm Edgehill No 194 3. Portion 1 of the farm Edgehill No 194 4. Portion 2 of the farm Edgehill No 194 5. Portion 5 of the farm Edgehill No 194 6. Remaining Extent of the farm Alphen No 442 7. Portion 3 of the farm Alphen No 442 8. Portion 4 of the farm Alphen No 442 9. Portion 5 of the farm Alphen No 442 10. Portion 6 of the farm Alphen No 442 11. Portion 7 of the farm Alphen No 442 12. Remaining Extent of the farm Boland No 133 13. Portion 1 of the farm Boland No 133 14. Portion 2 of the farm Boland No 133 15. Portion 3 of the farm Boland No 133 16. Portion 4 of the farm Boland No 133 17. Portion 5 of the farm Boland No 133 18. Portion 6 of the farm Boland No 133 19. Portion 7 of the farm Boland No 133 20. Portion 8 of the farm Boland No 133 21. Portion 9 of the farm Boland No 133 22. Portion 10 of the farm Boland No 133 23. Portion 11 of the farm Boland No 133 24. Portion 12 of the farm Boland No 133 25. Portion 13 of the farm Boland No 133 26. Portion 14 of the farm Boland No 133

	27. Portion 15 of the farm Boland No 133 28. Portion 16 of the farm Boland No 133 29. Portion 17 of the farm Boland No 133 30. Portion 20 of the farm Boland No 133 31. Portion 21 of the farm Boland No 133 32. Portion 23 of the farm Boland No 133 33. Portion 24 of the farm Boland No 133 34. Portion 25 of the farm Boland No 133 35. Portion 26 of the farm Boland No 133 36. Remaining Extent of the farm Seduall 124 37. Portion 1 of the farm Seduall 124 38. Portion 2 of the farm Seduall 124 39. Portion 3 of the farm Seduall 124 40. Remaining Extent of the farm Mora Schuba 201 41. Portion 1 of the farm Mora Schuba 201 42. Portion 2 of the farm Mora Schuba 201 43. Remaining Extent of the farm Kungkung No 123 44. Portion 1 of the farm Kungkung No 123 45. Portion 2 of the farm Kungkung No 123 46. Portion 3 of the farm Kungkung No 123 47. Remaining Extent of the farm Mahura Muthla No 198 48. Portion 1 of the farm Mahura Muthla No 198 49. Portion 2 of the farm Mahura Muthla No 198 50. Portion 3 of the farm Mahura Muthla No 198 51. Remaining Extent of Farm No 123 52. Portion 1 of the Farm No 123 53. Brandziekfontein No 124 54. Helvetia No 126 55. Remaining Extent of the farm Hartebeesdale No 564 56. Portion 1 of the farm Hartebeesdale No 564 57. Remaining Extent of the farm Kogelbeen No 44 58. Portion 1 of the farm Kogelbeen No 44 59. Portion 2 of the farm Kogelbeen No 44 60. Portion 3 of the farm Kogelbeen No 44 61. Remaining Extent of the farm Banghoek No 17
Distance and direction from nearest town	The earmarked portion on the Lower Kuruman Native Reserve No 219 is ±23 km north of Kuruman along the R31. Farms Edgehill No 194 and Alphen No 442 are ±6 km south of Kuruman when travelling along the R31.

	Farms Mora Schuba No 201, Mahura Muthla No 198, Kungkung No 123, Seduall No 124, and Boland No 133 lays ±50 km east of Kuruman when travelling on the R372. Farms Helvetia No 126, Brandziekfontein No 124, and Farm No 123 are ±60 km south-east of Kuruman when travelling along the R31. Farms Hartebeesdale No 564 and Kogelbeen No 44 are ±23 km north-east of Griekwastad. The farm Banghoek No 17 is ±47 km south-west of Douglas when travelling along the R357.

Table 3: Infrastructure and project activities

Type of development	Prospecting Application
Description of the overall activity.	Strata Africa Exploration (Pty) Ltd (the "Applicant") applies for environmental authorisation and a prospecting right (without bulk sampling) for Lithium (Li), Lead (Pb), Copper (Cu), Zinc (Zn), and Sulphides over 66 107.1283 ha of the above-mentioned properties. Should the relevant authorisations be granted, and the project commence the principal prospecting activities will entail the following: ❖ Non-Invasive Prospecting: o Desktop geological studies (Phase 1), o Geological field mapping (Phase 2), o Ground geophysical survey and ground magnetic survey (Phase 3), o Feasibility studies and target selection (Phase 5), o Metallurgical testing and analysis (Phase 5), o Analytical desktop pre-feasibility study (Phase 7). ❖ Invasive Prospecting: o Exploration boreholes (Phase 4 & 6), o Sloping, landscaping, and rehabilitation the affected areas (Phase 4 & 6). Once the target areas were identified (during non-invasive prospecting) and the invasive prospecting commences (phase 4 & 6), site establishment will entail discussions with the landowners regarding access to the properties, the clearance of vegetation (where necessary) from the areas to be prospected, the stripping and stockpiling of the topsoil, and the introduction of the prospecting equipment. The prospecting activities does not entail bulk sampling and do not require the use of any permanent equipment/infrastructure. A central site camp will be established at an area agreed to by the landowner where mobile containers will be used as office space and for storage. Chemical ablutions will be established, and the site camp will be fenced to control access. All chemicals/hydrocarbons

	will be kept in the storage containers or bunded areas with impermeable surfaces. **Drilling:** The targeting of all drilling activities will be dependent on the results obtained during the preceding phases of prospecting, namely the geological mapping and geophysical surveying and as such it is currently not possible to include a finalized surface plan showing the intended location, extent, and depth of boreholes to be completed. Diamond drilling will be of the standard BQ (60 mm outside diameter) or NQ (75.7 mm outside diameter) size. Down hole surveys will be done every 50 m in each hole. Core will be marked, logged, photographed, and sampled according to the standard of the applicant's logging and sampling procedures. Down the hole geophysical surveying will take place upon completion of the exploratory boreholes along with Ground EM surveys to determine positions of conductors. Rehabilitation of drill sites will be done according to an approved Environmental Management Plan. Percussion Rotary Air Blast (RAB) or Reverse Circulation (RC) drilling may be carried out for pre-collaring of diamond drill boreholes or for obtaining samples if significant depth of cover is encountered over particular targets. **Assaying:** Rock chip / soil samples will be sent to an off-site laboratory to be crushed, split, pulverized, and assayed. **Metallurgical Test Work:** Metallurgical test work will start during Phase 5 of the prospecting activities. These tests will be done off-site by and in consultation with an accredited Laboratory. **Electricity Need:** The prospecting activities do not require electricity as all equipment will be powered with generators. **Water Use:** Water will also be used for drilling, and dust suppression at the prospecting sites and access roads. Potable water will be transported to site daily, while the process water will be bought from a local source (to be identified) in the vicinity of the prospecting activities. **Waste Handling:** The general waste generated at the prospecting sites will be transported to the site camp where it will be contained in refuse bins. Once full the refuse bins will

	be emptied, and the waste will be disposed of at a registered landfill site in the vicinity of the project. Hazardous waste will be contained in designated hazardous waste containers to be removed daily to the hazardous waste storage area at the site camp. A registered contractor will be appointed to collect and dispose of the hazardous waste at a registered hazardous waste handling facility and the site will file the proof of safe disposal for auditing purposes. The chemical toilets will weekly be serviced by an appropriately qualified sewerage handling contractor who will furnish the site with proof of safe disposal. **Servicing and Maintenance:** No workshop, wash bay or service areas will be established at the prospecting sites and/or site camp. When needed maintenance/servicing of the equipment will be performed at the contractor's off-site workshop.

1.3 Alternatives

Presently, the project proposal entails the prospecting of 66 107.1283 ha area over the above listed properties. The proposed footprint was based on the available geological information which is of interest to the minerals applied for.

2 Legislative Requirements

The HIA, as a specialist study to the BA, is required under the following legislation:

- National Heritage Resources Act ((NHRA), Act No. 25 of 1999)
- National Environmental Management Act ((NEMA), Act No. 107 of 1998 - Section 23(2)(b))

A Phase 1 HIA is a pre-requisite for development in South Africa as prescribed by SAHRA and stipulated by legislation. The overall purpose of heritage specialist input is to:

- Identify any heritage resources, which may be affected;
- Assess the nature and degree of significance of such resources;
- Assess the negative and positive impact of the development on these resources; and
- Make recommendations for the appropriate heritage management (or avoidance) of these impacts.

The HIA should be submitted, as part of the impact assessment report or EMPr, to the Provincial Heritage Resource Agency (PHRA) or to The South African Heritage Resources Agency (SAHRA). SAHRA will ultimately be responsible for the evaluation of Phase 1 HIA reports upon which review comments will be issued. 'Best practice' requires Phase 1 HIA reports and additional development information, as per the impact assessment report and/or EMPr, to be submitted in duplicate to SAHRA after completion of the study. SAHRA accepts Phase 1 HIA reports authored by professional archaeologists, accredited with ASAPA or with a proven ability to do archaeological work.

SAHRA as a commenting authority under section 38(8) of the NHRA require all environmental documents, compiled in support of an EA application as defined by the National Environmental Management Act (NEMA) (Act No 107 of 1998) to be submitted to SAHRA for commenting. Environmental Impact Assessment (EIA) Regulations section 40 (1) and (2). The Environmental Impact Assessment (EIA) Regulations, Government Notice Regulation (GN) R.982 were published on 04 December 2014 and promulgated on 08 December 2014. Together with the EIA Regulations, the Minister also published GN R.983 (Listing Notice No. 1), GN R.984 (Listing Notice No. 2) and GN R.985 (Listing Notice No. 3) in terms of Sections 24(2) and 24D of the NEMA, as amended) Upon submission to SAHRA the project will be automatically given a case number as reference. As such the EIA report and its appendices must be submitted to the case as well as the EMPr, once it’s completed by the Environmental Assessment Practitioner (EAP).

Minimum accreditation requirements include an Honours degree in archaeology or related discipline and 3 years post-university CRM experience (field supervisor level). Minimum standards for reports, site documentation and descriptions are set by ASAPA in collaboration with SAHRA. ASAPA is based in South Africa, representing professional archaeology in the SADC region. ASAPA is primarily involved in the overseeing of ethical practice and standards regarding the archaeological profession. Membership is based on proposal and secondment by other professional members.

Phase 1 HIAs are primarily concerned with the location and identification of heritage sites situated within a proposed development area. Identified sites should be assessed according to their significance (refer to Section 3.5). Relevant conservation or mitigation recommendations should be made. Recommendations are subject to evaluation by SAHRA.

Section 3 of the NHRA distinguishes nine criteria for places and objects to qualify as 'part of the national estate' if they have cultural significance or other special value. These criteria are:

- Its importance in/to the community, or pattern of South Africa's history;
- Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- Its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- Its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- Its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa;
- Sites of significance relating to the history of slavery in South Africa

Conservation or mitigation recommendations, as approved by SAHRA, are to be used as guidelines in the developer's decision-making process.

Phase 2 archaeological projects are primarily based on salvage/mitigation excavations preceding development destruction or impact on a site. Phase 2 excavations can only be conducted with a permit, issued by SAHRA to the appointed archaeologist. Permit conditions are prescribed by SAHRA and includes (as minimum requirements) reporting back strategies to SAHRA and deposition of excavated material at an accredited repository.

In the event of a site conservation option being preferred by the developer, a site management plan, prepared by a professional archaeologist and approved by SAHRA, will suffice as minimum requirement. After mitigation of a site, a destruction permit must be applied for with SAHRA by the applicant before development may proceed.

Human remains older than 60 years are protected by the National Heritage Resources Act, with reference to Section 36 and GNR 548 as well as the SAHRA BGG Policy 2020. Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 of the National Heritage Resources Act (NHRA), as well as the National Health Act of 2003 and are the jurisdiction of SAHRA. The procedure for Consultation Regarding Burial Grounds and Graves (Section 36[5]) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in this age category, located inside a formal cemetery administrated by a local authority, require the same authorisation as set out for graves younger than 60 years, in addition to SAHRA authorisation. If the grave is not situated inside a formal cemetery, but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws, set by the cemetery authority, must be adhered to.

Human remains that are less than 60 years old are protected under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance No. 7 of 1925) re-instituted by Proclamation 109 of 17 June 1994 and implemented by CoGHSTA as well as the National Health Act 2003 and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the office of the relevant Provincial Premier. Authorisation for exhumation and reinternment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and regional provisions,

laws and by-laws must also be adhered to. To handle and transport human remains, the institution conducting the relocation should be authorised under the National Health Act of 2003

3 METHODOLOGY

3.1 Literature Review and background study

A brief survey of available literature was conducted to extract data and information on the area in question to provide general heritage context into which the development would be set. This literature search included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). Findings are included in Section 6.1 and 6.2.

3.2 Genealogical Society and Google Earth Monuments

Google Earth and 1:50 000 topographic maps of the area were utilised to identify possible places of heritage sensitivity might be located. The database of the Genealogical Society of South Africa (GSSA) was consulted to collect data on any known graves in the area. Results are included in Section 6.3.

3.3 Public Consultation and Stakeholder Engagement:

Stakeholder engagement is a key component of any BA process, it involves stakeholders interested in, or affected by the proposed development. Stakeholders are provided with an opportunity to raise issues of concern (for the purposes of this report only heritage related issues will be included). The aim of the public consultation process to be undertaken by the EAP was to capture and address any issues raised by community members and other stakeholders. Results will be included in Section 5 and the final BA report.

3.4 Site Significance and Field Rating

The presence and distribution of heritage resources define a 'heritage landscape'. In this landscape, every site is relevant. In addition, because heritage resources are non-renewable, heritage surveys need to investigate an entire Project area, or a representative sample, depending on the nature of the project. In the case of the proposed Project the local extent of its impact necessitates a representative sample and only the footprint of the areas demarcated for development were surveyed. In all initial investigations, however, the specialists are responsible only for the identification of resources visible on the surface. This section describes the evaluation criteria used for determining the significance of archaeological and heritage sites. The following criteria were used to establish site significance with cognisance of Section 3 of the NHRA:

- The unique nature of a site;
- The integrity of the archaeological/cultural heritage deposits;
- The wider historic, archaeological and geographic context of the site;
- The location of the site in relation to other similar sites or features;
- The depth of the archaeological deposit (when it can be determined/is known);
- The preservation condition of the sites; and
- Potential to answer present research questions.

In addition to this criteria field ratings prescribed by SAHRA (2006), and acknowledged by ASAPA for the SADC region, were used for the purpose of this report. The recommendations for each site should be read in conjunction with section 9 of this report.

Table 4. Heritage significance and field ratings

FIELD RATING	***GRADE***	***SIGNIFICANCE***	***RECOMMENDED MITIGATION***
National Significance (NS)	Grade 1	-	Conservation; national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation; mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A (GP. A)	-	High/medium significance	Mitigation before destruction
Generally Protected B (GP. B)	-	Medium significance	Recording before destruction
Generally Protected C (GP.C)	-	Low significance	Destruction

3.5 Impact Assessment Methodology

The criteria below are used to establish the impact rating on sites:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0-1 years), assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years), assigned a score of 2;
  - medium-term (5-15 years), assigned a score of 3;
  - long term (> 15 years), assigned a score of 4; or
  - permanent, assigned a score of 5;
  - The **magnitude**, quantified on a scale from 0-10 where; 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
  - The **probability of occurrence**, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1-5 where; 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
  - The **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
  - the **status**, which will be described as either positive, negative or neutral.
  - the degree to which the impact can be reversed.
  - the degree to which the impact may cause irreplaceable loss of resources.
  - the *degree* to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:
S= (E+D+M) P
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e., where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e., where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- 60 points: High (i.e., where the impact must have an influence on the decision process to develop in the area).

3.6 Assumptions and limitations of the study

The authors acknowledge that the brief literature review is not exhaustive on the literature of the area The study area was not subjected to a field survey at this stage in the environmental process, it is recommended that this will be done when the actual exploration localities are fixed. It is assumed that information obtained for the wider area is applicable to the study area. It is possible that new information could come to light in future, which might change the results of this Impact Assessment.

4 Description of Socio-Economic Environment

According to the 2011 Census, Joe Morolong Local Municipality has a total population of 89 530 people. The majority of the population in the municipality are black African (96,4%), 2,0% are coloured, with the other population groups making up the remaining 1,6%. Of those aged 20 years and older, 5,2% have completed primary school, 27,8% have some secondary education, 13,4% have completed matric and 4,1% have some form of higher education. Of the mentioned age group, 22,9% have no form of schooling. There are 12 740 people that are economically active (employed or unemployed but looking for work), and of these, 38,6% are unemployed. Of the 6 323 economically active youth (15–34 years) in the area, 49,5% are unemployed.

According to Census 2011, Ga-Segonyana Municipality has a total population of 93 651 of which 87,0% are black African, 7,6% are coloured, 4,6% are white, and 0,4% are Indian/Asian. Other groups make up 0,4% of the population. Of those aged 20 years and older, 4,9% completed primary school, 34,3% completed secondary school, 23,7% completed Grade 12, 10,0% have some form of higher education and only 9,7 % have no schooling. A total of 19 940 persons are employed, 10 154 are unemployed, and 3 895 are classified discouraged work-seekers.

According to Census 2011, Dikgatlong Local Municipality has a population of 46 841, of whom 58,5% are black African, 28,5% are coloured, 3,6% are white, with other population groups making up the remaining 9,4%. Setswana is the most widely spoken language (24 549 people), followed by Afrikaans (18 250 people). There are 97 males for every 100 females. 63,1% of the population is aged between 15 and 64 years, while 31,7% of the population is younger than 15 years. In 2011, 20,3% of the population aged 20 years and older had attained matric. Livestock, irrigation farming and commercial mining drive the municipality's economy. The unemployment rate in Dikgatlong is 39,7%, with the youth unemployment rate standing at 49,0%. The main contributing factor to the low levels of employment in Dikgatlong is the high percentage (86,2%) of the labour force that has not obtained a Grade 12 Senior Certificate and/or higher qualification, resulting in a primarily unskilled labour force.

According to census 2011, there are 35 093 people in the municipality. Of these, 52,8% are African black, 37,6% are coloured, and 8,4% are white. Other population groups make up the remaining 1,2% of the population. Of those aged 20 years and older, 13,9% had some primary schooling, 5,3% had completed primary, 35,4% had some secondary, and 25,4 had matric. Only 6,4% had a higher qualification, and 13,7% had no form of schooling. Economically Tsantsabane is known for being rich in minerals, and for its mining, agriculture, manufacturing and farming sectors. Tsantsabane has reinvented itself over the years as one of the leading investment hot spots in the Northern Cape. The construction of the Anglo American Kumba Iron Ore's Kolomela mine has brought an implosion of development to the area.

According to the 2011 Census, Siyancuma Local Municipality has a total population of 37 076 people. The majority of the population in the municipality are coloured at 57,5%,33,3% are black African,7,5% are White, 0,7% are Indian/Asian, with the other population groups making up the remaining 1,4%.

Of those aged 20 years and older,7,2% have completed primary school, 30,3% have some secondary education, 16,9% have completed matric and 5,4%have some form of higher education. Of the mentioned

age group, 16,8% have no form of schooling. There are 11 064 people that are economically active (employed or unemployed but looking for work), and of these,28,2% are unemployed. Of the 5 800 economically active youth (15–34 years) in the area, 35,2% are unemployed (statssa.gov.za).

5 Results of Public Consultation and Stakeholder Engagement:

In line with the NHRA, stakeholder engagement is a key component of any EA process, it involves stakeholders interested in, or affected by the proposed development. At the time of writing no heritage concerns have been raised. Advertisements will be placed in relevant newspaper/s (such as the Noordkaap Bulletin), and on-site notices will be placed.

6 Contextualising the study area

6.1 Archaeological Background

6.1.1 Stone Age

South Africa has a long and complex Stone Age sequence of more than 2 million years. The broad sequence includes the Later Stone Age, the Middle Stone Age and the Earlier Stone Age. Each of these phases contains sub-phases or industrial complexes, and within these we can expect regional variation regarding characteristics and time ranges. For (CRM) purposes it is often only expected/ possible to identify the presence of the three main phases. Yet sometimes the recognition of cultural groups, affinities or trends in technology and/or subsistence practices, as represented by the sub-phases or industrial complexes, is achievable. The three main phases can be divided as follows;

- Later Stone Age (LSA); associated with Khoi and San societies and their immediate predecessors. - Recently to ~30 thousand years ago.
- Middle Stone Age (MSA); associated with Homo sapiens and archaic modern human - . 30-300 thousand years ago.
- Earlier Stone Age (ESA); associated with early Homo groups such as Homo habilis and Homo erectus. - 400 000-> 2 million years ago.

The area in and surrounding Kathu is referred to as the Kathu Complex which is comprised of several Stone Age sites of varying heritage significance. A series of 11 localities which have been exposed due to sinkhole formations belong to the Kathu Complex (Beaumont 1990, Lukich et al 2019). The Kathu Pans form an important aspect of the study of human evolution due to the expansive occupation within the region. Evidence of the oldest lithic assemblage of the Fauresmith industry, dating back 500 thousand years can be found at the site of Kathu Pan 1 (Wilkins and Chazan 2012). Lithic assemblages found at Kathu Pan 1 show continued hominin occupation throughout the ESA, MA and LSA. Lithic technology at Kathu Pan 1 suggests one of the earliest evidence for the use of spears for hunting and blade production (Wilkens and Chazan 2012). On the farm Sims 462 Kathu Pan 6, 8,9,10, and 11 are found within a sinkhole that was caused by sediment collapse. Artefacts found on the farm Sims are associated with the Middle and Late Stone Age. Excavations on farm Sacha recovered Acheulean to Late Stone Age material from Kathu Pan 1. Stone tools recovered from the excavations are stored at the McGregor Museum (Beaumont 2000).

To the east of the town of Kathu, a site called the Townlands was discovered in 1980 by the land owner. Excavations and analysis of the site discovered the densest Stone Age scatter with over a million artefacts being recovered therefrom (Chazan 2021). An in-situ quarry is speculated to have been made use of at Kathu Townlands, indicating the local procurement of materials as well as the local production of stone tools within the area (Walker et al 2014). The site itself spans roughly 12 hectares in size and is an important archaeological site pertaining to early human activity within the country. In 2013, the Kathu Townlands was declared a Grade 1 National Heritage site (Walker et al 2014).

