



CEDAR TOWER
SERVICES

HERITAGE SCOPING ASSESSMENT SKA PHASE 1 PROJECT

For:

**Strategic Environmental Assessment
CSIR Lydia Cape**

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Specialist Reports

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Executive Summary

Introduction

The purpose of this report is to present a high level scoping assessment of heritage resources (archaeological, palaeontological and other cultural resources including visual resources) and sensitivities of the area proposed for the SKA Phase 1 project.

South African legislation (National Heritage Resources Act (Act No. 25 of 1999)) defines heritage resources and provides protection to all heritage resources of significance including places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. All heritage assessments, including scoping assessments, should therefore take into consideration all heritage resources including archaeology, shipwrecks, battlefields, graves, and significant structures, historical settlements, landscapes, geological sites as well as palaeontological sites and objects.

Heritage Impacts

The following heritage resources were identified as occurring within the footprint of the proposed SKA Phase 1 Project: Rock Art, Built Environment, Graves, Archaeological and Palaeontological Resources, Cultural Landscapes as well as examples of living heritage in the form of Indigenous Knowledge Systems and unique cultural practices.

A total of 105 “heritage resources” were identified within the SKA Phase 1 area from the heritage screener and field survey:

- Grade II sites: 6 (5.7%)
- Grade IIIa sites: 42 (40%)
- Grade IIIb sites: 20 (19.1%)
- Grade IIIc sites: 37 (35.2%)

It is expected that this number of sites will increase significantly once more thorough field assessments are conducted. Of these sites, 95% were deemed as having local significance (Grade III) with a relatively even split between sites of high local significance (~40%; mostly buildings) and medium or low local significance (~55%). From the assessment of the potential heritage impacts of the proposed stations and infrastructure during the operational and the construction phases of the SKA project, it is expected that most of the impact will occur during the construction phase.

Three of the Grade II sites, which consist of corbelled buildings at Grootfontein, Arbeidsfontein and Stuurmansfontein, are declared PHSSs (see tables in Appendix 10) and thus have the highest proclaimed significance in terms of the NHRA and should be considered as no-go areas. No impacts on these sites are anticipated. The other Grade II sites are Hartogskloof, Groot Pardekloof and Abiquaputs mentioned in the Bleek & Lloyd texts (Deacon, 1986), which have been identified as having provincial significance (Grade II) but they have not been formally protected under s. 27 of the NHRA. They should, however, also be considered as no-go areas and a buffer of 1km is recommended around them. Grade IIIa resources are of high local significance and should also be avoided as much as possible. Mitigation may only be considered as the least viable option. Burial grounds and graves may,

at times, be relocated if impacts from construction cannot be rerouted, but because of the process entailed avoidance is strongly recommended.

The impact on palaeontological resources is normally considered positive if fossil material of significance is identified during construction and properly mitigated. The overall significance for the formations identified within the SKA Phase 1 area has been given a rating of “not high” and the impact was deemed as neutral. In instances where the heritage resources are not expected to be impacted by the development, the nature of the impact was identified as neutral, except for the Abrahamskraal Formation which will require a field assessment if impacted upon. After mitigation (field survey and possibly Phase 2 for excavation and collection), the impact will be considered as low. This may change if the position of the proposed infrastructure is amended during the planning and construction phase and results in direct impacts on the heritage resources.

Indirect impact during the operational phase is expected on farmsteads in the core area which may be expropriated for the establishment of the SKA Phase 1 stations. While it is expected that no direct impact will occur to them, the removal of their owners from the land will mean that a maintenance plan will need to be put in place by SKA to ensure that the structures and related infrastructure are not left to decay. Most of these farmsteads have been provisionally graded as Grade IIIa and therefore have high local significance (HER-SKA001, 030, 033, 040, 042, Williston006).

Visual Impacts

Potential cumulative visual impacts could result from a combination of MeerKAT and SKA Phases 1 and 2 over time. Proposals for future phases of the SKA are not known at this stage and would need to be assessed for possible cumulative visual impacts as part of the rollout of the SKA. Related infrastructure to the SKA project include the access roads and powerlines to each of the dish antennae, which seen together could result in additional cumulative visual impacts representing an industrialised landscape.

The dish antennae require an uninterrupted exposure to the horizon and their locations are based on technical requirements. As the dish antennae cannot easily be visually screened, mitigation is limited and confined to micro-siting. The related infrastructure (access roads, powerlines and substations) would have a lower risk than the dish antennae because of their smaller size visually. The construction phase would also have a lower risk because it is short term, but could continue with future phases of the SKA.

Recommendations

It is important to note that heritage resources, for the most part, are finite and irreplaceable. Impacts on heritage resources are therefore generally treated as negative, permanent and irreversible. However, mitigatory measures lessen the severity of the impacts. In the absence of development, the majority of the SKA Phase 1 area scored between low and medium potential impact/sensitivity (Figure 28). Should the development of the SKA project be realised, none of the heritage resources identified within the SKA Phase 1 area are expected to be significantly impacted if the appropriate mitigation measures are implemented. All heritage resources have therefore scored between low and medium potential impact, with no highly significant potential impact being calculated.

However, it is important to note that the assessment completed was a high level assessment of likely impacts and was by no means exhaustive. It is also important to note that the high level assessment completed does not satisfy the requirements of section 38(3) of the NHRA. A more detailed site specific HIA is required for this project at a later stage.

Heritage Impacts:

1. A complete Heritage Impact Assessment is required that satisfies section 38(3) of the NHRA. This HIA should include the following:
 - a. A field assessment for archaeology of the locations of any infrastructure to be developed that impacts dolerite outcrops, Grade IIIA resources or is within 100m of a river bed. The results of this assessment may require that infrastructure be relocated.
 - b. A field assessment for palaeontology of the locations of any infrastructure to be developed that impacts the Beaufort Group and older, consolidated (e.g. calcretised) alluvial deposits
 - c. A record and assessment of the structures within the SKA footprint area to inform a Conservation Management Plan
2. A Fossil Finds Procedure must be implemented for the construction phase of the project that includes training for ECO's regarding fossil identification.
3. A Heritage Conservation Management Plan be drafted for the ongoing management of heritage resources within the SKA development footprint, including:
 - a. Maintenance of significant structures
 - b. Maintenance and access to burial grounds and graves
4. The mitigation measures proposed in the Impact Assessment Tables included in Appendix A to this chapter must be implemented.
5. The town of Carnarvon, and other historic towns, represent potentially important gateways to the SKA project, particularly for visitors to the area, and it is recommended that a major social, heritage and environmental programme be implemented as an on-going project to uplift the presently degraded portions of these townscapes. It is recognised that that some programmes have already been initiated, but that more needs to be done for the image of the town in consultation with Municipalities, the business community and NGOs.
6. The projects identified in section 4.4 of this assessment must be implemented.

Visual Impacts:

1. The general nature of the terrain for the proposed project, scenic resources and a number of potential sensitive receptors were identified.
2. The general location selected for the SKA 1 consists largely of flat plains, with some low sandstone and doleritic mountains in a sparsely populated area (mainly farmsteads).
3. The main scenic resources are concentrated in the mountainous terrain across the middle of the study area, where peaks, ridgelines, scarp edges, steep side slopes and dolerite rock outcrops are potentially visually sensitive, particularly in terms of structures on the skyline.
4. The proposed dish antennae, including those in the spiral arms, cover a relatively large area of approximately 154 by 137 km, some of the dishes being located in more mountainous terrain. The exposed nature of the landscape suggests that the dishes could be highly visible up to 1 km, but only marginally visible beyond 5 km.

5. There are no major settlements or roads, (except for the R63), in the study area, and the farmsteads are spread relatively far apart. Some of the farmsteads affected by the SKA appear to not be permanently inhabited.
6. The composite visual sensitivity map (Figure) indicates that high and moderately high visual sensitivity zones tend to be concentrated in the more mountainous terrain and near farmsteads. A number of the proposed dish antennae, and related infrastructure, are within these sensitivity zones. (See also Map 10 in the Addendum).
7. Given that the position of the dish antennae are determined by technical criteria, re-siting of the dishes may be limited. In cases where the proposed location of dishes coincides with visually sensitive landscape features or sensitive receptors, this can be partly overcome through micro-siting the dishes.
8. Particular attention needs to be paid to those dish antennae that are within 1 to 2.5 km of farmsteads, mainly in the proposed spiral arms, as highlighted in Figure . These should be subject to a more detailed visual assessment, including photomontages, once a final layout has been prepared.
9. The cumulative visual impacts of the Meerkat and SKA Phase 1 have been considered, but given the nature of the landscape, careful siting of the dishes and the minimal sensitive receptors, the overall project should not represent a fatal flaw in visual terms after mitigation.
10. A number of mitigation measures have been recommended, which could help to reduce the potential visual impacts relating to the project. Mitigations relating to the construction phase, including the location of the construction camps, should be included in the EMPr.