Excavations at the Wonderwerk Cave situated in the Kuruman Hills yielded a deep deposit rich with Stone Age materials. The cave shows a long period of hominin occupation as the cave was used throughout the

Stone Age. Rock engravings can also be found within the cave (Beaumont and Vogel 2006). Due to the importance of the finds, the cave has been registered as a National Heritage Site by SAHRA. Closer to Kuruman two shelters on the northern and southern faces of GaMohaan (in the Kuruman Hills north west of the town) contain Later Stone Age remains and rock paintings. Archaeological surveys have shown rocky outcrops and hills, drainage lines, riverbanks and confluences to be prime localities for archaeological finds and specifically Stone Age sites, as these areas were utilized for settlement of base camps close to water and hunting ranges.

Sotho-Tswana and Nguni societies, the descendants of the LIA mixed farming communities, found the region already sparsely inhabited by the Late Stone Age (LSA) Khoisan groups, the so-called 'first people'. Most of them were eventually assimilated by LIA communities and only a few managed to survive, such as the Korana and Griqua. This period of contact is referred to as the Ceramic Late Stone Age (De Jong 2010) and is represented by the Blinkklipkop specularite mine near Postmasburg and a cluster of important finds at Kathu Pan. Kathu Pan has been the subject of numerous heritage studies and is a notable heritage site (Beaumont 2004, Wilkins et al 2012). Additional specularite workings with associated Ceramic Later Stone Age material and older Fauresmith sites (early Middle Stone Age) are known from Lylyfeld, Demaneng, Mashwening, King, Rust & Vrede, Paling, Gloucester and Mount Huxley (Morris 2005).

6.1.2 Iron Age

Bantu-speaking people moved into Eastern and Southern Africa about 2,000 years ago (Mitchell 2002). These people cultivated sorghum and millets, herded cattle and small stock and manufactured iron tools and copper ornaments. Because metalworking represents a new technology, archaeologists call this period the Iron Age. Characteristic ceramic styles help archaeologists to separate the sites into different groups and time periods. The Iron Age as a whole represents the spread of Bantu speaking people and includes both the Pre-Historic and Historic periods. It can be divided into three distinct periods:

- The Early Iron Age (EIA): Most of the first millennium AD.
- The Middle Iron Age (MIA): 10th to 13th centuries AD.
- The Late Iron Age (LSA): 14th century to colonial period.

Iron Age expansion southwards past Kuruman into the Ghaap Plateau and towards Postmasburg dates to the 1600's (Humphreys, 1976 and Thackeray, 1983). Definite dates for Tswana presence in the Postmasburg area are around 1805 when Lichtenstein visited the area and noted the mining activities of the Tswana (probably the Thlaping) tribes in the area. The Thlaro and Thlaping settled the area from Campbell in the east to Postmasburg and towards the Langeberg close to Olifantshoek in the north west before 1770 (Snyman, 1988). The Korana expansion after 1770 started to drive the Thlaro and Thlaping further north towards Kuruman (Shillington, 1985). Morris (2005) indicated that 3 Iron Age sites are on record within the area (Demaneng, Lylyveld and Kathu).

6.1.3 Historical Background

The 'Eye' and the water course springing from it have been a focus of utilization and settlement and it was in its immediate vicinity that Kuruman, as town, evolved from the late nineteenth century. Kuruman's name is thought to be derived from the name of an 18th century San leader Kudumane.

The earliest documented exploration of this region by European explorers occurred in 1801 when P.J. Truter and Dr. W. Somerville crossed the Orange River near Prieska and traversing through Blinkklip en route to what is now Kuruman (Bergh 1999). In the same period, William Anderson and Cornelius Kramer, representing the London Missionary Society, founded a mission station called Leeuwenkuil. Their primary focus was on a community referred to as 'the Bastards', a group characterized by a mix of cultural backgrounds stemming from various racial and cultural unions, including European and Khoi ancestry, as well as remnants of Khoi and San groups and liberated slaves. This diverse group eventually came to be known as the Griqua (Erasmus, 2004). Due to the persistent threat posed by lions in the vicinity of Leeuwenkuil, the mission station was relocated in 1805 to Klaarwater. In 1813, the settlement that had developed there was officially renamed Griquatown. This change was proposed by Reverend John Campbell, Director of the London Missionary Society, during his visit to the area (Raper 2004).

On the 20th of December 1820, Andries Waterboer was elected to replace Berend Berends as leader of Griquatown. This would lead to tensions between Waterboer and the Griqua and during the 1820s, a group of Griqua left Griquatown and settled along the Modder River and became known as the Bergenaars. The Bergenaars would often attack the Thlaro, Thlaphing, and Griqua. They also undertook various attacks on Griquatown and the mission station in Kuruman which Robert Moffat had established in 1824.

A treaty was signed on the 22nd of April 1842 between Griqua leader Andries Waterboer and Thlaping leader Mahura at Mahura's settlement near Taungs. This agreement was comprehensive, encompassing an allocation of the boundary between the two groups. However, it is essential to recognize that this boundary line was subject to change and negotiation. This demarcation closely resembled an earlier boundary, believed to have been established during the 1820s, marking the division between the Griqua and the Thlaping (Legassick, 2010).

Following the passing of Andries Waterboer, his son, Nicolaas Waterboer, assumed leadership in Griquatown. Nicolaas governed Griquatown until the British annexed the area in 1871 (Legassick 2010). It was under Nicolaas Waterboer's leadership that diamonds were uncovered in the region, sparking a contentious period of competing claims involving the Griqua, the Orange Free State, and the Zuid-Afrikaansche Republiek (ZAR). The area claimed as British territory became known as Griqualand West. Tensions rose in Griqualand West which sparked a rebellion amongst Tswana communities against the British and spread as far as the Langberg mountains.

The British territory grew as the whole area between Griqualand West and the Modder River was proclaimed the Crown Colony of British Bechuanaland. This included various areas which had been occupied by Tswana communities. This led to various 'native reserves' being established in Deben, Gatlhose, Langberg, and Kathu (Snyman 1986). In 1895, the Crown Colony of British Bechuanaland was annexed by the Cape Colony.

In the late 1890s, Rinderpest became widespread, and the residents were unable to stop the spread of the viral disease in cattle. The Rinderpest epidemic also sparked the Langberg Rebellion of 1897 whereby conflicts rose between authorities and Galeshiwe, a Thlaping leader from Taung. The conflict erupted when government representatives destroyed infected cattle belonging to Galishewe as a measure to halt the spread of disease. In retaliation, Galishewe killed an officer and fled to seek refuge with the Thlaro leader Toto of the Langberg. This incident triggered a widespread rebellion (Breutz 1963). The British authorities responded by assembling a military force, which included units from the Cape Mounted Rifles and Bechuanaland Field Force. By March 14, 1897, this force numbered approximately 1,000 men. In contrast,

the Tswana rebels, facing serious shortages of provisions and ammunition from the outset of the rebellion, fielded an army of around 1,500 men (Snyman 1986). Despite their numerical advantage, the rebels faced a formidable and well-equipped British force supported by artillery. The rebellion was quelled and concluded when rebel leader Toto, along with his son Robanyane and their Thlaro followers, surrendered on the 2nd of August 1897 (Snyman 1986).

6.1.4 Historical Mining

The South African Railways Administration's intention to extend the railway line from Postmasburg to Kapstewel and Lohatla, transformed the entire manganese industry north of Postmasburg. This marked a significant milestone as Postmasburg became one of the select towns in the Northern Cape with a direct rail connection. While the railway extension to Beeshoek was constructed by the Manganese Corporation, subsequent extensions to Lohatla and Manganore, Sishen, and Hotazel were undertaken by the South African Railways (Snyman 1983). The prospect of railway extensions to this region also spurred other mining ventures, such as the establishment of Gloucester Manganese, a mining company formed to exploit manganese deposits on the farm Gloucester. Shortly thereafter, Gloucester Manganese merged with the Manganese Corporation to create the Associated Manganese Mines of South Africa Limited (Ammosal). Ammosal reconstructed the old ore handling plant from Beeshoek on the farm Gloucester, with operations here contributing significantly to the overall manganese production of 250,000 tons (S.A. Manganese, 1977).

In 1930, an Englishman named Pringle-Smith was appointed by S.A. Manganese to develop and implement a comprehensive prospecting program for the company's properties (S.A. Manganese 1977:46). This initiative aimed to resume prospecting work that had been initiated in 1927 but had been halted due to unfavourable financial conditions and the absence of a railway connection. Pringle-Smith swiftly commenced opening up the mineral beds on the farms Kapstewel and Doornput. However, despite these efforts, S.A. Manganese lacked the market presence enjoyed by entities like the Manganese Corporation at that time. Consequently, the ore extracted was stockpiled at these two farms. Pringle-Smith departed from the Postmasburg area in 1932, driven by the intensified financial challenges of the Great Depression. His departure was prompted by S.A. Manganese's need to adjust his salary significantly downward (S.A. Manganese 1977). The economic repercussions of the Great Depression led to the closure of several smaller manganese mining companies. This period of economic hardship prompted a wave of merging and amalgamation within the industry. As a result, South African Manganese Limited and Associated Manganese Miners of South Africa Limited emerged as the dominant players in the manganese mining sector (Snyman 1983).

In the 1930s, the South African Geological Survey conducted a geological assessment of the minerals and ore deposits in the Postmasburg District. Among the team members was Dr. Leslie Gray Boardman, tasked with investigating manganese and hematite deposits in the district. In addition to identifying manganese deposits near Postmasburg, Dr. Boardman also discovered substantial iron ore deposits on farms situated along the northern extent of their study area, including Sishen, Bruce, and King (S.A. Manganese 1977).

From 1937, S.A. Manganese began acquisitions of various farms for mining. They would also establish a staff village to supplement for labour needed for the mining. In the 1940s, S.A. Manganese and the African Metals Corporation (Amcor), established a new company called Manganore Iron Mining Lt in order to mine iron ore. Dr Boardman had later convinced S.A. Manganese to acquire the farm Lilyveld as his geological survey had uncovered large amounts of haematite iron ore there.

In 1953, Iscor began with iron production at Sishen. The railway line from Postmasburg to Sishen had also been extended in this year in order to send ore to various Iscor plants in Pretoria, Vanderbijlpark, and Newcastle. By 1973, a second mine was established at Sishen and iron ore was exported to Saldanha Bay. This growth in the mining industry led to the establishment of the town of Kathu in order to house mine workers. By 1977, the Sishen-Saldanha railway line was completed.

6.2 Literature Review (SAHRIS)

Several Cultural Resource Management (CRM) surveys are on record for the general area and the relevant results of these studies are briefly discussed below and outlined in Table 6.

Table 5. Studies consulted for the project.

Author	Year	Project	Findings
Morris, D.	2005	Archaeological Impact assessment of mining areas on the farms Bruce, King, Mokaning and Parson between Postmasburg and Kathu in the Northern Cape.	Cemeteries, Stone Age sites.
Morris, D.	2008	Archaeological and Heritage Phase 1 Impact Assessment for Proposed Upgrading of Sishen Mine Diesel Depot Storage Capacity at Kathu, Northern Cape.	MSA scatters.
Beaumont, P.	2005	Heritage Assessment for an EMPR amendment relating to a proposed crusher at Sishen Iron Ore Mine near Kathu in the Northern Cape province.	No sites were identified.
Beaumont, P.	2007	Supplementary Archaeological Impact Assessment Report on Sites near or on the Farm Hartnolls 458, Kgalagadi District Municipality, Northern Cape Province.	Widespread ESA scatters
Beaumont, P.	2008a	Phase 1 Heritage Impact Assessment Report on Portion 463/8 of the Farm Uitkoms 463, near Kathu, Kgalagadi Municipality, Northern Cape Province.	Stone Age scatters
Beaumont, P.	2008b	Phase 1 Archaeological Impact Assessment Report on Areas at Hotazhel Mine on the Farm Hotazhel 280, Kgalagadi District Municipality, Northern Cape Province.	No sites were identified.
Huffman, T.N.	2001	Draft Archaeological Survey of the Smartt/Rissik Mine, Northern Cape.	An isolated MSA lithic.
Fourie, W., van der Walt, J.	2006	Kalahari Manganese Mines: Heritage Assessment on Umtu 281, Olive Pan 282, Gama 283.	A cemetery, Stone Age scatter.
Van der Walt, J.	2012	Aia Report for the Proposed Extension of An Abandoned Gravel Pit on the Farm Harvard 171 in the Kudumane Magisterial District 13km East of Kuruman.	No sites were identified.
Van der Walt, J.	2013	Archaeological Impact Assessment for the Proposed Prospecting Right of a Quarry on the Farm Gamohaan 438 Portion 1 in the Kuruman Magisterial District.	No sites were identified.
Van der Walt, J.	2016	Archaeological Impact Assessment Report for the Proposed Metals Industrial Cluster near Kuruman, Northern Cape Province.	No sites were identified.
Van der Walt, J.	2017	Heritage Impact Assessment for the Proposed Khumani Iron Ore Mine Project, Sishen, Northern Cape.	No sites were identified.
Pistorius, J.C.C.	2006	A Phase 1 Heritage Impact Assessment (HIA) Study for the Proposed New United Manganese of Kalahari (Umk) Mine on the Farms Botha 313, Smartt 314 and Rissik 330 near Hotazhel in the Northern Cape Province of South Africa.	Remains of mining activities, Stone Age scatters.
Pistorius, J.C.C.	2008	A Phase I Heritage Impact Assessment (HIA) Study for a Proposed New Power Line for the United Manganese of Kalahari (UMK) Mine near Hotazel in the Northern Cape Province of South Africa.	No sites were identified.
Webley, L., Halkett, D.	2008	Phase 1 Heritage Impact Assessment: Proposed Prospecting on the Farms Adams 328 and Erin 316, Kuruman, Ga-Segonyana Municipality in the Northern Cape.	MSA/LSA scatters, graves, Historical structures and artefacts.
Kaplan, J.	2008	An Archaeological Assessment of Three Borrow Pits Alongside D300 Mothibistad, Northern Cape Province.	Stone Age scatter.
Dreyer, C.	2007	First Phase Archaeological and Cultural Heritage Assessment of the Proposed Garona-Mercury Transmission Power Line, Northern Cape, North-West Province & Free State.	ESA scatters, a cemetery, and traditional settlements.

Angel, J., Fourie, W.	2016	Upgrading of the 66kv Network to a 132kv Network in the Hotazel, Kuruman and Kathu Area, Northern Cape Province – Post Authorisation Walkdown from Mothibistad Substation to Sekgame Switching Station. Heritage Walk Down and Management Plan.	Cemeteries, historic structure, Stone Age site.
Birkholtz, P.	2019	Proposed Extension of Mining Activities and the Widening of a Haul Road on the Farm Lylyveld 545, near Kathu, Northern Cape Province	No sites were identified.

6.3 Google Earth and the Genealogical Society of South Africa (Graves and Burial Sites)

Google Earth and 1:50 000 maps of the area were utilised to identify possible places where archaeological and historical sites might be located. The database of the Genealogical Society of South Africa indicated no known grave sites within the study area.

7 Heritage Baseline

7.1 Description of the Physical Environment

The Project area traverses various vegetation types including Kuruman Vaalbosveld, Kuruman Thornveld, Ghaap Plateau Vaalbosveld, Olifantshoek Plains Thornveld, and Northern Upper Karoo. The Kuruman Vaalbosveld is described as open tree layer characterised by *Acacia erioloba, A. karro, Rhus lancea* and *Ziziphus mucronate.* Shrub layer poorly developed, with *Grewia flava* and *Tarchonanthus camphoratus* and grass layer open, with much bare soil in places. The Kuruman Thornveld is described as flat rocky plains and sloping hills with very-developed, closed shrub layer and well-developed open tree stratum consisting of *Acacia erioloba.* The Ghaap Plateau Vaalbosveld is described as flat plateau with well-developed shrub layer with *Tarchonanthus camphoratus* and *Acacia karroo.* Open tree layer has *Olea europaea* subsp. *Africana, A. tortilis, Ziziphus mucronate* and *Rhus lancea. Olea* is more important in the southern parts of the unit, while *A. tortilis, A. hebeclada* and *A. mellifera* are more important in the north and part of the west of the unit. Much of the south-central part of this unit has remarkably low cover of *Acacia* species for an arid savanna and is dominated by the nonthorny *T. camphoratus, R. lancea* and *O. europaea* subsp. *Africana.* The Olifantshoek Plains Thornveld is described as a very wide and diverse unit on plains with usually open tree and shrub layers with, for example, *Acacia luederitzii, Boscia albitrunca* and *Rhus tenuinervis* and with a usually sparse grass layer. The Northern Upper Karoo is described as shrubland dominated by dwarf karoo shrubs, grasses and *Acacia mellifera* subsp. *detinens* and some other low trees (especially on the sandy soils in the northern parts and vicinity of the Orange River). Flat to generally sloping, with isolated hills of Upper Karoo Hardeveld in the south and Vaalbos Rocky Shrubland in the northeast and with many interspersed pans (Mucina and Rutherford 2006).

The various farms which will undergo non-invasive prospecting and invasive prospecting activities cover an area of 66 107.1283 hectares and covers a wide region from north of Kuruman to Higgs' Hope towards Prieska.

The Kuruman and Asbestos Hills consist of banded iron formation, with jaspilite, chert and riebeckite-asbestos (Mucina and Rutherford 2006). Many stone tools found in the region of Kuruman have been seen to be made from jaspilite. Aeolian red sand can be found across much of the landscape in which the study areas lie.

7.2 Heritage Resources

The various farms earmarked for prospecting are situated within a larger sphere of significant archaeological sites. Stone Age sites and artefacts can be expected across the entirety of the landscape with more significant sites clustered and expected on rocky outcrops, hills, and watercourses. Low density scatters relating to the ESA, MSA, and MSA can also be expected in flat plains. The northern farms which will be prospected are situated closer to Kuruman, Kathu Townlands, and the Kathu Complex and

significant sites could be more prominent and expected within these farms. Known sites include Grade IIIC Stone Age scatters recorded around topographical focal points, only on the Lower Kuruman Native Reserve 219 (Figure 7.1 and 7.2).

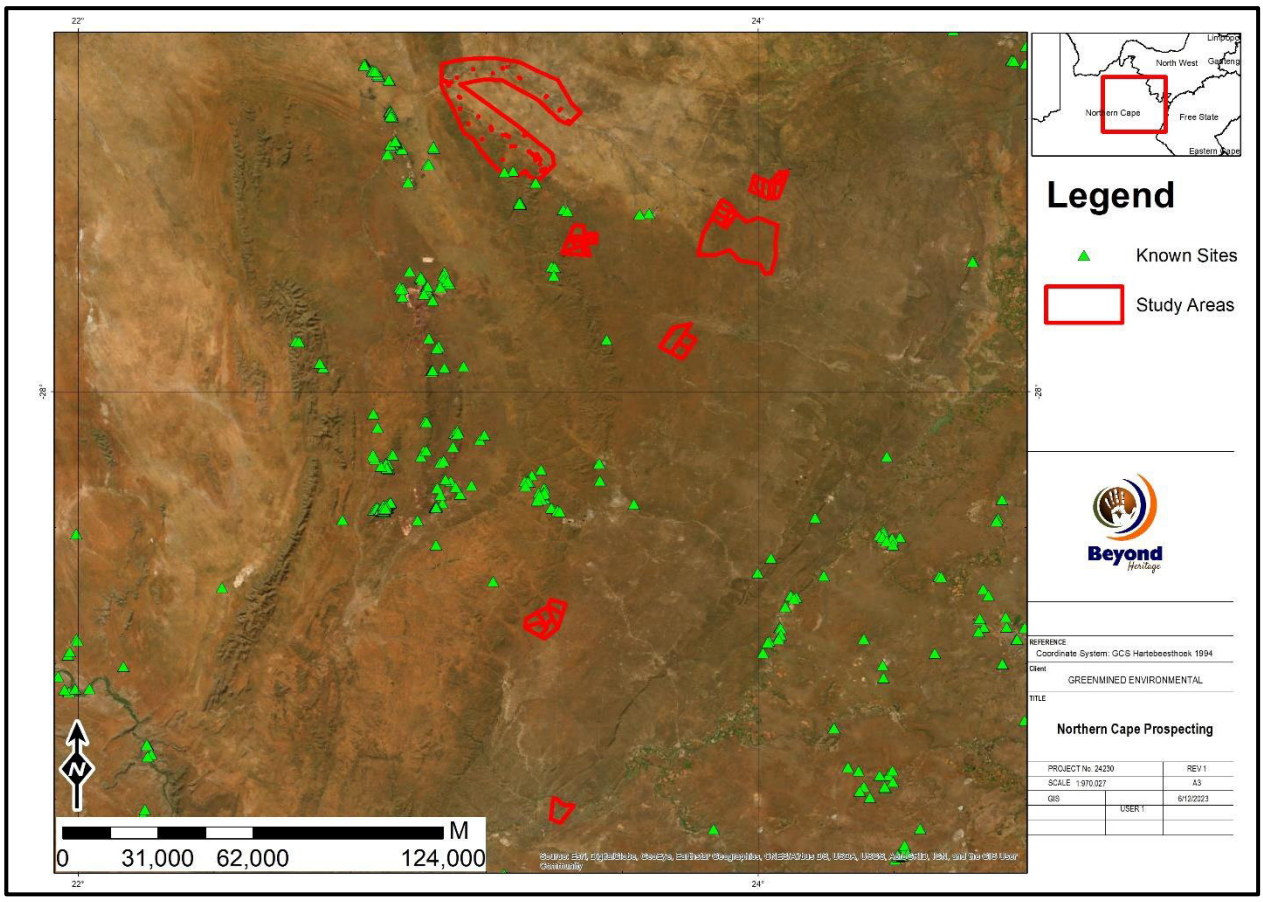


Figure 7.1. Known site distribution in relation to the study area.

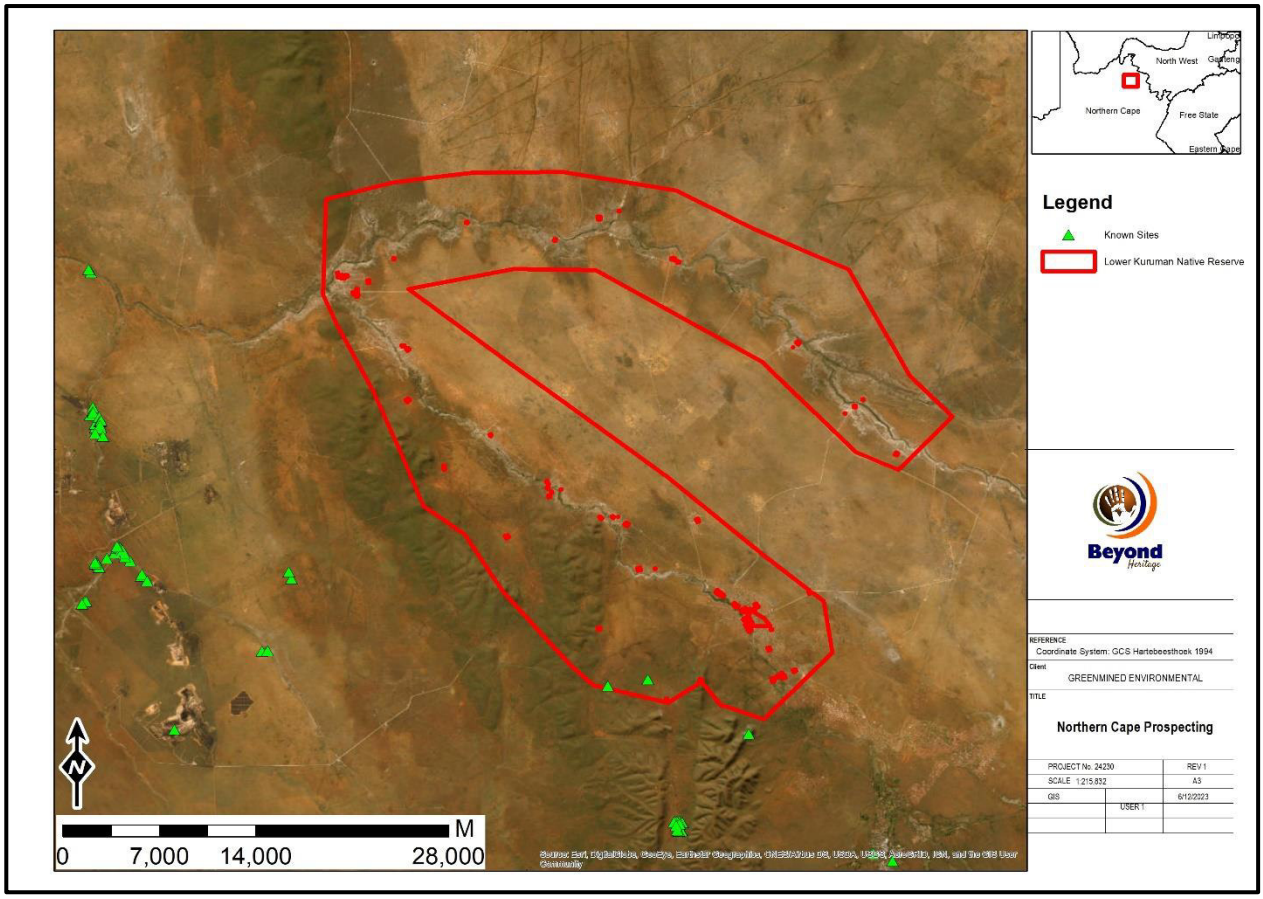


Figure 7.2. Stone age scatters recorded in relation to the Lower Kuruman Native Reserve.

Burial sites can occur anywhere on the landscape. A memorial site occurs at 27˚33'32.4"S; 23˚29'39.3"E at Edgehill 194/5 (Figure 7.3).

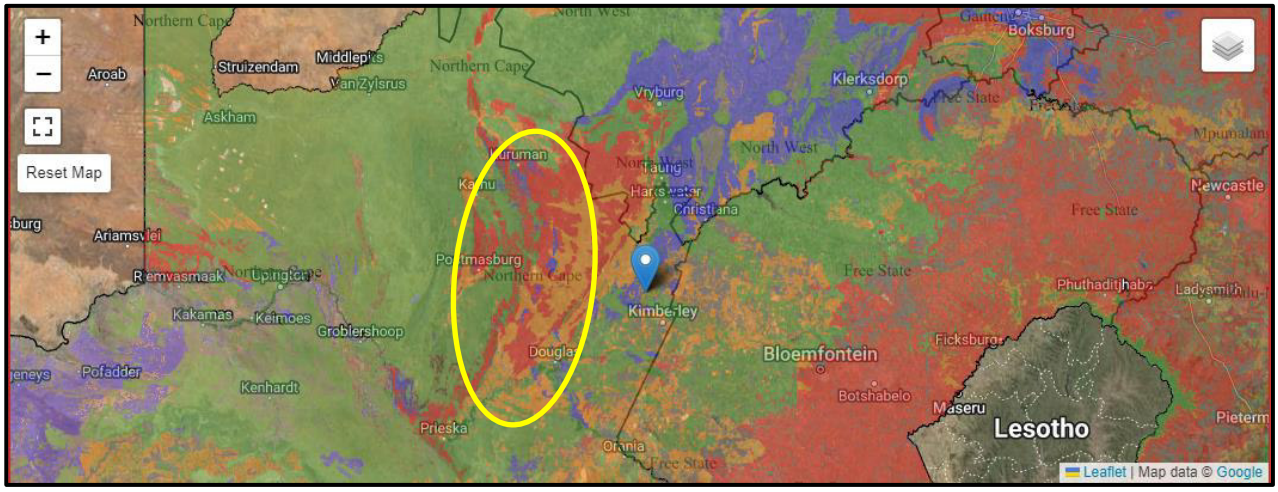
Figure 7.3. Memorial site at Edgehill 194/5 (Photograph provided by the client).

7.3 Cultural Landscape

The landscape has been mined since the contact period known as the Ceramic Later Stone Age whereby evidence of specularite mining and workings have been documented. The region is rich in minerals, and mining is a great driving force of the local economy. The project areas are situated within a landscape which is known for its extensive cultural layering spanning from the Early Stone Age to the Historic Period.

7.4 Paleontological Heritage

According to the SAHRA palaeontological sensitivity map, the various study areas are indicated as varying sensitivities of low, moderate, high, and very high palaeontological sensitivity (Figure 7.4), and an independent study was commissioned for this aspect (Bamford 2024).



Colour	Sensitivity	Required Action
RED	VERY HIGH	Field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	Desktop study is required
BLUE	LOW	No palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	No palaeontological studies are required
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map

Figure 7.4. Paleontological sensitivity of the approximate study area (yellow polygon) as indicated on the SAHRA Palaeontological sensitivity map.

8 Assessment of impacts

8.1 Impacts on tangible heritage resources.

It is assumed that the prospecting phase involves the removal of topsoil and vegetation drilling activities and creating new roads to get to the drill points. These activities can result in impacts that include destruction or partial destruction of previously unknown and non-renewable heritage resources.

Any additional effects to subsurface heritage resources can be successfully mitigated by implementing a chance find procedure. Mitigation measures as recommended in this report should be implemented during all phases of the project. Impacts of the project on heritage resources is expected to be low during all phases of the development if mitigation measures are followed.

8.1.1 Cumulative impacts

Cumulative impacts considered as an effect caused by the proposed action that results from the incremental impact of an action when added to other past, present, or reasonably foreseeable future actions. (Cornell Law School Information Institute, 2020). Cumulative impacts occur from the combination of effects of various impacts on heritage resources. The importance of identifying and assessing cumulative impacts is that the whole is greater than the sum of its parts. In the case of this project, impacts can be mitigated to an acceptable level. However, when this project proceeds to actual mining this and other projects in the area can have a negative impact on heritage sites, the cultural landscape, and the sense of place.

8.2 Impact Assessment Tables

Table 6. Impact assessment for invasive activities of the project

Nature: Activities resulting in disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological material or objects.		
	Without mitigation	**With mitigation (Preservation/ excavation of site)**
Extent	Site specific (1)	Site specific (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (3)	Low (3)
Probability	Probable (3)	Improbable (2)
Significance	**27 (Low)**	**18 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: • Once the drill sites have been confirmed these areas have to be subjected to a heritage walk down, this should be conducted prior to the commencement of invasive prospecting activities; • Drill sites must be kept as close as possible to existing roads to minimise the impact on the landscape; • Focal points on the landscape like rocky outcrops or pans must be avoided as far as possible as these areas could be sensitive from a heritage point of view; • Further palaeontological studies should be conducted once the impact areas are confirmed; • Monitoring of the project area by the ECO during the exploration phase for heritage chance finds, and if chance finds are encountered to implement the Chance Find Procedure for the project.		
Residual Impacts: If sites are destroyed this results in the depletion of the archaeological record of the area and even though surface features can be avoided or mitigated, there is a chance that completely buried sites would still be impacted but this cannot be quantified.		

9 Conclusion and recommendations

The scope of work comprises a heritage desktop report for a large prospecting right area comprising approximately 66 107.1283 ha across various farms. Due to the geographical size of the exploration application and the fact that no intrusive activities will occur at this point of the application, it was deemed not feasible to conduct fieldwork at this point. Several large-scale heritage surveys were conducted for mining projects in the area and the archaeological character of the area is now well described (e.g., Beaumont 2007; 2008, Morris 2005; 2008, Huffman 2001, Fourie and van der Walt 2006, Webley and Halkett 2008). Extensive archaeological research has also been conducted at the Kathu Complex and Kuruman (Beaumont 2000). This provides the opportunity to establish an overview of potential heritage resources that could be affected in the area by the proposed prospecting activity.

National Heritage sites of Kathu Townlands and Wonderwerk Cave in the Kuruman Hills are situated near farms which will undergo prospecting and the Kogelbeen Caves are located in the study area. The Kathu Complex comprised of 11 Stone Age sites of great significance are also situated in the landscape (Beaumont 1990). It is clear from the studies conducted that the general area has a wealth of heritage sites and a cultural layering dating back to the Stone Age with scatters and sites dating to the ESA, MSA and LSA. Sites and artefacts dating to these periods are scattered over the landscape with MSA and LSA sites centred on rocky outcrops, pans and watercourses and similar sites are expected to occur in the project areas. Due to the considerable archaeological significance of the landscape, especially relating to the Stone Age, rocky outcrops, hills, and watercourses such as drainage lines and pans should be avoided as significant Middle and Late Stone Age sites are more likely to be found within these topographical features.

Burial sites can occur anywhere on the landscape. A memorial site occurs at 27˚33’32.4”S; 23˚29’39.3”E at Edgehill 194/5.

According to the South African Heritage Resource Authority (SAHRA) Paleontological sensitivity map the study areas are of varying sensitivities of low, moderate, high, and very high palaeontological sensitivity an independent study was commissioned for this aspect (Bamford 2024).

No intrusive activities will occur at this point of the application and the potential impact on heritage resources is expected to be very low.

The impact to heritage resources is expected to be low provided that the recommendations in this report are adhered to, based on the South African Heritage Resource Authority (SAHRA) ’s approval.

9.1 Recommendations for condition of authorisation

The following recommendations for Environmental Authorisation apply and the Project may only proceed based on approval from SAHRA:

- Once the drill sites have been confirmed these areas have to be subjected to a heritage walk down, this should be conducted prior to the commencement of invasive prospecting activities;
- Drill sites must be kept as close as possible to existing roads in order to minimise the impact on the landscape;
- Focal points on the landscape like rocky outcrops, caves (including the Kogelbeen Caves) or pans must be avoided as far as possible as these areas could be sensitive from a heritage point of view;
- Monitoring of the Project area by the ECO during the exploration phase for heritage and palaeontology chance finds, if chance finds are encountered to implement the Chance Find Procedure for the Project as outlined in Section 9.

9.2 Chance Find Procedure

9.2.1 Heritage Resources

The possibility of the occurrence of subsurface finds cannot be excluded. Therefore, if during invasive activities any possible finds such as stone tool scatters, artefacts or bone and fossil remains are made, the operations must be stopped, and a qualified archaeologist must be contacted for an assessment of the find and therefor chance find procedures should be put in place as part of the EMP. A short summary of chance find procedures is discussed below and monitoring guidelines applicable to the Chance Find procedure is discussed below and monitoring guidelines for this procedure are provided in Section 9.5.

This procedure applies to the developer's permanent employees, its subsidiaries, contractors and subcontractors, and service providers. The aim of this procedure is to establish monitoring and reporting procedures to ensure compliance with this policy and its associated procedures. Crews must be properly inducted to ensure they are fully aware of the procedures regarding chance finds as discussed below.

- If during the invasive phases of this Project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance or heritage site, this person must cease work at the site of the find and report this find to their immediate supervisor, and through their supervisor to the senior on-site manager.
- It is the responsibility of the senior on-site Manager to make an initial assessment of the extent of the find and confirm the extent of the work stoppage in that area.
- The senior on-site Manager will inform the ECO of the chance find and its immediate impact on operations. The ECO will then contact a professional archaeologist for an assessment of the finds who will notify the SAHRA.

9.2.2 Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.
2. When excavations begin the rocks and discard must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, fossils of plants, insects, bone or coalified material) should be put aside in a suitably protected place. This way the Project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones. This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer then the qualified palaeontologist sub-contracted for this Project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered, then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the Project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished, then no further monitoring is required.

9.3 Reasoned Opinion

The overall impact of the Project with the recommended mitigation measures is acceptable and residual impacts can be managed to an acceptable level through implementation of the recommendations made in this report. The socio-economic benefits also outweigh the possible impacts of the development if the correct mitigation measures are implemented for the Project.

9.4 Potential risk

Potential risks to the proposed Project are the occurrence of intangible features and unrecorded cultural resources (of which graves, and subsurface cultural material are the highest risk). This can cause delays during construction, as well as additional costs involved in mitigation and possible layout changes. The stakeholder engagement process will assess intangible heritage resources further if this is listed as a concern.

9.5 Monitoring Requirements

Day to day monitoring during invasive prospecting activities can be conducted by the ECO. The ECO or other responsible persons should be trained along the following lines:

- *Induction training:*
  - Responsible staff identified by the developer should attend a short course on heritage management and identification of heritage resources.
  - Staff should also receive training on the CFP.
- *Site monitoring and watching brief*: As most heritage resources occur below surface, all earth-moving activities need to be routinely monitored in case of accidental discoveries. The greatest potential impacts are expected by clearing activities and invasive activities. The ECO should monitor all such activities. If any heritage resources are found, the chance finds procedure must be followed as outlined above.

Table 7. Monitoring requirements for the Project

Heritage Monitoring					
Aspect	**Area**	**Responsible for monitoring and measuring**	**Frequency**	**Proactive or reactive measurement**	**Method**
Cultural Heritage Resource Chance Find	Entire Project area	ECO	Weekly (during invasive activities)	Proactively	If risks are manifested (accidental discovery of heritage resources) the chance find procedure should be implemented: 1. Cease all works immediately; 2. Report incident to the Sustainability Manager; 3. Contact an archaeologist to inspect the site; 4. Report incident to the competent authority; and 5. Employ reasonable mitigation measures in accordance with the requirements of the relevant authorities. Only recommence operations once impacts have been mitigated.

9.7 Management Measures for inclusion in the EMPr

Table 8. Heritage Management Plan for EMPr implementation

Area	Mitigation measures	Phase	Timeframe	Responsible party for implementation	Target	Performance indicators (Monitoring tool)
General project area	• Once the drill sites have been confirmed these areas have to be subjected to a heritage walk down, this should be conducted prior to the commencement of invasive prospecting activities; • Drill sites must be kept as close as possible to existing roads in order to minimise the impact on the landscape; • Focal points on the landscape like rocky outcrops or pans must be avoided as far as possible as these areas could be sensitive from a heritage point of view;	Prior to exploration	Once off	Project Archaeologist Applicant EPC Contractor	Ensure compliance with relevant legislation and recommendations from SAHRA under Sections 35, 36 and 38 of NHRA	General project area
General project area	Monitoring of the project area by the ECO during invasive phases for chance finds, if chance finds are encountered to implement the Chance Find Procedure for the project	During any invasive activities	Weekly	Applicant EPC Contractor	Ensure compliance with relevant legislation and recommendations from SAHRA under Sections 35, 36 and 38 of NHRA	General project area

10 References

Angel, J. & Fourie, W. 2016. Upgrading of the 66kv Network to a 132kv Network in the Hotazel, Kuruman and Kathu Area, Northern Cape Province – Post Authorisation Walkdown from Mothibistad Substation to Sekgame Switching Station. Heritage Walk Down and Management Plan.

Beaumont, P.B. 1990. Kathu Pan. In: Beaumont, P., Morris, D. (Eds.), Guide to Archaeological Sites in the Northern Cape, Chapter Kathu. McGregor Museum, Kimberley.

Beaumont, P.B. 2000. Archaeological Scoping Survey for the Purpose of an EMPR for the Sishen Iron Ore Mine.

Beaumont, P. 2005. Heritage Assessment for an EMPR amendment relating to a proposed crusher at Sishen Iron Ore Mine near Kathu in the Northern Cape province.

Beaumont, P.B. & Vogel, J.C. 2006. On a timescale for the past million years of human history in central South Africa.

Beaumont, P. 2007. Supplementary Archaeological Impact Assessment Report on Sites near or on the Farm Hartnolls 458, Kgalagadi District Municipality, Northern Cape Province.

Beaumont, P. 2008a. Phase 1 Heritage Impact Assessment Report on Portion 463/8 of the Farm Uitkoms 463, near Kathu, Kgalagadi Municipality, Northern Cape Province.

Beaumont, P. 2008b. Phase 1 Archaeological Impact Assessment Report on Areas at Hotazhel Mine on the Farm Hotazhel 280, Kgalagadi District Municipality, Northern Cape Province.

Beaumont, P.B. & Vogel, J.C. 2006. On a timescale for the past million years of human history in central South Africa.

Bergh, J.S. 1999. Geskiedenisatlas van die Vier Noordelike Provinsies. Pretoria: Van Schaik.

Birkholtz, P. 2019. Proposed Extension of Mining Activities and the Widening of a Haul Road on the Farm Lylyveld 545, near Kathu, Northern Cape Province

Breutz, P.J. 1963. The Tribes of the Districts of Kuruman and Postmasburg. Department of Bantu Administration and Development, Ethnological Publication No. 49.

Chazan, M. & Horwitz, L.K. 2015. An overview of recent research at Wonderwerk Cave, South Africa. *Preserving African Cultural Heritage* 253-261.

Chazan M., Wilkins J., Morris D., & Berna F. 2012. Bestwood 1: a newly discovered Earlier Stone Age living surface near Kathu, Northern Cape Province, South Africa. *Antiquity* 86: 331.

Chazan, M. 2021. Early hominin group size: A perspective from Bestwood 1, Northern Cape Province, South Africa. *Quaternary International*.

Dreyer, C. 2007. First Phase Archaeological and Cultural Heritage Assessment of the Proposed Garona-Mercury Transmission Power Line, Northern Cape, North-West Province & Free State.

Fourie, W. & van der Walt, J. 2006. Kalahari Manganese Mines: Heritage Assessment on Umtu 281, Olive Pan 282, Gama 283.

Huffman, T.N. 2001. Draft Archaeological Survey of the Smartt/Rissik Mine, Northern Cape.

Kaplan, J. 2008. An Archaeological Assessment of Three Borrow Pits Alongside D300 Mothibistad, Northern Cape Province.

Legassick, M.C. 1989. The northern frontier to c. 1840: the rise and decline of the Griqua people. In Elphick, R. & Giliomee, H. (Eds) *The shaping of South African society*, 1652-1840. Middletown: Wesleyan University Press.

Legassick, M. 2010. *The politics of a South African frontier: The Griqua, the Sotho-Tswana and the missionaries, 1780 – 1840*. Basle: Basler Afrika Bibliographien.

Lukich, V., Porat, N., Faershtein, G., Cowling, S. & Chazan, M. 2019. New chronology and stratigraphy for Kathu Pan 6, South Africa. *Journal of Paleolithic Archaeology*, 2(3): 235-257.

Morris, D. 2005. Archaeological Impact assessment of mining areas on the farms Bruce, King, Mokaning and Parson between Postmasburg and Kathu in the Northern Cape.

Morris, D. 2008. Archaeological and Heritage Phase 1 Impact Assessment for Proposed Upgrading of Sishen Mine Diesel Depot Storage Capacity at Kathu, Northern Cape.

Mucina, L. & Rutherford, M.C. 2006. The vegetation map of South Africa, Lesotho and Swaziland. SANBI, Pretoria.

National Heritage Resources Act NHRA of 1999 (Act 25 of 1999)

Pistorius, J.C.C. 2006. A Phase 1 Heritage Impact Assessment (HIA) Study for the Proposed New United Manganese of Kalahari (Umk) Mine on the Farms Botha 313, Smartt 314 and Rissik 330 near Hotazhel in the Northern Cape Province of South Africa.

Pistorius, J.C.C. 2008. A Phase I Heritage Impact Assessment (HIA) Study for a Proposed New Power Line for the United Manganese of Kalahari (UMK) Mine near Hotazel in the Northern Cape Province of South Africa.

S.A. Manganese. 1977. Kalahari wealth: The story of manganese 1926 -1976. Cape Town: Purnell.

Sahra Report Mapping Project Version 1.0, 2009

Snyman, P.H.R. 1983. Die ontstaan en groei van Postmasburg. *Contree* 13: 4-26.

Thackeray, A.I., Thackeray, J.F. & Beaumont, P.B.. 1983. Excavations at the Blinkklipkop Specularite Mine near Postmasburg, Northern Cape. *The South African Archaeological Bulletin* 38 (137): 17-25.

Van der Walt, J. 2012. AIA Report for the Proposed Extension of An Abandoned Gravel Pit on the Farm Harvard 171 in the Kudumane Magisterial District 13km East of Kuruman.

Van der Walt, J. 2013. Archaeological Impact Assessment for the Proposed Prospecting Right of a Quarry on the Farm Gamohaan 438 Portion 1 in the Kuruman Magisterial District.

Van der Walt, J. 2016. Archaeological Impact Assessment Report for the Proposed Metals Industrial Cluster near Kuruman, Northern Cape Province.

Van der Walt, J. 2017. Heritage Impact Assessment for the Proposed Khumani Iron Ore Mine Project, Sishen, Northern Cape.

Walker, S.J., Lukich, V. & Chazan, M. 2014. Kathu Townlands: a high density Earlier Stone Age locality in the interior of South Africa. *PLoS One*, 9(7): p.e103436.

Webley, L. & Halkett, D. 2008. Phase 1 Heritage Impact Assessment: Proposed Prospecting on the Farms Adams 328 and Erin 316, Kuruman, Ga-Segonyana Municipality in the Northern Cape.