Abbreviations and Acronyms

BGIS	Biodiversity Geographic Information System
CGS	Council for Geoscience
CMP	Conservation Management Plan
CSIR	Council for Scientific and Industrial Research
CTS	Cedar Tower Services
DEA	Department of Environmental Affairs
DST	Department of Science and Technology
ECO	Environmental Control Officer
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
FEPAs	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GPS	Global Positioning System
HIA	Heritage Impact Assessment
ID	Identification
KAPB	Karoo Array Processor Building
KAT	Karoo Array Telescope
KCAAA1	Karoo Central Astronomy Advantage Area 1
LAP	Land Acquisition Programme
LUPO	Land Use Planning Ordinance
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NBKB	Ngwao Boswa Kapa Bokoni (Northern Cape Provincial Heritage Resources Authority)
NEMA	National Environmental Management Act 107 of 1998
NEMPA	National Environmental Management: Protected Areas Act 57 of 2003
NGO	Non-governmental organization
NHRA	National Heritage Resources Act 25 of 1999
NRF	National Research Foundation
ODK	OpenDataKit
PAA	Protected Areas Act 57 of 2003
PHRA	Provincial Heritage Resources Authority
PHS	Provincial Heritage Site
PIA	Palaeontological Impact Assessment
PSM	PalaeoSensitivity Map
QGIS	Quantum Geographic Information System
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SANBI	South African National Biodiversity Institute
SARADA	South African Rock Art Digital Archive
SEA	Strategic Environmental Assessment
SEF	Strategic Environmental Focus (Pty) Ltd
SKA	Square Kilometre Array
SO ₂	Sulfur dioxide
SRTM	Shuttle Radar Topographic Mission

Section 1. Scope

The purpose of this report is to present a high level scoping assessment of heritage resources (archaeological, palaeontological and other cultural resources including visual resources) and sensitivities of the area proposed for the SKA Phase 1 project. The assessment of visual resources (including visual, scenic, aesthetic and amenity values) is included in this assessment as the scenic resources form part of the National Estate and therefore the visual findings should be seen in conjunction with heritage sensitivities. Visual resources contribute to the area's overall 'sense of place' and encompass both natural and cultural landscape characteristics.

Heritage Impacts

The protection of heritage resources in South Africa is governed by the National Heritage Resources Act (No. 25 of 1999; NHRA), by which any place or object considered to have cultural significance in terms of aesthetic, architectural, scientific, historical, social, spiritual, linguistic or technological value is regarded as part of the National Estate. The NHRA provides protection for archaeological, palaeontological and other cultural resources, including significant structures and graves (ACRM, 2015).

Phase 1 of the SKA will expand the MeerKAT project by increasing the receptors from 64 to 197. In light of this, an assessment is required to evaluate and understand the impact(s) of the development on the significance of any heritage resources(s), and to recommend the means/approach to conserve the resource(s), as well as methods to avoid or mitigate negative impacts (Morris and Wilson, 2009). This scoping assessment is intended to inform a more detailed HIA in terms of section 38(3) of the NHRA to be completed at a later stage.

HIAs typically provide details of the proposed development including written and visual descriptions of the proposed activities, site(s) and alternative(s); a background analysis pertaining to the heritage resources potentially occurring on site; a statement of significance for those identified heritage resources and a description of their current condition (baseline); the potential impact(s) of the proposed development on those heritage resources; and recommendations and methods for avoiding and/or mitigating negative impacts with reference to applicable legislation.

The heritage resources and sensitivities of the area proposed for the SKA Phase 1 project were investigated from November 2015 to May 2016 by the following experts:

- Kyla Bluff from Cedar Tower Services
- Jayson Orton from ASHA Consulting
- John Almond from NaturaViva
- Nicholas Wiltshire from Cedar Tower Services

The scoping heritage assessment consisted of two phases:

- A desktop study conducted end 2015 reviewing existing heritage impact assessments (HIA) and heritage surveys within the area proposed for the SKA Phase 1 project as well as the broader Karoo Central Astronomy Advantage Area 1 (KCAAA1); and

- A more detailed, but still high level, sensitivity and resource assessment for the area proposed for the SKA Phase 1 project informed by a site visit and fieldwork conducted in March-April 2016.