Wilkins, J. & Chazan, M. 2012. Blade production 500 thousand years ago at Kathu Pan 1, South Africa: support for a multiple origins hypothesis for early Middle Pleistocene blade technologies. *Journal of Archaeological Science* 39:1883-1900

Electronic sources:

www.statssa.gov.za Cited April 2024

Palaeontological Impact Assessment for the proposed Prospecting Application on 66 107.1283 ha in the Northern Cape Province

Desktop Study (Phase 1)

For

Beyond Heritage (Pty) Ltd
Greenmined Environmental (Pty) Ltd

18 May 2024

Prof Marion Bamford
Palaeobotanist
P Bag 652, WITS 2050
Johannesburg, South Africa
Marion.bamford@wits.ac.za

Expertise of Specialist

The Palaeontologist Consultant: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf
Experience: 35 years research and lecturing in Palaeontology
27 years PIA studies and over 350 projects completed

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Beyond Heritage (Pty) Ltd, Modimolle South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: *MKBamford*

Executive Summary

The proposed prospecting application is located on a Portion of Lower Kuruman Native Reserve No 219, Remaining Extent of the farm Edgehill No 194, Remaining Extent of the farm Alphen No 442, Remaining Extent of the farm Boland No 133, Farm Boland 133, Remaining Extent of the farm Seduall 124, Remaining Extent of the farm Mora Schuba 201, Remaining Extent of the farm Kungkung No 123, Remaining Extent of the farm Mahura Muthla No 198, Remaining Extent of Farm No 123, Farm Brandziekfontein No 124, Farm Helvetia No 126, Remaining Extent of the farm Hartebeesdale No 564, Remaining Extent of the farm Kogelbeen No 44, and Remaining Extent of the farm Banghoek No 17.

The Project areas are situated in Joe Morolong Local Municipality, Ga-Segonyana Local Municipality, Dikgatlong Local Municipality, Tsantsabane Local Municipality, and Siyancuma Local Municipality, Northern Cape. Greenmined Environmental has been appointed as the independent environmental assessment practitioner (EAP) to apply for the environmental authorisation for the Project. Marion Bamford Consulting was appointed by Beyond Heritage to conduct a Palaeontological Impact Assessment (PIA) for the project and the study area was assessed through a desktop assessment The background information and maps were taken from the HIA report but the geology and palaeontology were completed by the palaeontologist. Key findings of the assessment include:

To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed sites lie on moderately sensitive Quaternary sands and the Dwyka Group diamictites, on highly sensitive Tertiary-Quaternary calcretes and very highly sensitive Ghaap Group dolomites and alluvial sands in palaeo-channels. Fossils have been recorded from the very highly sensitive sites. Once precise locations for drill hoes and excavation have been determined, and if they are on very highly sensitive sites, a palaeontologist must do a site visit verification and walk down. For the other sites a Fossil Chance Find Protocol should be added to the EMPr.

For the less sensitive sites it is recommended that no further palaeontological impact assessment is required unless fossils are found by the contractor, environmental officer or other designated responsible person once excavations or drilling activities have commenced..

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Very High to moderate	Very High to Moderate	Palaeontological Impact Assessment	Section 7.2. SAHRA Requirements

Table of Contents

*Table for pages for each farm

Farm Name	Geological map		SAHRIS Palaeosensitivity map	
	Figure No	Page	Figure No	Page
Banghoek 17	5	16	19	28
Hartebeesdale 564	6	18	19	28
Kogelbeen 44	7	18	19	28
Alphen 442	8	19	20	29
Brandzeikfontein 124	9	19	20	29
Edgehill 194	11	20	20	29
Helvetica 125	12	21	21	30
Kung Kung 123	13	21	21	30

Lower Kuruman NR	14	22	21	30
Mahura Muthla 198	15	22	21	30
Schuba 201	16	23	22	31
Seduell 124	17	23	22	31
Toekoms 123	18	24	22	31

1. Background

Beyond Heritage was appointed to conduct a desk based Heritage Impact Assessment (HIA) for the proposed prospecting application that is located on Portion of Lower Kuruman Native Reserve No 219, Remaining Extent of the farm Edgehill No 194, Remaining Extent of the farm Alphen No 442, Remaining Extent of the farm Boland No 133, Remaining Extent of the farm Seduall 124, Remaining Extent of the farm Mora Schuba 201, Remaining Extent of the farm Kungkung No 123, Remaining Extent of the farm Mahura Muthla No 198, Remaining Extent of Farm No 123, Farm Brandziekfontein No 124, Farm Helvetia No 126, Remaining Extent of the farm Hartebeesdale No 564, Remaining Extent of the farm Kogelbeen No 44, and Remaining Extent of the farm Banghoek No 17. The Project areas are situated in Joe Morolong Local Municipality, Ga-Segonyana Local Municipality, Dikgatlong Local Municipality, Tsantsabane Local Municipality, and Siyancuma Local Municipality, Northern Cape (Figure 1.1 to 1.3). The report forms part of the Basic Assessment environmental authorisation process for the project.

The aim of the study is to assess the proposed development footprint on a desktop level to understand the cultural layering of the study area. It serves to assess the potential impact of the proposed project on non-renewable heritage resources, and to submit appropriate recommendations about the responsible cultural resources management measures required. It is also conducted to protect such resources within the framework provided by the National Heritage Resources Act of 1999 (Act No 25 of 1999) (NHRA). The report outlines the approach and methodology utilized, which includes review of relevant literature; desktop assessment of the study area; reporting the outcome of the study.

At this stage of the project, it is impossible to define the exact locations of drill sites or number of drill holes to be dug and a heritage walk down can be conducted once this is confirmed. Possible impacts were identified, and mitigation measures are proposed in this report. The South African Heritage Resources Agency (SAHRA) as a commenting authority under section 38(8) of NHRA requires all environmental documents, compiled in support of an Environmental Authorisation application as defined by National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations section 40 (1) and (2), to be submitted to SAHRA for commenting. Upon submission to SAHRA the project will be automatically given a case number as reference. As such the Basic Assessment (BA) report and its appendices must be submitted to the case as well as the EMPr, once it's completed by the Environmental Assessment Practitioner (EAP).

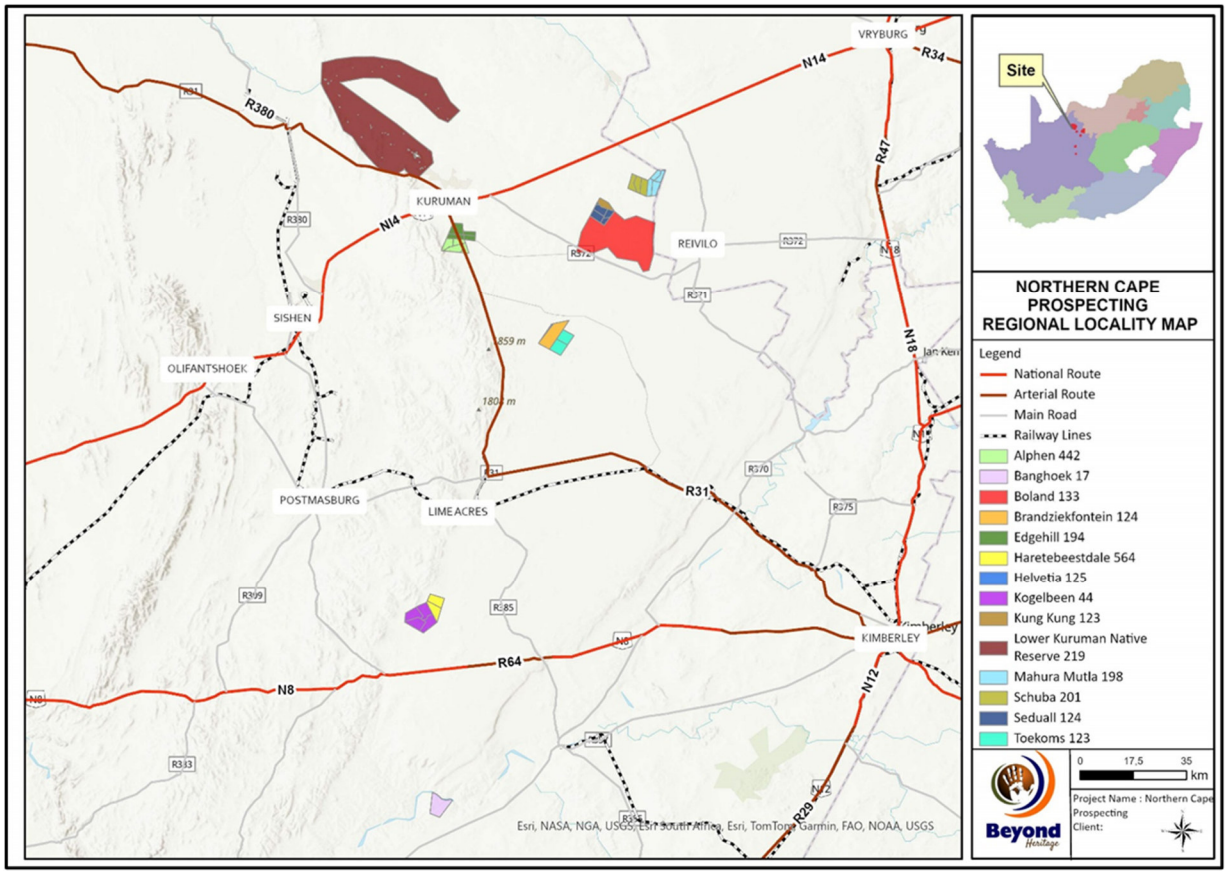


Figure 1: Map showing all the prospecting areas that are included in the 66 107.1283 ha Northern Cape Prospecting area. Maps from Beyond Heritage (with permission).

A Palaeontological Impact Assessment was requested for the Northern Cape Prospecting Study project. To comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6). Includes the requirements from GNR Appendix 6 of GN 326 EIA Regulation 2017.

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report,	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	Section 8, Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Sections 6, 8
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies of any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

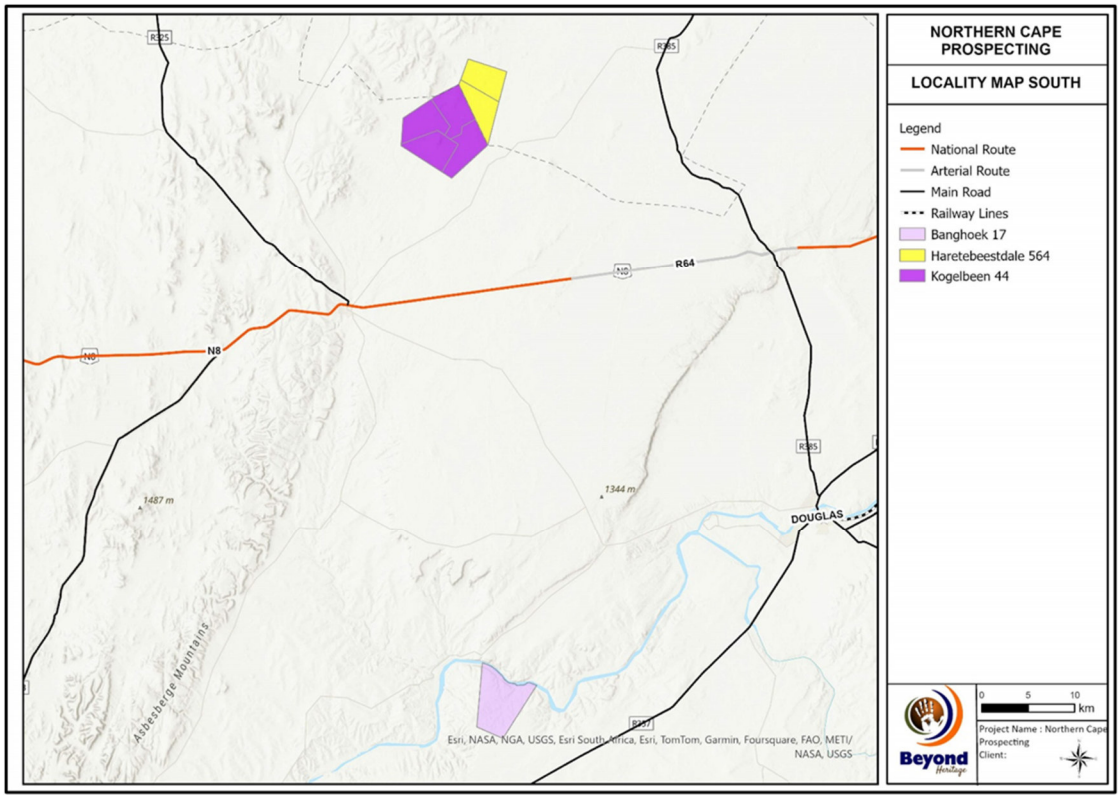


Figure 2: Map of the southern prospecting general areas.

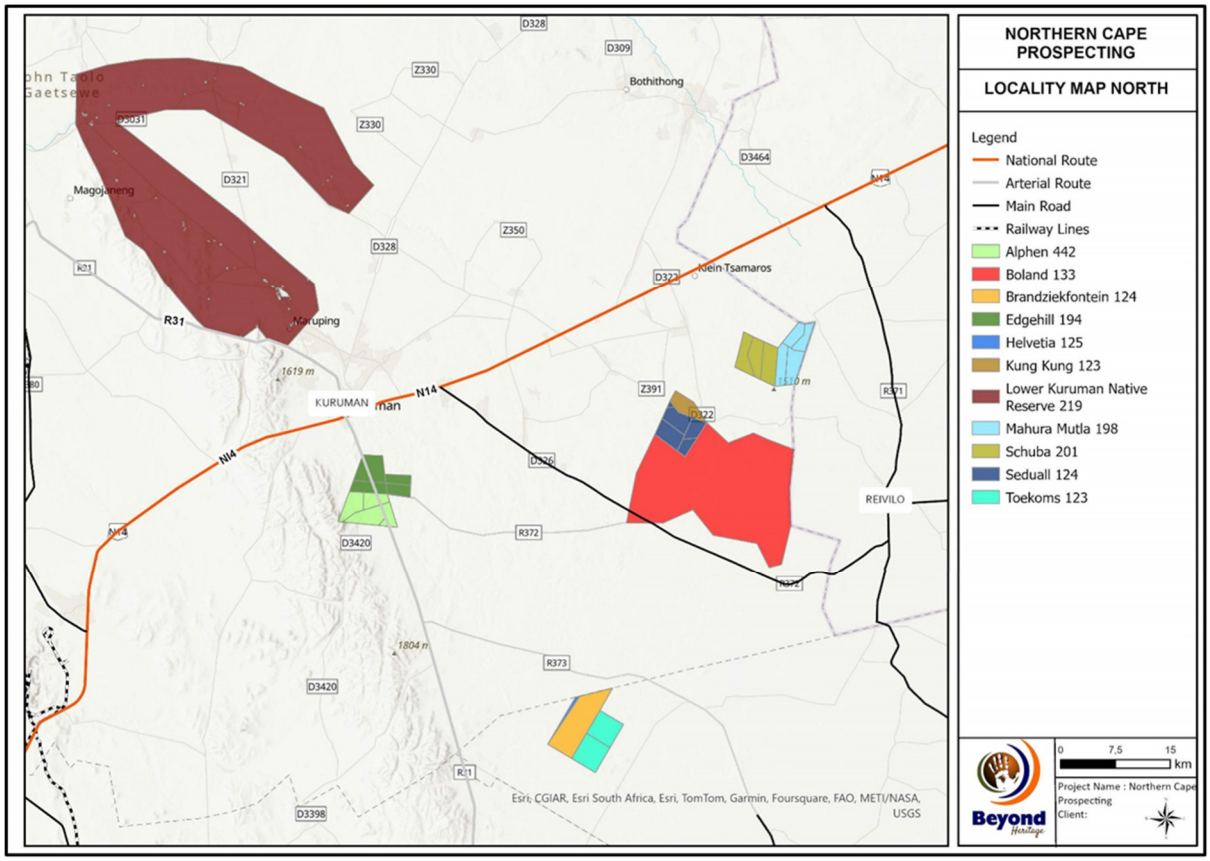


Figure 3: Map of the northern prospecting areas around Kuruman.

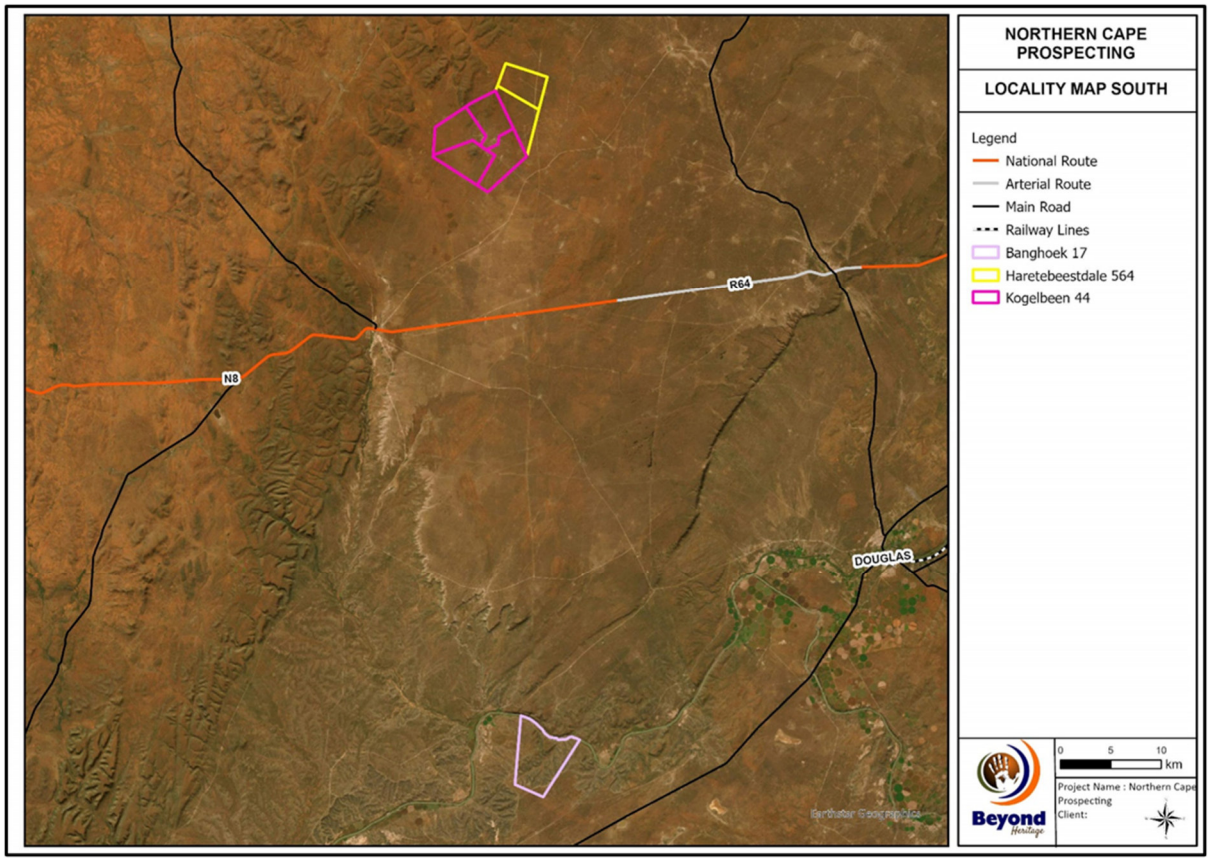


Figure 4a: Aerial map of the southern section of the Prospecting area.

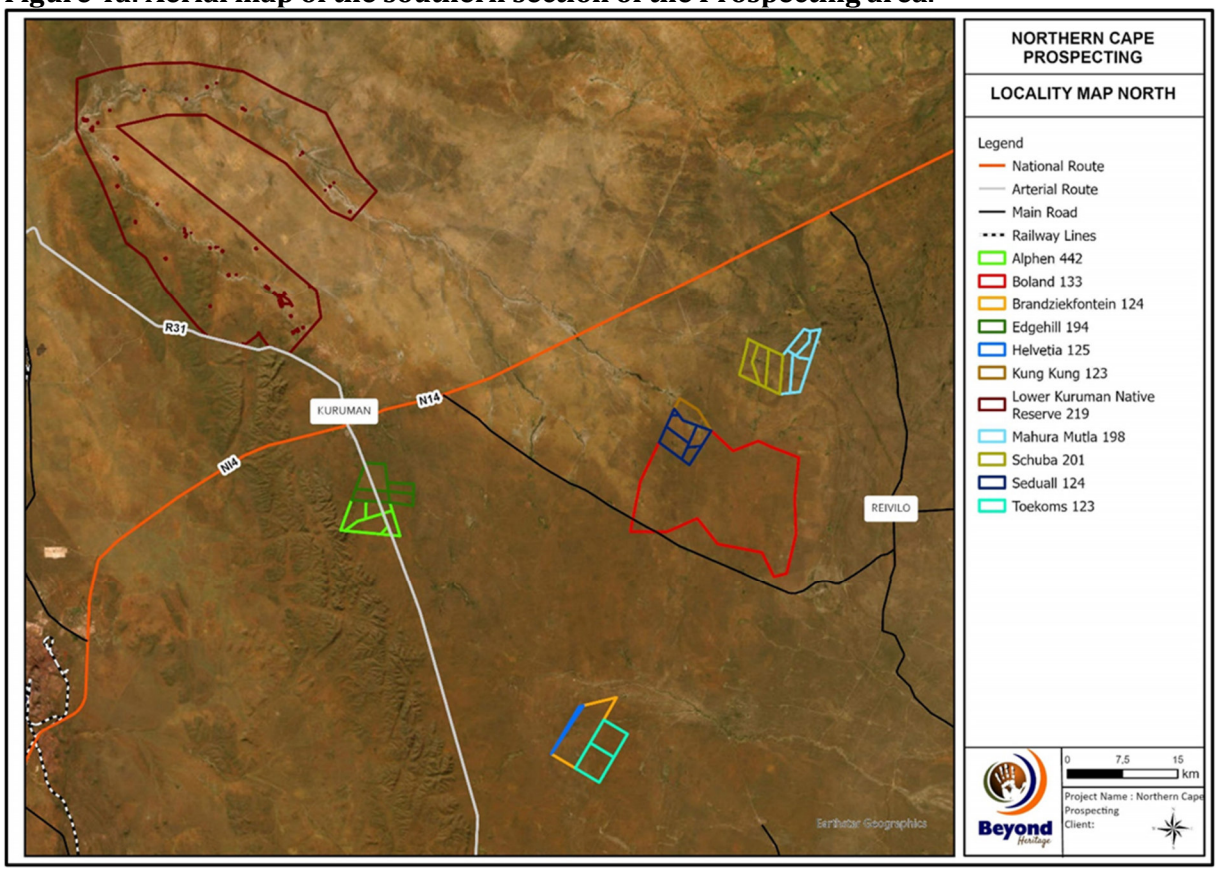


Figure 4b: Aerial map of the northern section prospection areas around Kuruman.

Project Description

Table 2: Land parcels for prospecting.

Magisterial Districts	Joe Morolong Local Municipality, Ga-Segonyana Local Municipality, within the John Taolo Gaetsewe District Municipality; Dikgatlong Local Municipality within the Frances Baard District Municipality; Tsantsabane Local Municipality within the Z F Mgcawu District Municipality; and Siyancuma Local Municipality within the Pixley ka Seme District Municipality
Central co-ordinates of the development	27° 4'28.60"S; 23° 7'34.53"E 27°33'59.74"S; 23°27'39.00"E 27°24'5.46"S; 24° 1'39.76"E 27°33'13.19"S; 23°57'49.66"E 27°51'25.16"S; 23°45'43.26"E 28°40'34.38"S; 23°22'20.37"E 29°14'18.05"S; 23°24'47.82"E
1:50 000 Topographic Map Number	2723 AA, AB, AC, AD, CB, DA, BD, DB, DC, DD 2724 AC, CA 2923AB, AD 2823 CB
Farm Name:	Portion of Lower Kuruman Native Reserve No 219 (Farm No 219) Remaining Extent of the farm Edgehill No 194 Portion 1 of the farm Edgehill No 194 Portion 2 of the farm Edgehill No 194 Portion 5 of the farm Edgehill No 194 Remaining Extent of the farm Alphen No 442 Portion 3 of the farm Alphen No 442 Portion 4 of the farm Alphen No 442 Portion 5 of the farm Alphen No 442 Portion 6 of the farm Alphen No 442 Portion 7 of the farm Alphen No 442 Remaining Extent of the farm Boland No 133 Portion 1 of the farm Boland No 133 Portion 2 of the farm Boland No 133 Portion 3 of the farm Boland No 133 Portion 4 of the farm Boland No 133 Portion 5 of the farm Boland No 133 Portion 6 of the farm Boland No 133 Portion 7 of the farm Boland No 133 Portion 8 of the farm Boland No 133 Portion 9 of the farm Boland No 133 Portion 10 of the farm Boland No 133 Portion 11 of the farm Boland No 133 Portion 12 of the farm Boland No 133 Portion 13 of the farm Boland No 133 Portion 14 of the farm Boland No 133 Portion 15 of the farm Boland No 133 Portion 16 of the farm Boland No 133 Portion 17 of the farm Boland No 133 Portion 20 of the farm Boland No 133

	Portion 21 of the farm Boland No 133 Portion 23 of the farm Boland No 133 Portion 24 of the farm Boland No 133 Portion 25 of the farm Boland No 133 Portion 26 of the farm Boland No 133 Remaining Extent of the farm Seduall 124 Portion 1 of the farm Seduall 124 Portion 2 of the farm Seduall 124 Portion 3 of the farm Seduall 124 Remaining Extent of the farm Mora Schuba 201 Portion 1 of the farm Mora Schuba 201 Portion 2 of the farm Mora Schuba 201 Remaining Extent of the farm Kungkung No 123 Portion 1 of the farm Kungkung No 123 Portion 2 of the farm Kungkung No 123 Portion 3 of the farm Kungkung No 123 Remaining Extent of the farm Mahura Muthla No 198 Portion 1 of the farm Mahura Muthla No 198 Portion 2 of the farm Mahura Muthla No 198 Portion 3 of the farm Mahura Muthla No 198 Remaining Extent of Farm No 123 Portion 1 of the Farm No 123 Brandziekfontein No 124 Helvetia No 126 Remaining Extent of the farm Hartebeesdale No 564 Portion 1 of the farm Hartebeesdale No 564 Remaining Extent of the farm Kogelbeen No 44 Portion 1 of the farm Kogelbeen No 44 Portion 2 of the farm Kogelbeen No 44 Portion 3 of the farm Kogelbeen No 44 Remaining Extent of the farm Banghoek No 17
Distance and direction from nearest town	The earmarked portion on the Lower Kuruman Native Reserve No 219 is ±23 km north of Kuruman along the R31. Farms Edgehill No 194 and Alphen No 442 are ±6 km south of Kuruman when travelling along the R31. Farms Mora Schuba No 201, Mahura Muthla No 198, Kungkung No 123, Seduall No 124, and Boland No 133 lays ±50 km east of Kuruman when travelling on the R372.

	Farms Helvetia No 126, Brandziekfontein No 124, and Farm No 123 are ±60 km south-east of Kuruman when travelling along the R31. Farms Hartebeesdale No 564 and Kogelbeen No 44 are ±23 km north-east of Griekwastad. The farm Banghoek No 17 is ±47 km south-west of Douglas when travelling along the R357.

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources include records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases; eg https://sahris.sahra.org.za/map/palaeo
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representativity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

The Northern Cape Prospecting area lies on various formations of the Griqualand West Basin that preserves rocks of the Palaeoproterozoic Transvaal Supergroup. These rocks are unconformably by Palaeozoic rocks of lower Karoo Supergroup. Overlying many of the older rocks are the Quaternary sands, alluvium soils and alluvial diamondiferous sands in Mesozoic river channels or valleys.

The southern section of the prospecting area, Farms Banghoek 17, Hartebeestdale 564 and Kogelbeen 44 are clustered together in this report, following the order used in the HIA report (Figures 5-7). The northern cluster geological maps are clustered together in alphabetical order (Figures 8-18). A geological map is provided for each farm after the general geological description.

GENERAL
The Late Archaean to early Proterozoic Transvaal Supergroup is preserved in three structural basins on the Kaapvaal Craton (Eriksson et al., 2006). In South Africa are the

Transvaal and Griqualand West Basins, and the Kanye Basin is in southern Botswana. The Griqualand West Basin is divided into the Ghaap Plateau sub-basin and the Prieska sub-basin. Sediments in the lower parts of the basins are very similar but they differ somewhat higher up the sequences. Several tectonic events have greatly deformed the south western portion of the Griqualand West Basin between the two sub-basins.

The Transvaal Supergroup comprises one of world's earliest carbonate platform successions (Beukes, 1987; Eriksson et al., 2006; Zeh et al., 2020). In some areas there are well preserved stromatolites that are evidence of the photosynthetic activity of blue green bacteria and green algae. These microbes formed colonies in warm, shallow seas.

In the Transvaal Basin the Transvaal Supergroup is divided into two Groups, the lower Chuniespoort Group and the upper Pretoria Group (with ten formations; Eriksson et al., 2006). The Chuniespoort Group is divided into the basal Malmani Subgroup that comprises dolomites and limestones and is divided into five formations based on chert content, stromatolitic morphology, intercalated shales and erosion surfaces. The top of the Chuniespoort Group has the Penge Formation and the Duitschland Formation.

Making up the lower Pretoria Group are the Timeball Hill Formation and the Boshoek Formation. The Hekpoort, Dwaalheuwel, Strubenkop and Daspoort Formations form a sequence as the middle part of the Pretoria Group, Transvaal Supergroup, and represent rocks that are over 2060 million years old. The Hekpoort Formation is a massive lava deposit and is overlain by the Dwaalheuwel conglomerates, siltstone and sandstone (not present here). A hiatus separates the Strubenkop Formation slates and shales from the overlying quartzites of the Daspoort Formation. Upper Pretoria Group formations are the Silverton, Magaliesberg, Vermont, Lakenvalei, Nederhorst, Steenkampsberg and Houtenbek Formations

The Transvaal sequence has been interpreted as three major cycles of basin infill and tectonic activity with the first deep basin sediments forming the Chuniespoort Group, the second cycle deposited the lower Pretoria Group, and the sediments in this area are from the interim lowstand that preceded the third cycle. These sediments were deposited in shallow lacustrine, alluvial fan and braided stream environments (Eriksson et al., 2012).

Transvaal Supergroup rocks in the Transvaal Basin were intruded by the Bushveld Complex at around 2060 million year ago (Eriksson et al. 2006; 2055 Ma in Zeh et al., 2020), with the Magaliesberg Formation of the Pretoria Group forming the floor rocks in most areas (Eriksson et al., 2006). In other areas of the basin the lavas and other subordinate sedimentary rocks of the Rooiberg Group form the floor instead (ibid).

Outliers of the Transvaal Supergroup, i.e. surrounding the Bushveld complex exposures, occur in the Rooiberg, Crocodile River, Stavoren, Marble Hall and Dennilton areas. In the far western Transvaal, however, the Transvaal Supergroup rocks lie on the Archaean basement rocks, namely the Witwatersrand and Ventersdorp Supergroups.

The Transvaal Supergroup rocks in the Griqualand West Basin can be correlated with the rocks in the Transvaal Basin. These rocks represent on a very large scale, a sequence of sediments filling the basins under conditions of lacustrine, fluvial, volcanic and glacial

cycles in a tectonically active region. The predominantly carbonaceous sediments are evidence of the increase in the atmosphere of oxygen produced by algal colony photosynthesis, the so-called Great Oxygen Event (ca 2.40 – 2.32 Ga) and precursor to an environment where diverse life forms could evolve. The Neoarchean-Paleoproterozoic Transvaal Supergroup in South Africa contains the well-preserved stromatolitic Campbellrand -Malmani carbonate platform (Griqualand West Basin – Transvaal Basin respectively), which was deposited in shallow seawater shortly before the Great Oxidation Event (GOE).

BOTH THE PRIESKA AND GHAAP SUB-BASINS

Vryburg Formation (Prieska Sub-basin and Ghaap Plateau Sub-basin)

The Vryburg Formation directly overlies the Ventersdorp SG in the Griqualand West Basin. It has a basal transgressive conglomerate with quartzites, shales and subordinate stromatolitic carbonates, passing up in places into basaltic to andesitic amygdaloidal lavas dated to about 2642 Ma (Walraven and Martini, 1995; Eriksson et al., 2006).

It has been interpreted as a fluvial to marine marginal deposit with material from the western to northwestern regions (Beukes, 1979 in Eriksson et al., 2006).

Schmidtsdrift Subgroup (both sub-basins)

There are two Formations in the Schmidtsdrift Subgroup and occur in both of the sub-basins of the Griqualand West Basin. The lower Boomplaas Formation comprises stromatolitic and oolitic platform carbonates. Only the upper 100m is visible in surface outcrops but it extends another 185m in borehole core (Beukes, 1979, 1983). They represent deep lagoonal deposits, transported oolites and carbonate shelf rocks. The upper Clearwater Formation comprises shales, tuffites and BIF-like cherts and is interpreted as a transgressive deposit over the Boomplaas Formation (ibid; Eriksson et al., 2006).

Ghaap Group, Campbell Rand Subgroup

Summary from Sumner and Beukes (2006):

Based on the earlier works of Button (1976) and Beukes (1980, 1987) and updated after the application of sequence stratigraphy, Sumner and Beukes (2004) have described the 2650-2500 Ma Campbellrand and Malmani subgroups as being correlative and they form an extensive carbonate platform. Today there are preserved outcrops that cover 190,000 km^2 but these carbonate platforms probably originally covered the entire Kaapvaal Craton, >600,000 km2 (ibid). The thick platform has predominantly peritidal facies in the north and east and deeper facies to the south and west. However, thinner basinal sediments and plaform slopes are preserved near Prieska. The ca 2.5 - 2.46 Ga Kuruman iron-formations conformably overlie the Campbellrand Subgroup and the Penge Formation overlies the Malmani Subgroup. Both the Kuruman Iron Formation and the lower Penge Iron Formation consist of deep water, microbanded iron formation that formed on a stable marine shelf below wave base and then shallowed to sea level (Sumner and Beukes, 2006).

GRIQUALAND WEST subbasin:

In the Griqualand West sub-basin are the basal Schmidtsdrift Subgroup, Campbell Rand Subgroup and Asbestos Hills Subgroup with the latter composed of banded Iron formation deposits, the Kliphuis, Kuruman and Danielskuil Formations.

The **Schmidtsdrift Subgroup** is composed of the basal limestone-rich Boomplaas Formation the shale-rich Clearwater Formation.

The **Campbell Rand Subgroup** has been divided into seven formations based on the different environmental settings that produces stromatolites, microbial mats, laminates, chert and carbonate platform.

The **Monteville Formation** of the Campbell Rand Subgroup in the Ghaap Plateau Sub-basin overlies the Clearwater Formation and is composed of up to 200m thickness of stromatolitic domes, then microbial laminites (laminated stromatolitic carbonate rocks)with fenestrae and carbonate argillites, all with intercalated shales and siltstones (Eriksson et al., 2006). The environment is interpreted as successive transgressive-regressive cycles superimposed on a lower-order shallowing upward cycle as the basin filled stromatolitic carbonates and shales.

Next in the sequence is the **Reivilo Formation** and is the most extensive component of the Campbell Rand Subgroup. It is up to 900m thick, represents a renewed transgressive phase with the upper Kamden Member BIF-like part; the rest is composed of dolomite with giant stromatolitic domes intercalated with cycles of columnar stromatolites (Eriksson et al., 2006).

The overlying **Fairfield Formation** represents shallow platform conditions again with the clastic laminated carbonate beds passing upward in unto columnar stromatolites and fenestrated laminates. The next two formations, the Klipfonteinheuwel and Papkuil Formations are also composed of platform carbonates with columnar stromatolites and oolitic beds.

The lower **Klippan Formation** has small stromatolites that pass upwards to form microbial laminates representing a transgression to deep water facies in a lagoonal setting. The overlying **Kogelbeen Formation** has varying dolomite, limestone and chert lithologies, then domal to columnar stromatolites, laminates and chert. The limestone-rich Lime Acres Member that contains economically important limestone completes this formation,

Next are the **Gamohaan** and **Tsineng Formations** with microbial mats, laminates and chert for the top strata of the Campbell Rand Group

The **Asbestos Hills Subgroup** has three formations, the lower Kliphuis Formation, the Kuruman Formation and the Danielskuil Formation. They are all banded iron formations and have vast economically important reserves,

Above the Asbestos Hills Subgroup is the **Postmasburg Group**. The Makganyene Formation has diamictites and shales from glacial conditions. Disconformably overlying these are the Ongeluk Formation basaltic andesitic lavas. According to Cornell et al. (1996) and Schroder et al. (2016) the Ongeluk Formation is equivalent to the lavas of the Hekpoort Formation in the Transvaal Basin.

QUATERNARY

There were two large basins dominating southern Africa during the Cenozoic, with the Kalahari Basin to the west and the Bushveld basin to the east. Both basins are bounded along their southern extent by the more or less west-east trending Griqualand-Transvaal Axis (Partridge et al., 2006). These sediments are not easy to date but recent attempts are gradually filling in the history of the sands, sand dunes and inter-dunes (Botha, 2021).

Quaternary Kalahari sands cover large parts of the rocks in this region, especially to the west. This is the largest and most extensive palaeo-erg in the world (Partridge et al., 2006) and is composed of extensive aeolian and fluvial sands, sand dunes, calcrete, scree and colluvium. Periods of aridity have overprinted the sands, and calcrete and silcrete are common. Most geological maps indicate these sands simply descriptively (aeolian sand, gravelly sand, calcrete) or they are lumped together as the Gordonia Formation because the detailed regional lithostratigraphic work has not been done, Nonetheless, these sands have eroded from the interior and have been transported by wind or water to fill the basin. Reworking of the sands or stabilisation by vegetation has occurred. Probable ages of dune formation are around 100 kya (thousand years), 60 kya, 27-23 kya and 17-10 kya (in Botha, 2021).

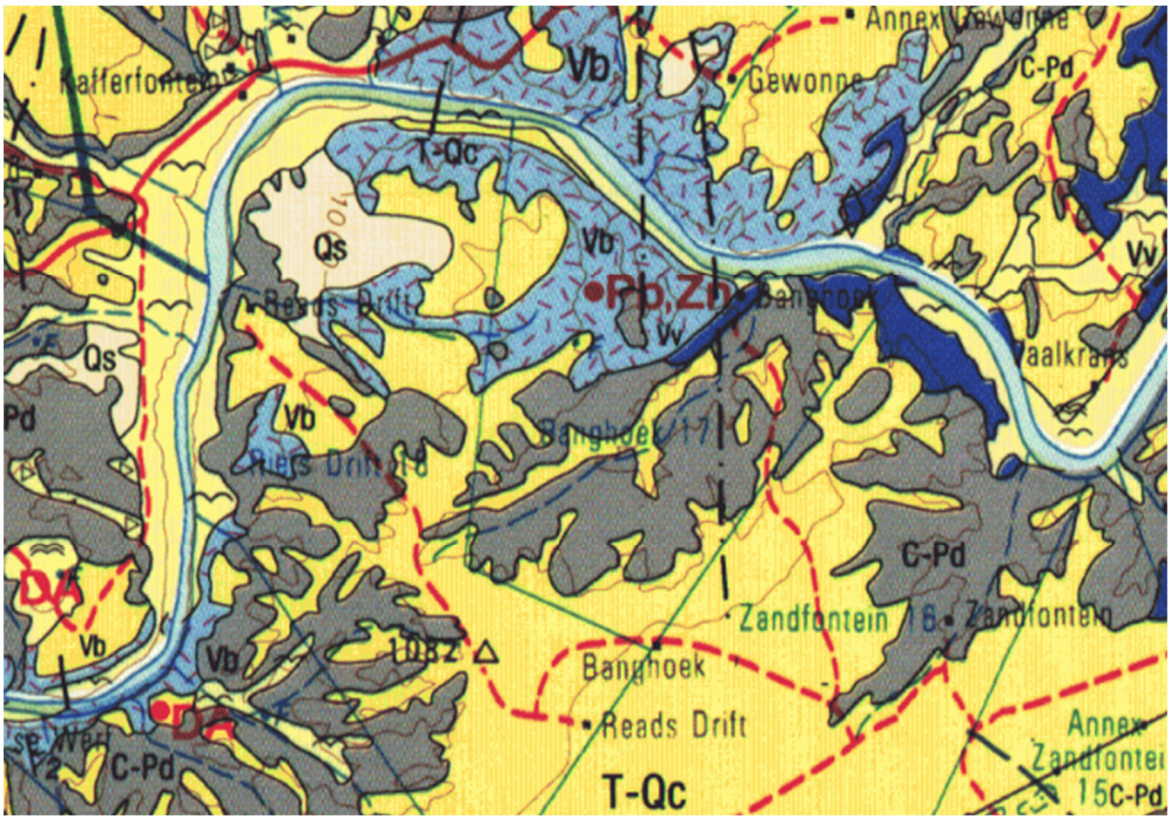


Figure 5: Geological map of the area around the Farm Banghoek 17 (southern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2922 Prieska.

Table 3: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. Johnson et al., 2006; Zeh et al., 2020). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Quaternary	Alluvium, sand, calcrete	Quaternary, ca 1.0 Ma to present
QΔ	Quaternary sands	White to red, loosely consolidated sands, often containing alluvial diamonds.	Quaternary - Tertiary
Qg	Gordonia Fm, Kalahari Group	Unconsolidated sand, red or white	Quaternary or Holocene; Post 1 Ma
T-Qc	Tertiary-Quaternary	sands and calcrete, surface limestone	Tertiary to Quaternary
C-Pd	Dwyka Group, Karoo SG	Tillites, diamictites, mudstones	Late Carboniferous to Early Permian
Vad	Danielskuil Fm, Asbestos Hills Subgroup/ Manganore Iron Formation, Ghaap Group, Transvaal SG	Brown jaspilite and crocidolite, (Banded iron formation and manganese formation)	
Vak	Kuruman Fm, Asbestos Hills Subgroup/ Manganore Iron Formation, Ghaap Group, Transvaal SG	Banded iron formation with bands of amphibolite; conglomerate layers	Palaeoproterozoic Ca 2460 Ma
Vgd	Ghaap Group, Transvaal SG	Light blue = undifferentiated; dark blue = prominent interbedded chert	Palaeoproterozoic Ca 2460 – 2590 Ma
Vgl/Vl	Lime Acres Fm, Cambellrand Subgroup, Ghaap Group, Transvaal SG	Chert and chert breccia; Dolomitic limestone; Banded chert, chert breccia;	Ca 2590 – 2500 Ma
Vgf/Vf	Fairfield Fm, Cambellrand Subgroup, Ghaap Group, Transvaal SG	Coarsely crystalline dolomite	
Vr	Reivilo Fm, Cambellrand Subgroup, Ghaap Group, Transvaal SG	Fine-grained dolomite with interbedded chert	
Vb	Boomplaas Fm, Schmidtsdrift Subgroup, Ghaap Group, Transvaal SG	Oolitic, stromatolitic and algal mat limestone; interbedded flagstone, quartzite	Palaeoproterozoic >2600 Ma

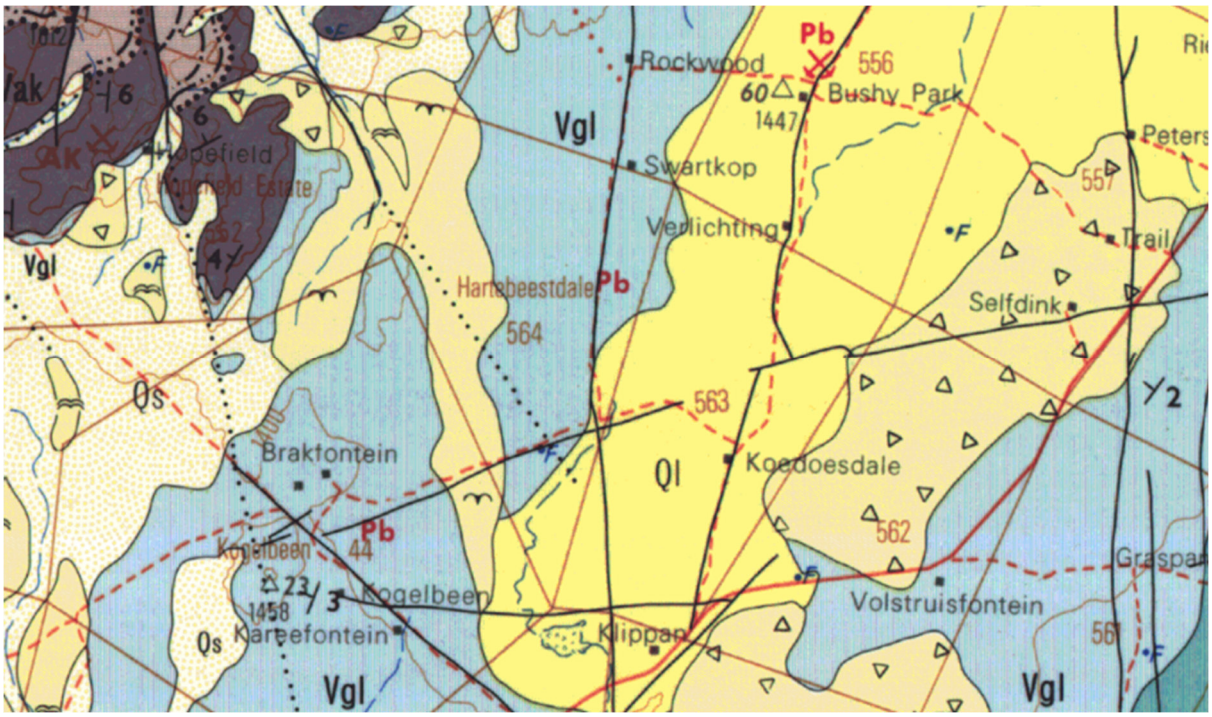


Figure 6: Geological map of the area around the Farm Hartebeesdale 564 (southern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2822 Postmasburg.