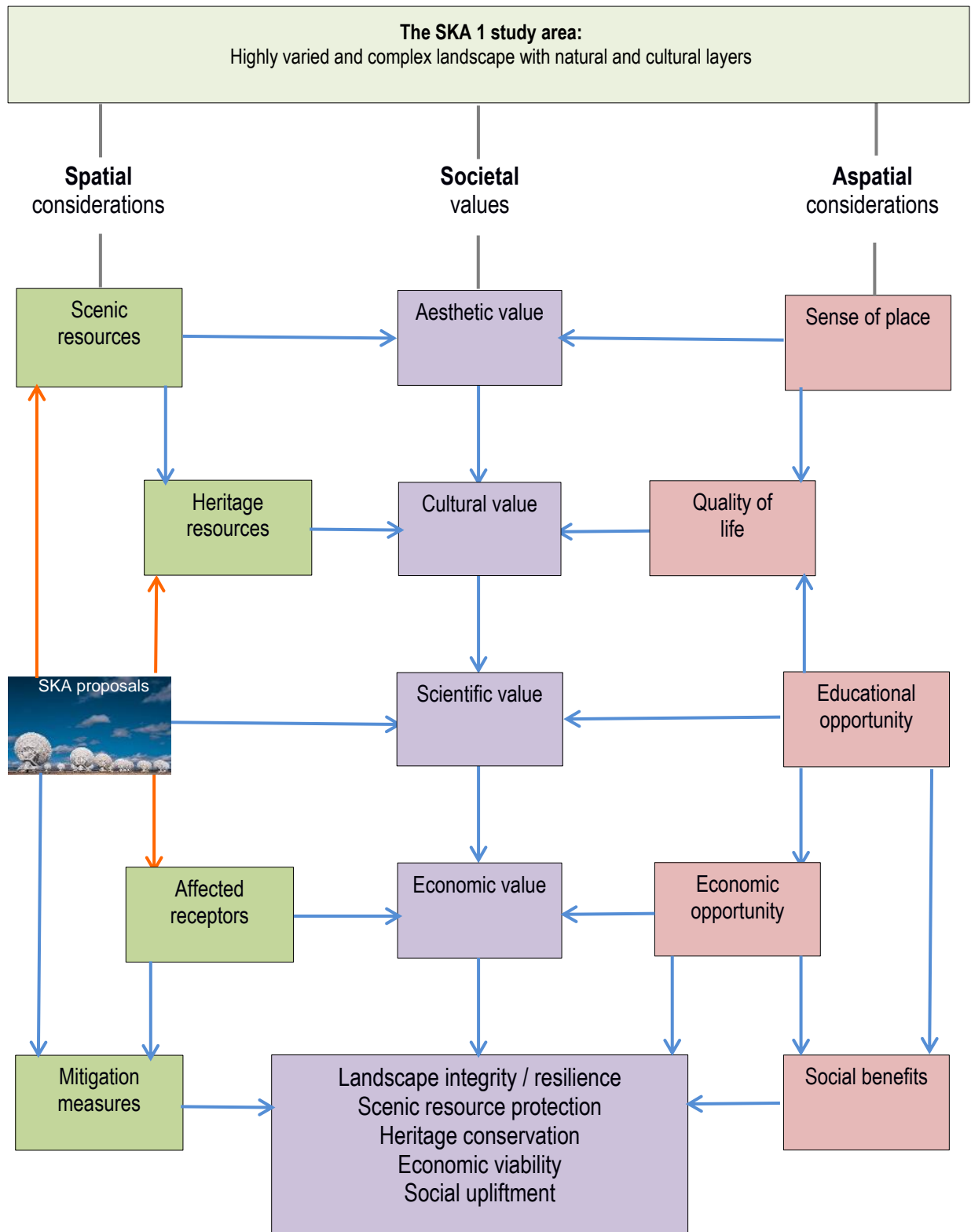
Visual Impacts

The visual resources and sensitivities of the area proposed for the SKA Phase 1 project were investigated by the following experts:

- Bernard Oberholzer from BOLA Landscape Architect
- Quinton Lawson from MLB Architects

A desktop visual assessment study was conducted to establish and describe the landscape character of the receiving environment. This baseline study was based on the identification of landscape types and characteristics together with scenic significance. A combination of data analysis using a Geographic Information System (GIS) and literature review was used to identify land cover, landforms and land use in order to gain an understanding of the regional landscape. Landscape features of special interest were identified and mapped, and verified in the field during the site visit. The different levels of sensitivity were identified based on the interpretation of natural and scenic resources and their aesthetic and economic value to the local community and the region.