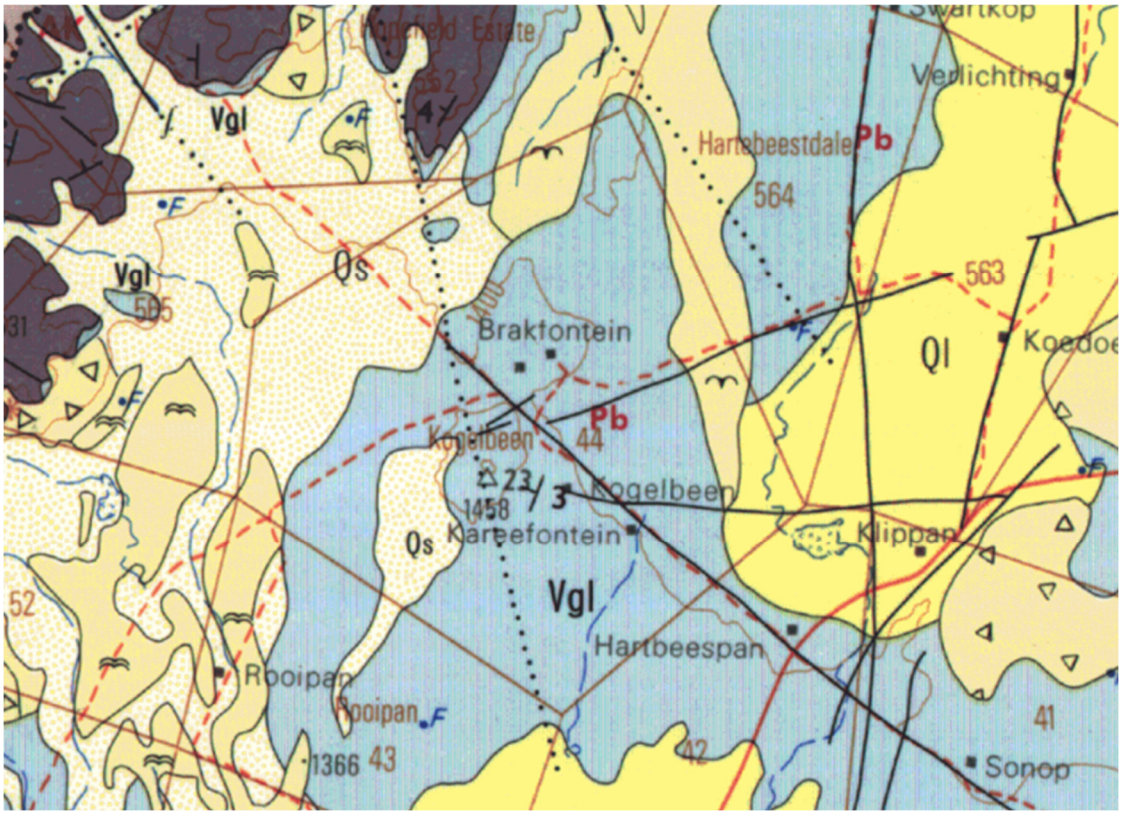


Figure 7: Geological map of the area around the Farm Kogelbeen 44(southern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2922 Postmasburg.

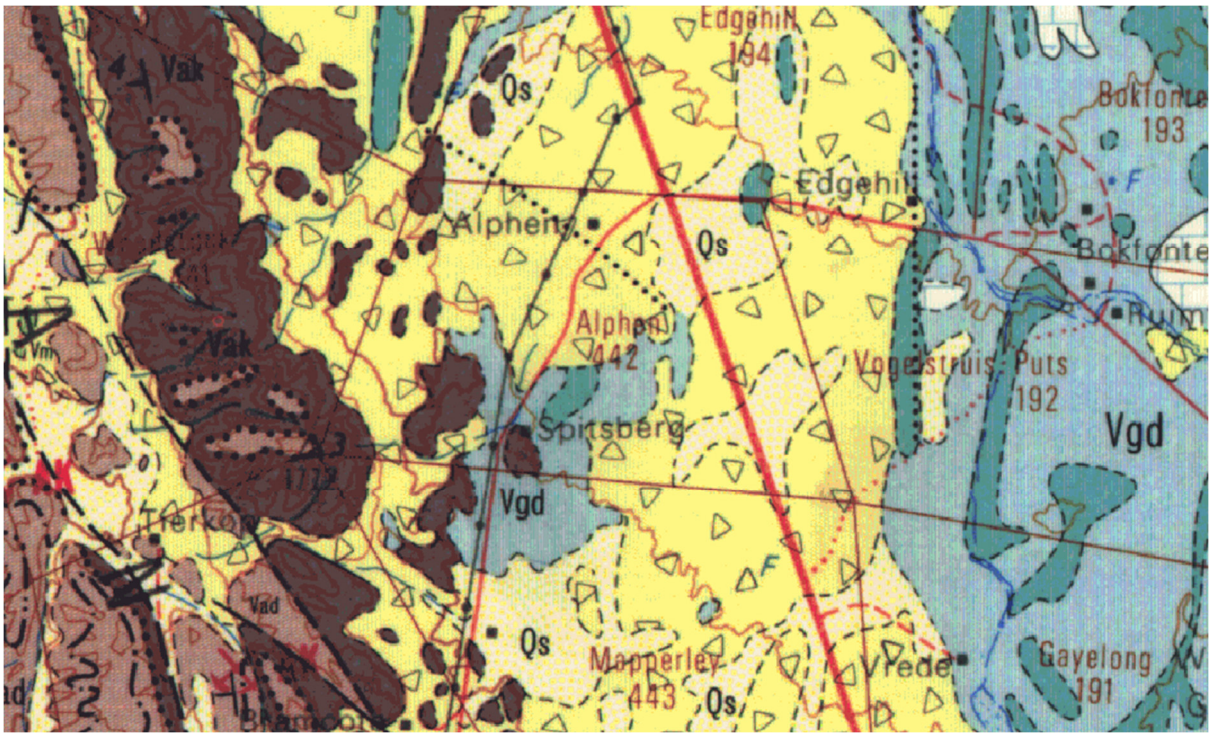


Figure 8: Geological map of the area around the Farm Alphen 442 (<u>northern section</u>) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman.

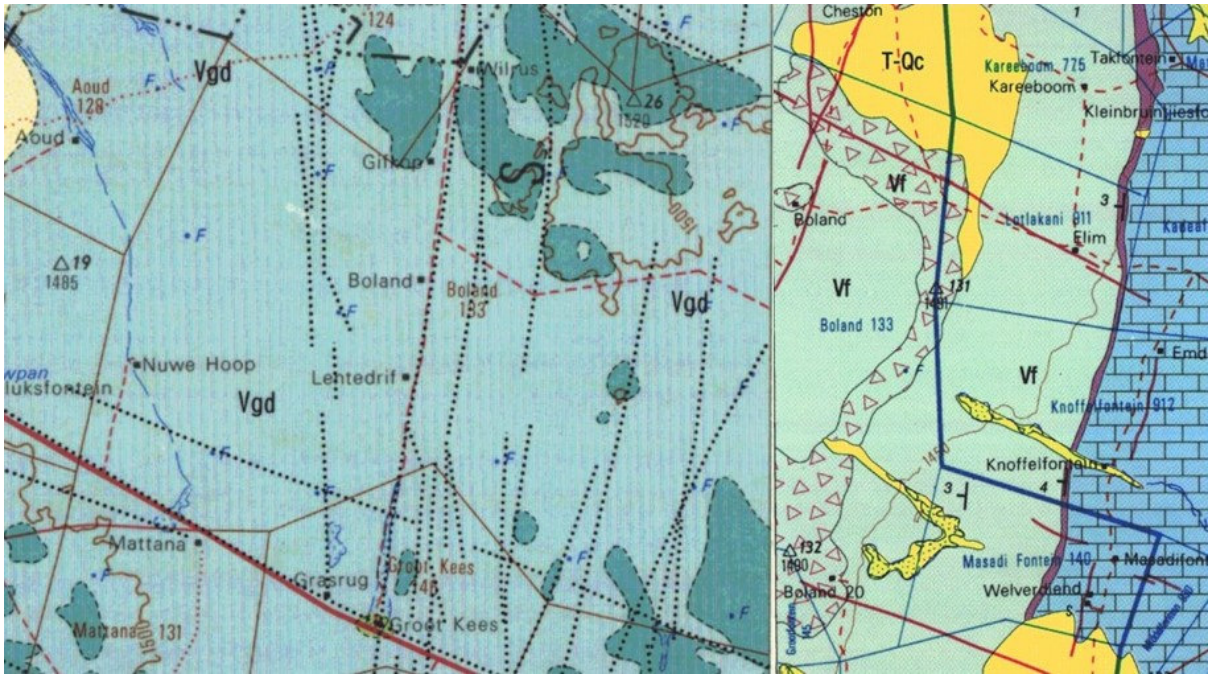


Figure 9: Geological map of the area around the Farm Boland 133 (northern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman (left) and 2724 Christiana.

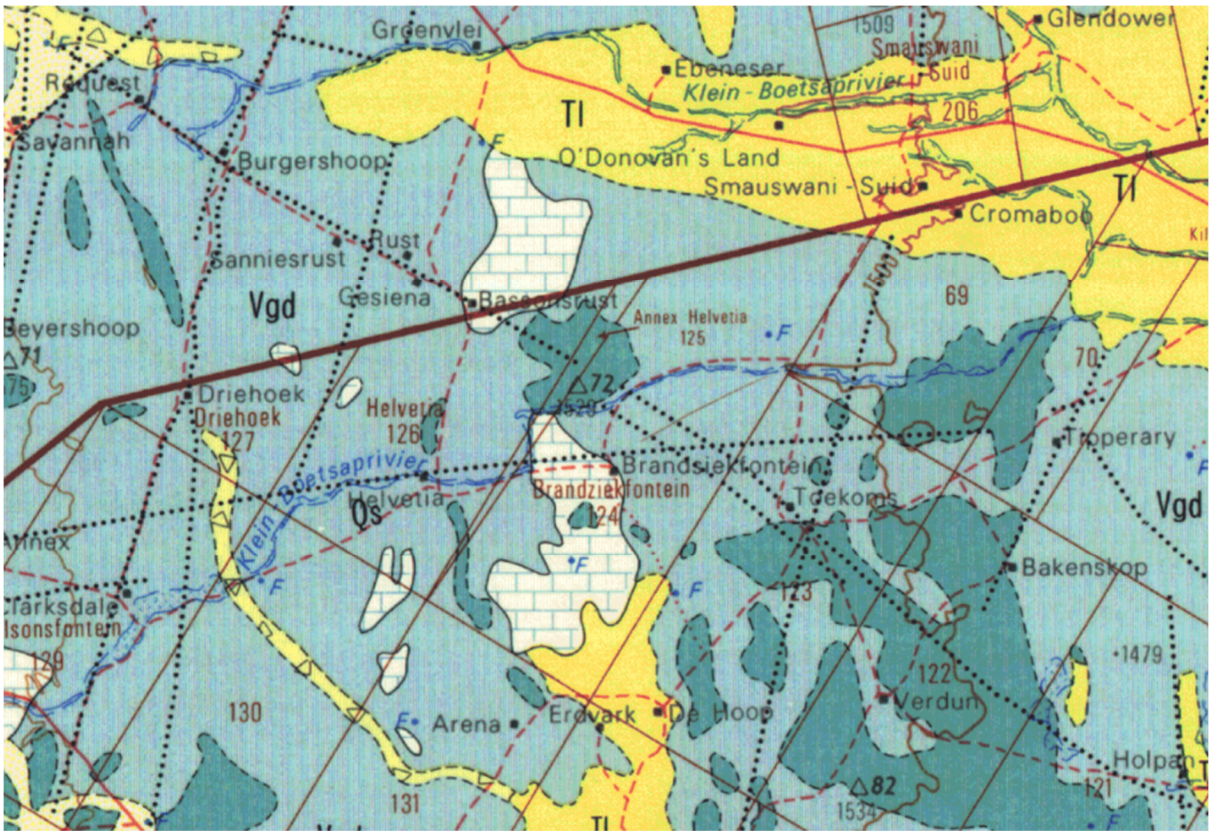


Figure 10: Geological map of the area around the Farm Brandzeikfontein 124(northern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman.

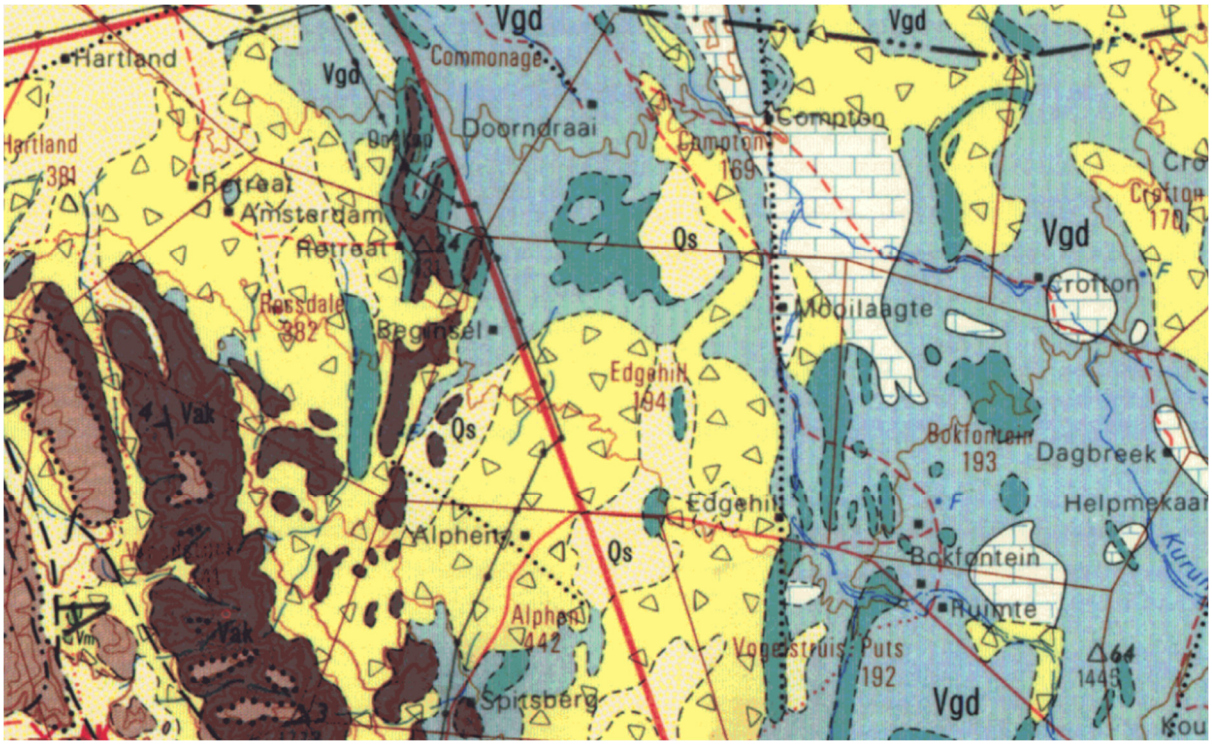


Figure 11: Geological map of the area around the Farm Edgehill 194 (northern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman.

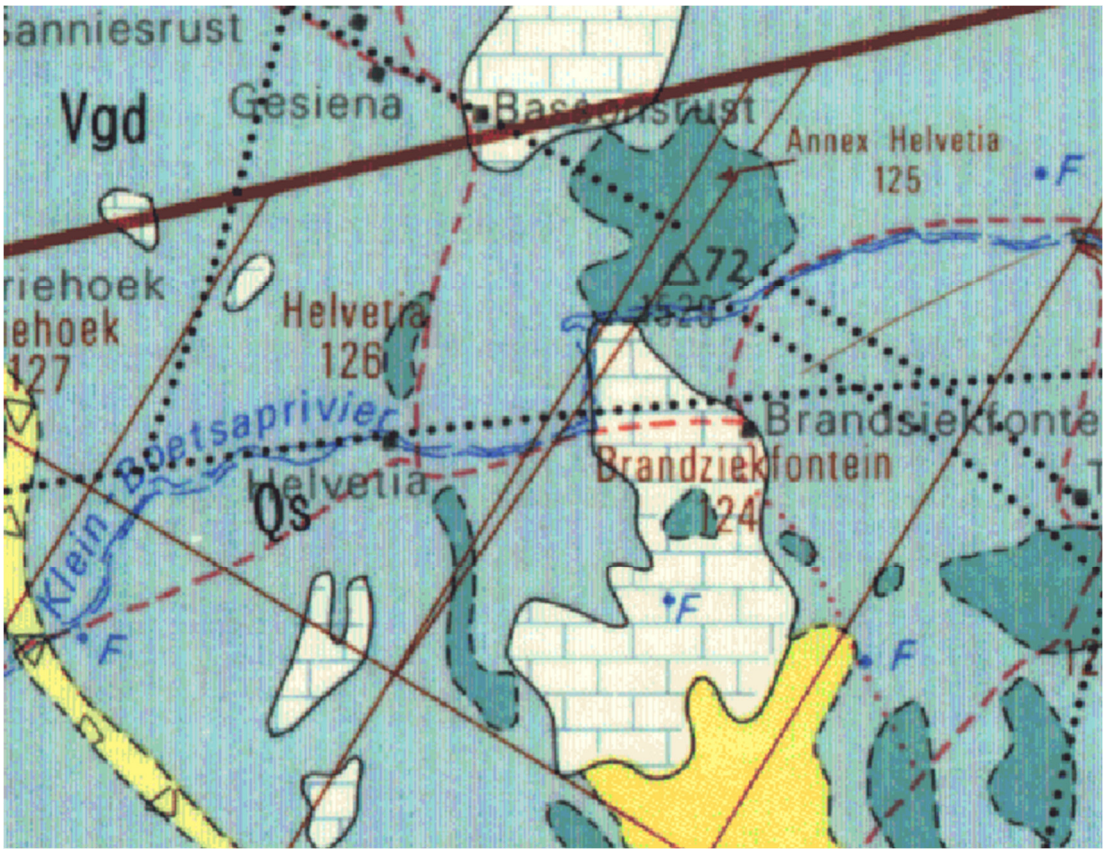


Figure 12: Geological map of the area around the Farm Helvetica 125 (northern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman.

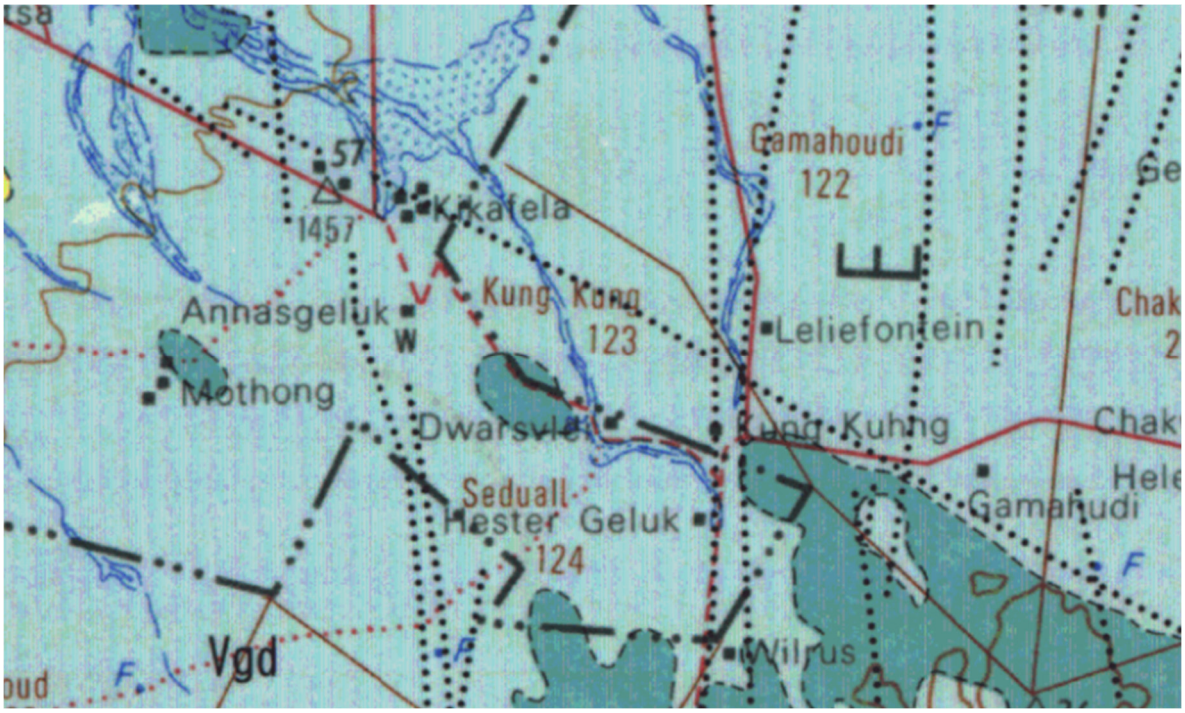


Figure 13: Geological map of the area around the Farm Kung Kung 123 (northern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman.

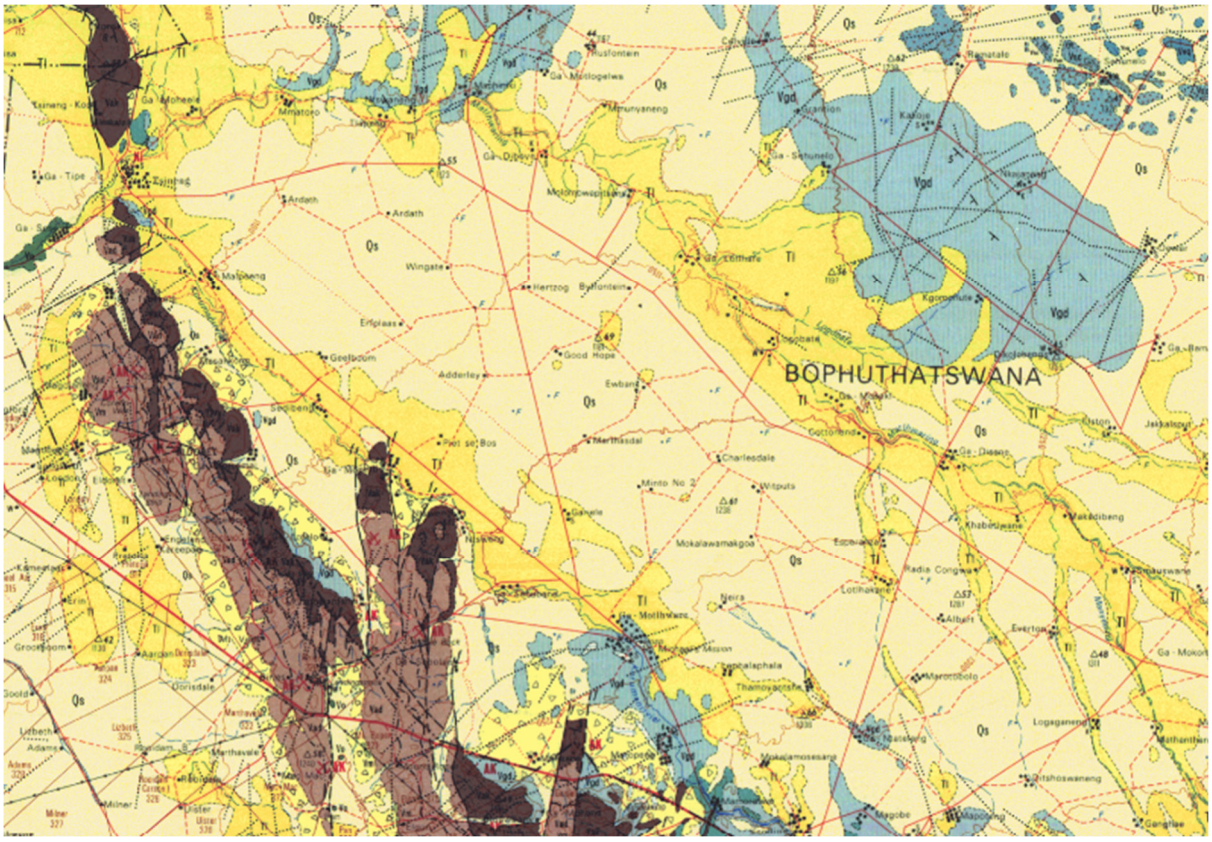


Figure 14: Geological map of the area around the Farm Lower Kuruman Native Reserve (northern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman.

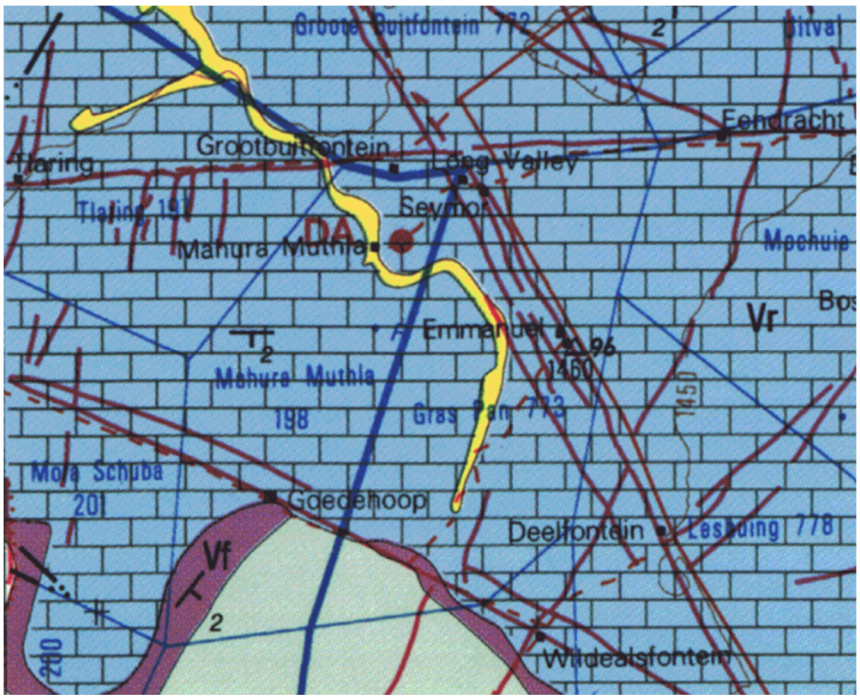


Figure 15: Geological map of the area around the Farm Mahura Muthla 198 (northern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 27224 Christiana.

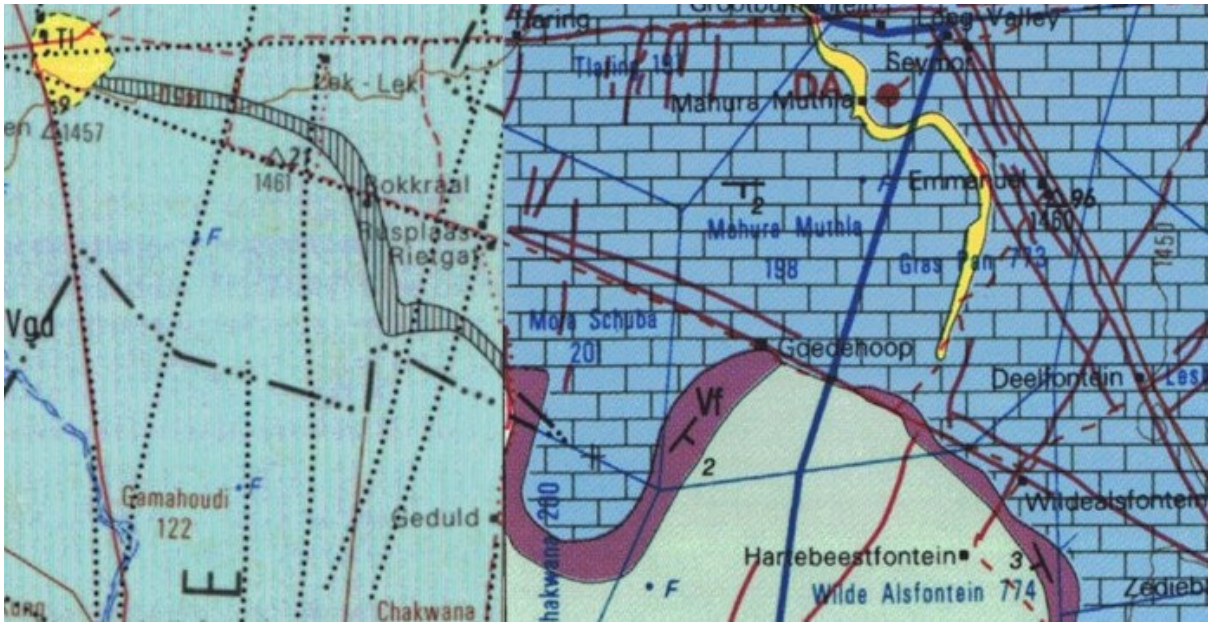


Figure 16: Geological map of the area around the Farm Schuba 201 (northern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman (left) and 2724 Christiana (right).

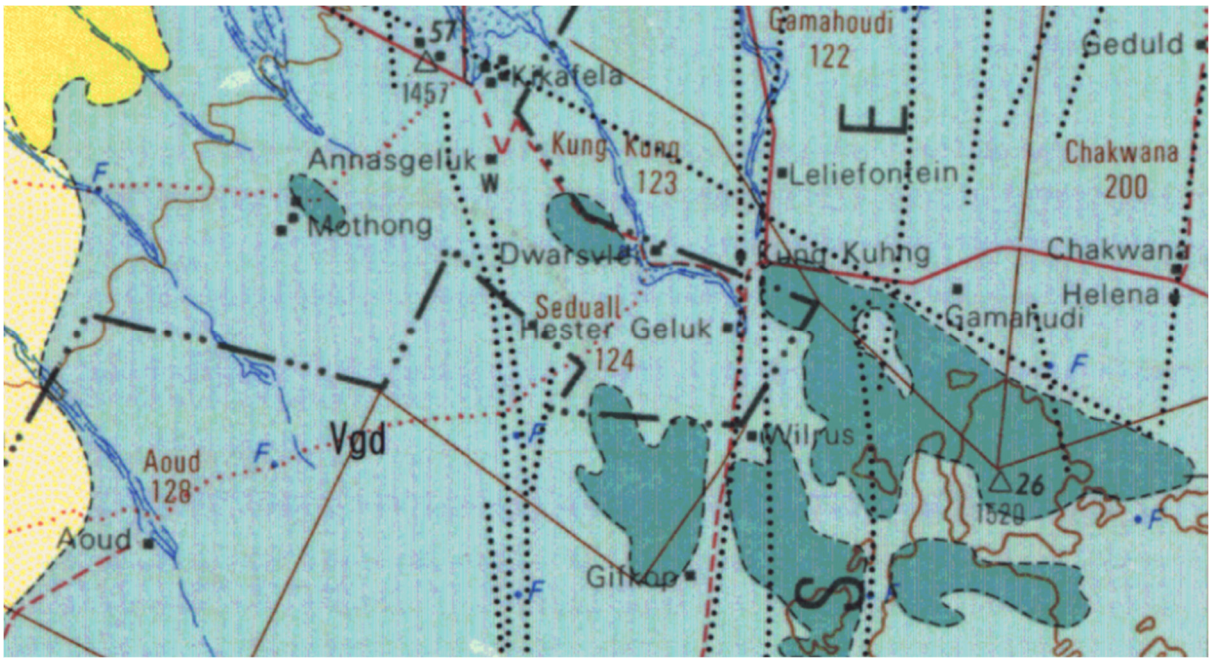


Figure 17: Geological map of the area around the Farm Seduell 124 (northern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman.

Figure 18: Geological map of the area around the Farm Toekoms 123 (northern section) indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 3. Map enlarged from the Geological Survey 1: 250 000 map 2922 Prieska.

ii. Palaeontological context

Table 4: Summary of the palaeosensitivity for each formation and the farms on which they occur with SAHRIS colour coding. Refer to geology maps in Figures 5-10 and SAHRIS maps in Figures 19-22.

NC prospecting areas	Geology and colour codes for palaeosensitivity					
Farm name	Qs	QΔ*	Qg	T-Qc/l	C-Pd	V (all)
Banghoek 17	+			+	+	+
Hartebeesdale 564	+			+		+
Kogelbeen 44	+	+	+			+
Alphen 442	+	+				+
Boland 133	+					+
Brandzeikfontein 124	+			+		+
Edgehill 194	+	+				+
Helvetica 125	+	+	+			+
Kung Kung 123						+
Lower Kuruman Native Res	+	+	+	+		+
Mahura Muthla 198	+	+	+			+
Schuba Mora 201	+		+			+
Seduell 124	+		+	+		+
Toekoms 123				+		+

The palaeontological sensitivity of the area under consideration is presented in composite Figures 19-22 that are SAHRIS palaeosensitivity maps for each farm. A summary of the geology and palaeosensitivity for each farm is presented in Table 4 above. Most farms lie on more than one geological formation and it not known where the boreholes or test excavations will be placed. SAHRIS colour coding is as follows: Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

TRANSVAAL SUPERGROUP
According to the Palaeotechnical Report for the Northern Cape (Almond and Pether, 2008), the whole of the Vryburg Formation and all the formations in the Ghaap Group could have fossils, particularly stromatolites. NOTE maps usually just indicate the Ghaap Group or Campbell Rand Subgroup, while each member has a slightly different type of dolomite, stromatolites and chert.

The Boomplaas Formation in some areas is composed of stromatolitic and oolitic platform carbonates (Beukes, 1979, 1983) or of shales and carbonates.
The overlying Clearwater (or Lokamona) Formation is composed of shales, tiffites and BIF-like cherts and does not have a fossil record to date.
Giant stromatolitic domes overlain by microbial laminites with fenestrae and carbonate argillites, shales and siltstones make up the Monteville Formation (Beukes, 1987; Eriksson et al. 2006). The thickest stratum is the overlying Reivilo Formation that is made up of dolomite with giant stromatolitic domes, columnar stromatolites and fenestral facies (Beukes, 1980a).

Stromatolites are the trace fossils that were formed by colonies of green algae and blue-green algae (Cyanobacteria) that grew in warm, shallow marine settings. These algae were responsible for releasing oxygen via the photosynthetic process where atmospheric carbon dioxide and water, using energy from the sun, are converted into carbon chains and compounds that are the building blocks of all living organisms. The released carbon dioxide initially was taken up by the abundant reducing minerals to form oxides, e.g. iron oxide. Eventually free oxygen was released into the atmosphere and some was converted into ozone by the bombardment of cosmic rays. The ozone is critical for the filtering out of harmful ultraviolet rays.

Stromatolites are the layers upon layers of inorganic materials that were deposited during photosynthesis, namely calcium carbonate, magnesium carbonate, calcium sulphate and magnesium sulphate. These layers can be in the form of flat layers, domes or columns depending on the environment where they grew (Beukes, 1987). Some environments did not form stromatolites, just layers of limestone that later was converted to dolomite. The algae that formed the stromatolites are very rarely preserved, and they are microscopic so they can only be seen from thin sections studies under a petrographic microscope.

DWYKA SUBGROUP (KAROO SUPERGROUP)
The **Dwyka Group** is made up of seven facies that were deposited in a marine basin under differing environmental settings of glacial formation and retreat (Visser, 1986, 1989; Johnson et al., 2006). In the north and east these are called the Mbizane Formation, and

the Elandsvlei Formation in the south and west. Described below are the seven facies (Johnson et al., 2006 p. 463-465):
The massive diamictite facies comprises highly compacted diamictite that is clast-poor in the north. It was deposited in subaqueous or subglacial positions.
The stratified diamictite comprises alternating diamictite, mudrock, sandstone and conglomerate beds. They are interpreted as being rapidly deposited, sediment gravity flows but with some possible reworking of the subglacial diamictites.
The massive carbonate-rich diamictite facies is clast-poor and was formed by the rainout of debris, with the carbonate probably originating by crystallisation from interstitial waters.
The conglomerate facies ranges from single layer boulder beds to poorly sorted pebble and granule conglomerates. The boulder beds are interpreted as lodgement deposits whereas the poorly sorted conglomerates are a product of water-reworking of diamicton by high-density sediment gravity flows.
The sandstone facies were formed as turbidite deposits.
The mudrock with stones facies represents rainout deposits in the distal iceberg zone.
The **mudrock facies** consists of dark-coloured, commonly carbonaceous mudstone, shale or silty rhythmite that was formed when the mud or silt in suspension settled. This is the only fossiliferous facies of the Dwyka Group.

The Dwyka *Glossopteris* flora outcrops are very sporadic and rare. Of the seven facies that have been recognised in the Dwyka Group fossil plant fragments have only been recognised from the mudrock facies. They have been recorded from around Douglas only (Johnson et al., 2006; Anderson and McLachlan 1976) although the Dwyka Group exposures are very extensive. Jurassic Dolerites do not contain fossils as they are igneous intrusives.

KALAHARI GROUP
Tertiary calcretes cover large parts of the Northern Cape but they are difficult to date and there are several schools of thought (see Partridge et al., 2006). Nonetheless, it is accepted that calcretes form under alternating cycles humid and arid climatic conditions in strata that have calcium carbonate (Netterberg, 1969). More recent research using geophysical techniques to measure uplift of the continent during the Cretaceous and tertiary, combined with the fossil record (Braun et al., 2014) suggest that there were two predominant humid periods during the Tertiary. The whole of the Eocene (56-33 Ma) and a short period during the early Miocene (ca 20-19 Ma) were humid according to their estimation. It is possible that the Northern Cape calcretes formed during one of these periods.

Overlying many of these rocks are loose sands and sand dunes of the Gordonia Formation, Kalahari Group of Neogene Age. The Gordonia Formation is the youngest of six formations and is the most extensive, stretching from the northern Karoo, Botswana, Namibia to the Congo River (Partridge et al., 2006). It is considered to be the biggest palaeo-erg in the world (ibid). The sands have been derived from local sources with some additional material transported into the basin (Partridge et al., 2006). Much of the Gordonia Formation comprises linear dunes that were reworked a number of times before being stabilised by vegetation (ibid).

Aeolian sands and alluvium are fairly mobile and very porous so they do not provide suitable conditions for preservation of organic matter (Cowan, 1995). Only in places where the sands have been waterlogged, such as palaeo-pans or palaeo-springs, is there any chance of fossilisation. For example, roots can be encased in calcium-rich or silica-rich sands and crusts, known as rhizoliths or rhizocretions, can form around the roots, invertebrates or bones around the margin of a pond, pan or spring (Klappa, 1980; Cramer and Hawkins, 2009; Peters et al., 2022).

According to Goudie and Wells (1995) there are two conditions required for the formation of pans. Firstly, the fluvial processes must not be integrated, and second, there must be no accumulation of aeolian material that would fill the irregularities or depressions in the land surface. Favoured materials or substrates for the formation of pans in South Africa are Dwyka and Ecca shales and sandstones (ibid).

Along with diamonds, the Quaternary-Tertiary calcretes and cemented sands may also have trapped the more robust fossils, such as bone or silicified wood. These fossils would be fragmented and transported, so out of primary context, but such occurrences have been useful for determining the source of the rivers, their direction of flow, and the ages of rivers (de Wit and Bamford, 1993; de Wit et al., 2009). Some abandoned fluvial channels or palaeo-channels contain diamonds that have been transported from the source kimberlites, as well as fossil wood. Examples are from the palaeo-Sak River (Bamford and de Wit, 1993) that represent the palaeo-Karoo River, and along the palaeo-channels adjacent to the present day Orange River at Auchas (Pickford et al., 1996; Bamford, 2000). In this area the abandoned fluvial channels on Farm **Mahura Muthla 198** and surrounding farms have incorporated silicified woods of both Karoo age and Early Cretaceous woods that have been used to determine the direction of flow of the palaeo-rivers and periods of avulsion (de Wit et al., 2009).

SAHRIS palaeosensitivity maps for each farm are presented in figures 19-22 below and the results are summarised in Table 4 above. The southern cluster of farms are mostly on Quaternary and Tertiary sands and alluvium while most of the northern farm sites are on very highly sensitive dolomites that are likely to preserve trace fossils such as stromatolites. Once the precise positions of boreholes and prospecting excavations have been determined those sites on very highly sensitive rocks will need to be assessed by a palaeontologist on site. The sites in palaeo-channels, that are likely to preserve diamonds, are also likely to preserve fossil woods and bones of any ages.

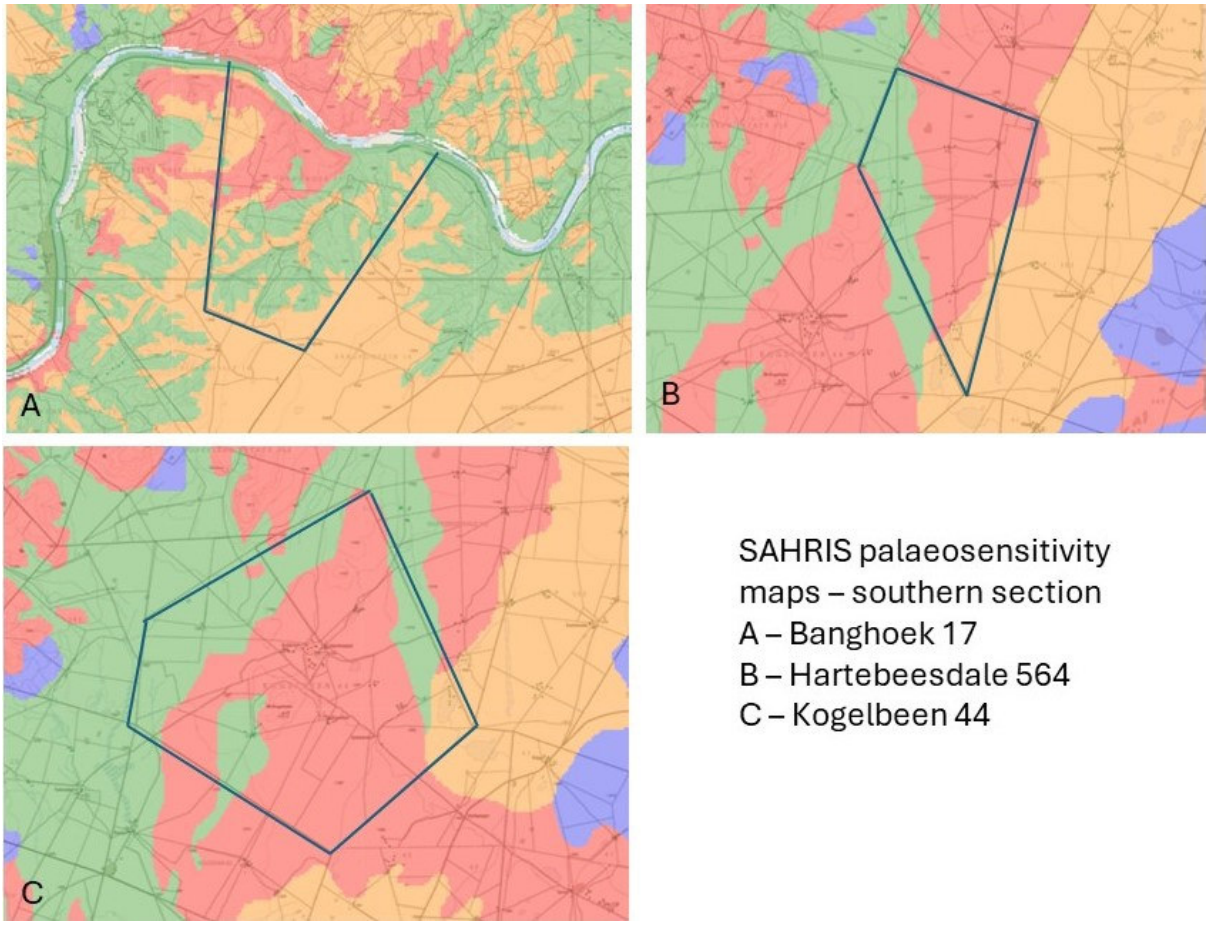


Figure 19: SAHRIS palaeosensitivity maps for the proposed Northern Cape Prospecting Project for the southern section (Farms Banghoek 17, Hartebeesdale 564 and Kogelbeen 44) shown within the blue polygons. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

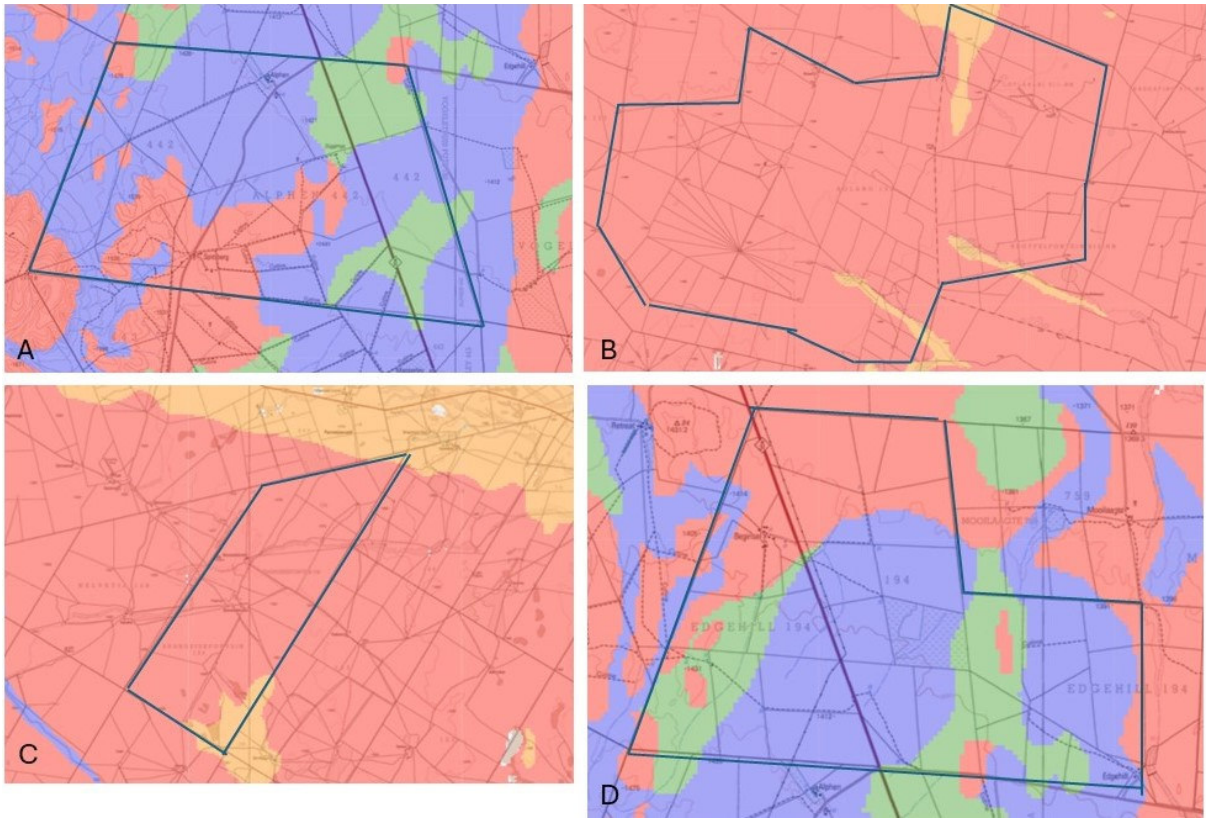


Figure 20: SAHRIS palaeosensitivity maps for the northern section for farms A – Alphen 442, B – Boland 133, C - Brandzeikfontein 124, D – Edgehill 194, shown within the blue polygons. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

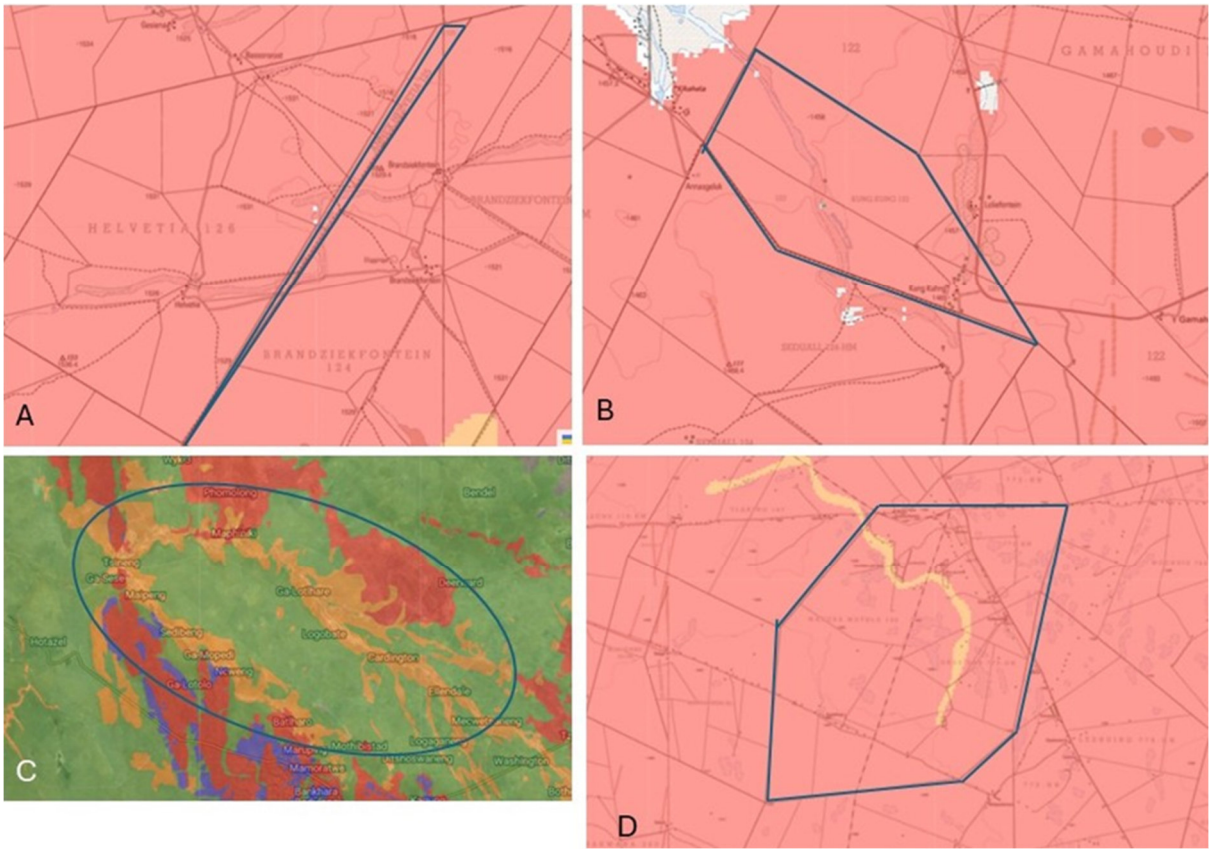


Figure 21: SAHRIS palaeosensitivity maps for the northern section on Farms A - Helvetica 125, B – Kung Kung 123, C – Lower Kuruman Native Reserve, D – Mahura Muthla 198 shown within the blue polygons. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero

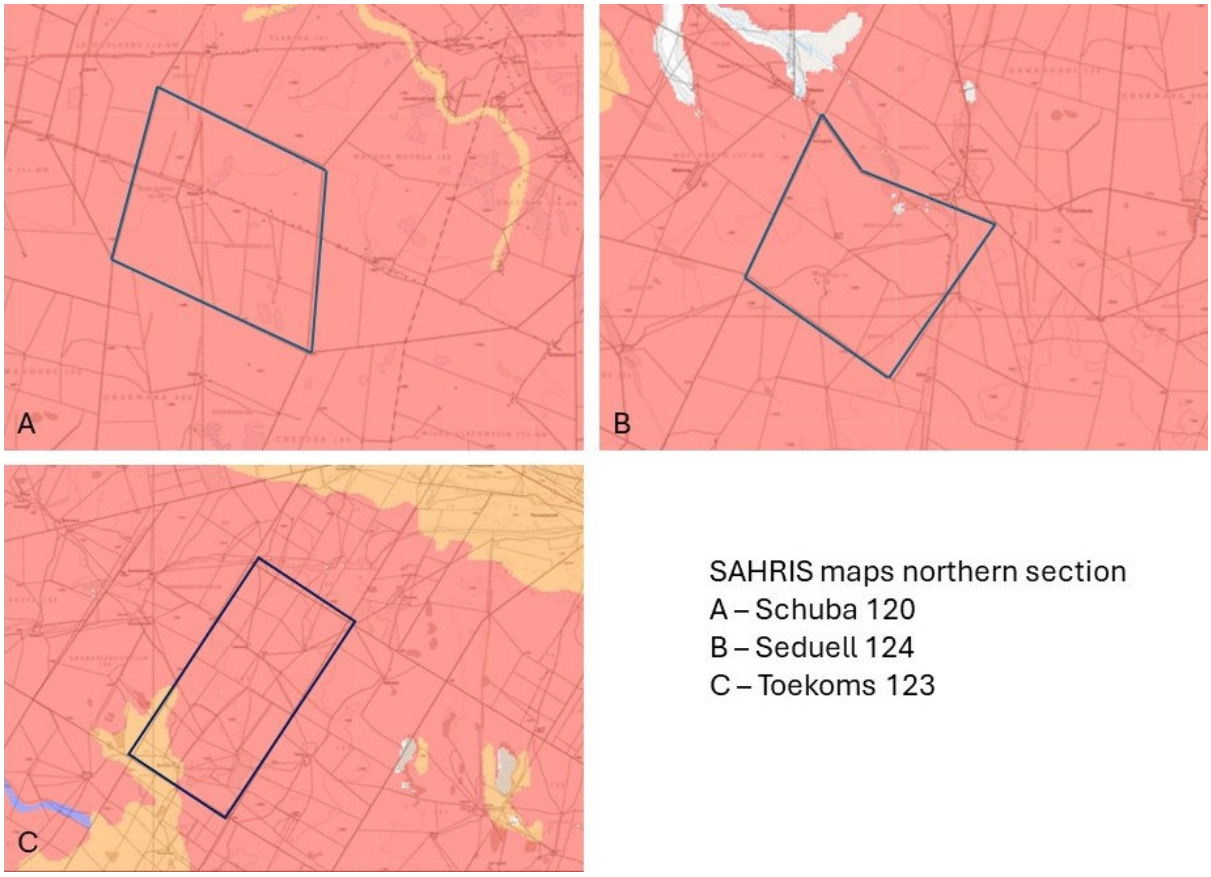


Figure 22: SAHRIS palaeosensitivity maps for the northern section on Farms A – Schuba Mora 201, B – Seduell 124, C – Toekoms 123 shown within the blue polygons. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

4. Impact assessment

Impacts on tangible palaeontological heritage resources.
It is assumed that the prospecting phase involves the removal of topsoil and vegetation before drilling activities and creating new roads to get to the drill points. These activities can result in impacts that include destruction or partial destruction of previously unknown and non-renewable palaeontological heritage resources.

Any additional effects to subsurface heritage resources can be successfully mitigated by implementing a chance find procedure. Mitigation measures as recommended in this report should be implemented during all phases of the project. Impacts of the project on heritage resources is expected to be low during all phases of the development if mitigation measures are followed.

Cumulative impacts
Cumulative impacts considered as an effect caused by the proposed action that results from the incremental impact of an action when added to other past, present, or reasonably foreseeable future actions. (Cornell Law School Information Institute, 2020). Cumulative impacts occur from the combination of effects of various impacts on heritage resources. The importance of identifying and assessing cumulative impacts is

that the whole is greater than the sum of its parts. In the case of this project, impacts can be mitigated to an acceptable level. However, when this project proceeds to actual mining this and other projects in the area can have a negative impact on the palaeontological heritage as scientific information will be lost.

- **Impact Assessment Tables**

Table 5. Impact assessment for invasive activities of the project

Nature: Activities resulting in disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological material or objects.		
	Without mitigation	**With mitigation (Preservation/ excavation of site)**
Extent	Site specific (1)	Site specific (1)
Duration	Permanent (5)	Low (1)
Magnitude	Low (3)	Low (3)
Probability	Probable (3)	Improbable (2)
Significance	**27 (Low)**	**10 (Low)**
Status (positive or negative)	Negative	Positive
Reversibility	Not reversible	Is reversible
Irreplaceable loss of resources?	Yes	No, unknown fossils will become known to science
Can impacts be mitigated?	Yes	Yes
Mitigation: • Once the drill sites have been confirmed the very highly sensitive areas (red in figures 19-22) have to be subjected to a palaeontological walk down, this should be conducted prior to the commencement of invasive prospecting activities; • Drill sites must be kept as close as possible to existing roads to minimise the impact on the landscape; • Focal points on the landscape like rocky outcrops or pans must be avoided as far as possible as these areas could be sensitive from a palaeontological point of view; • Monitoring of the project area by the ECO during the exploration phase for any surface fossil chance finds, and below surface finds once drilling or excavating commences. See Section 8 for the Fossil Chance Find Procedure for the project.		
Residual Impacts: If sites are destroyed this results in the depletion of the palaeontological record of the area and even though surface features can be avoided or mitigated, there is a chance that completely buried sites would still be impacted but this cannot be quantified.		

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are the correct type and age to contain fossils. Since there is a chance that fossils transported in the Quaternary-Tertiary sands and calcretes and trace fossils in the Ghaap Group (Transvaal Supergroup) may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is very high to moderate but mitigation would make the impact Low..

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and only some contain trace fossils, fossil plant, insect, invertebrate and vertebrate material. The soils of the Quaternary period would not preserve fossils.

6. Recommendation

Based on experience and the published records of fossils on some of the farms in the project, it is extremely likely that some fossils would be preserved in the Ghaap Group dolomites and in the Quaternary-Teriary fluvial sands in abandoned or palaeo-channels. Therefore, once drill and excavation sites have been determined, and if they fall on very highly sensitive rocks, then a site visit by a palaeontologist must be done. For the other sites a Fossil Chance Find Protocol should be followed. If fossils are found by the environmental officer, or other responsible person once excavations, drilling and clearing of vegetation for roads, etc, have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. The impact on the palaeontological heritage would be very high on some sites and low on other sites, as described in Table 4.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Very High to Moderate	Very High to Moderate	Palaeontological Impact Assessment	Section 7.2. SAHRA Requirements

7. References

Almond, J.E., Pether, J. 2009. Palaeontological Heritage of the Northern Cape; Palaeotechnical Report for SAHRA. 115pp.

Bamford, M.K. 2003. Fossil woods from Auchas and their palaeoenvironment. *Geology and Palaeobiology of the central and southern Namib Desert, southwestern Africa. Volume 2: Palaeontology. Geological Survey of Namibia, Memoirs,* **19**, 23-34.

Bamford, M.K., de Wit, M.C.J. 1993. Taxonomic description of fossil wood from Cainozoic Sak River terraces, near Brandvlei, Bushmanland, South Africa. *Palaeontologia africana*, **30**:71-80.

Benton, M.J. 2005. Vertebrate Palaeontology. Oxford: Blackwell Science, 2005. 3rd edn.

Beukes, N.J., 1987. Facies relations, depositional environments and diagenesis in a major early Proterozoic stromatolitic carbonate platform to basinal sequence, Campbellrand Subgroup, Transvaal Supergroup, southern Africa. Sedimentary Geology 54, 1-46.

Beukes, N.J., 1980. Stratigrafie en lithofacies van die Campbellrand-Subgroep van die Proterofitiese Ghaap-Groep, Noordkaapland. Transactions of the Geological Society of South Africa 83, 141-170.

Cowan, R., 1995. History of Life. 2nd Edition. Blackwell Scientific Publications, Boston. 462pp.

De Wit, M.C.J., Bamford, M.K. 1993. Fossil wood from the Brandvlei area, Bushmanland, as an indication of palaeoenvironmental changes during the Cainozoic. *Palaeontologia africana,* **30**:81-89

De Wit, M.C.J. Ward, J.D., Bamford, M.K., Roberts, M., 2009. The significance of the Cretaceous Diamondiferous gravel deposit at Mahura Muthla in the Vryburg District of the Northern Cape Province in South Africa. South African Journal of Geology 112, 89-108.

Eriksson, P.G., Altermann, W., 1998. Eriksson, An overview of the geology of the Transvaal Supergroup dolomites (South Africa). Environmental Geology 36, 178-188.

Eriksson, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. pp 237-260.

Eriksson, P.G., Bartman, R., Catuneanu, O., Mazumder, R., Lenhardt, N., 2012. A case study of microbial mats-related features in coastal epeiric sandstones from the Palaeoproterozoic Pretoria Group, Transvaal Supergroup, Kaapvaal craton, South Africa; the effect of preservation (reflecting sequence stratigraphic models) on the relationship between mat features and inferred palaeoenvironment. Sedimentary Geology 263, 67-75.

Groenewald, G., Groenewald, D., Groenewald, S., 2014. SAHRA Palaeotechnical Report. Palaeontological Heritage of the Northern Cape. 23 pages.

Hannah, J.L., Bekker, A., Stein, H.J., Markey, R.J., Holland, H.D., 2004. Primitive Os and 2316 Ma age for marine shale: implications for Paleoproterozoic glacial events and the rise of atmospheric oxygen. Earth and Planetary Science Letters 225, 43–52.

Parizot, M., Eriksson, P.G., Aifa, T., Sarkar, S., Banerjee, S., Catuneanu, O., Altermann, W., Bumby, A.J., Bordy, E.M., Rooy, J.L. and Boshoff, A.J. (2005). Suspected microbial mat-related crack-like sedimentary structures in the Palaeoproterozoic Magaliesberg Formation sandstones, South Africa. Precambrian Research, 138, 274-296.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Sumner, D.Y., Beukes, N.J., 2006. Sequence stratigraphic development of the Neoarchean Transvaal carbonate platform, Kaapvaal Craton, South Africa. South African Journal of Geology 109, 11–22.

Tice, M.M., Thornton, D.C.O., Pope, M.C., Olszewski, T.D., Gong, J., 2011. Archean microbial mat communities. Annual Review of Earth and Planetary Sciences 39, 297–319.

Truswell, J.F., Eriksson, K.A., 1973. Stromatolitic associations and their palaeo-environmental significance: a reappraisal of a lower Proterozoic locality from the northern Cape Province, South Africa. Sedimentary Geology 10, 1–23.

Zeh, A., Wilson, A.H., Gerdes, A., 2020. Zircon U-Pb-Hf isotope systematics of Transvaal Supergroup – Constraints for the geodynamic evolution of the Kaapvaal Craton and its hinterland between 2.65 and 2.06 Ga. Precambrian Research 345, 105760. https://doi.org/10.1016/j.precamres.2020.105760

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.
2. When excavations begin the rocks must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (stromatolites, plants, insects, bone or coal) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the trace fossils such as stromatolites or microbially features (trails, curls, rip-ups, mudcracks) trace fossils in the dolomites, limestones, shales and mudstones (for example see Figure 23). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be

obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.

7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

9. Appendix A – Examples of fossils from the Ghaap Group

Figure 23: Photographs from the Malmani Subgroup of different types of stromatolites in dolomite.

10. Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
January 2024

Present employment: Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DSI Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa
Telephone : +27 11 717 6690
Cell : 082 555 6937
E-mail : marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) **Academic qualifications**
Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) **Professional qualifications**
Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) **Membership of professional bodies/associations**
Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+
Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

v) **Supervision of Higher Degrees**

All at Wits University

Degree	Graduated/completed	Current

Honours	13	0
Masters	13	3
PhD	13	7
Postdoctoral fellows	14	4

vi) **Undergraduate teaching**
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 12 - 20 students per year.

vii**) Editing and reviewing**
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Associate Editor: Cretaceous Research: 2018-2020
Associate Editor: Royal Society Open: 2021 -
Review of manuscripts for ISI-listed journals: 30 local and international journals

viii) **Palaeontological Impact Assessments**
27 years' experience in PIA site and desktop projects
Selected from recent projects only – list not complete:

- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe
- Glosam Mine 2022 for AHSA
- Wolf-Skilpad-Grassridge OHPL 2022 for Zutari
- Iziduli and Msenge WEFs 2022 for CTS Heritage
- Hendrina North and South WEFs & SEFs 2022 for Cabanga
- Dealesville-Springhaas SEFs 2022 for GIBB Environmental
- Vhuvhili and Mukondeleli SEFs 2022 for CSIR
- Chemwes & Stilfontein SEFs 2022 for CTS Heritage
- Equestria Exts housing 2022 for Beyond Heritage
- Zeerust Salene boreholes 2022 for Prescali
- Tsakane Sewer upgrade 2022 for Tsimba
- Transnet MPP inland and coastal 2022 for ENVASS
- Ruighoek PRA 2022 for SLR Consulting (Africa)
- Namli MRA Steinkopf 2022 for Beyond Heritage
- Adara 2 SEF 2023 for CTS Heritage
- Buffalo & Lyra SEFs 2023 for Nextec
- Camel Thorn Group Prospecting Rights 2023 for AHSA
- Dalmanutha SEFs 2023 for Beyond Heritage
- Elandsfontein Residential 2023 for Beyond Heritage
- Waterkloof Samancor 2023 for Elemental Sustainability
- Zonnebloem WTP 2023 for WSP
- Elders Irrigation 2023 for SRK

- Leghoya WEFS 2023 for Red Cap & SLR

ix) **Research Output**
Publications by M K Bamford up to January 2024 peer-reviewed journals or scholarly books: over 175 articles published; 5 submitted/in press; 14 book chapters.
Scopus h-index = 32; Google Scholar h-index = 40; -i10-index = 121 based on 7261 citations.
Conferences: numerous presentations at local and international conferences.