The connections between heritage and visual resources, including the relationship with other environmental, social and economic issues are indicated below (see Appendix E). The methodology and findings of the heritage and visual resources assessment, including subsequent recommendations, are described in the following sections in greater detail.



Section 2. Heritage Conservation Principles

Heritage

South African legislation (National Heritage Resources Act (Act No. 25 of 1999,) defines heritage resources and provides protection to all heritage resources of significance including places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. All heritage assessments, including scoping assessments, should therefore take into consideration all heritage resources including archaeology, shipwrecks, battlefields, graves, and significant structures, historical settlements, landscapes, geological sites as well as palaeontological sites and objects.

Section 38 of the NHRA (Act 25 of 1999) provides the process for assessing the impacts of developments on heritage resources. In terms of section 38(1), at the earliest stages of a development, the relevant heritage authority must be notified of the proposed development. The relevant heritage authority is then required to respond within 14 days indicating whether or not heritage resources are likely to be impacted by the development, and if they are, indicating that a Heritage Impact Assessment in terms of section 38(3) is required. Section 38(3) of the NHRA details the kind of information that must be submitted as part of a Heritage Impact Assessment (HIA).

In terms of section 38(8) of the NHRA, any proposed development that requires an Environmental Impact Assessment in terms of the National Environmental Management Act (NEMA), the consenting authority must ensure that the evaluation of impacts to heritage completed as part of the impact assessment fulfils the requirements of the relevant heritage resources authority in terms of section 38(3) of the NHRA and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent. As the Strategic Environmental Assessment (SEA) for the SKA is seeking exemption from compliance with NEMA requirements, section 38(8) does not apply to this project, however the provisions of section 38(1), (2), (3) and (4) do apply. As such, the SEA is submitted to SAHRA in order to satisfy the requirements of section 38(1) of the NHRA.

All archaeological and palaeontological specialist work that forms part of the requirements stipulated in section 38(3) of the NHRA should conform to international best practice as well as comply with SAHRA minimum standards for the archaeological and palaeontological components of impact assessment reports (2007) and the minimum standards for Phase 2 palaeontological studies recently developed by SAHRA (2013).

As described in the SAHRA minimum standards, the process of assessment for the archaeological (AIA) or palaeontological (PIA) specialist components of heritage impact assessments usually involves:

1. Initial pre-assessment (scoping) phase, where the specialist establishes the scope of the project and terms of reference for the developer.
2. Phase 1 Impact Assessment/Specialist Report:
 - a. Identifies heritage resources;
 - b. Assesses their significance;
 - c. Comments on the impact of the development;

- d. Makes recommendations for their mitigation or conservation,
 - e. OR: A Letter of Recommendation for Exemption (if there is no likelihood that any sites will be impacted).
3. Phase 2 Mitigation/Rescue, which involves planning the protection of significant heritage resources via excavation/collection at sites that may be lost.
 4. 'Phase 3 Heritage Site Management Plan (for heritage conservation), may be required in rare cases where the site is so important that development will not be allowed. Developers may also choose to, or be encouraged to, enhance the value of the sites retained on their properties with appropriate interpretive material or displays.

The SAHRA minimum standards also specifies three points during development at which SAHRA or the relevant heritage resources authority may be approached for permission to disturb a site during the impact assessment process. Those three permitting requirements are:

1. 'Shovel-Test Permits': in particular circumstances 'shovel-test' permits may be issued prior to or immediately after a Phase 1 survey (e.g. for testing the extent of coastal middens or collecting restricted ceramic samples for identification from Iron Age sites).
2. 'Mitigation Permits': these are generally issued for excavation or collection of samples and assess sites that will be impacted by the development. These are issued to the specialist before the Phase 2 study, and after assessment of the Phase 1 report.
3. 'Destruction Permits/Permission' and/or 'Interpretation Permits': these are generally issued to the developer after assessment of the Phase 2 report (but are usually filled in by the archaeologist). 'Interpretation Permits' refer to situations where the addition of boardwalks or notice boards may impact on the site and the permitting process allows for the proposed actions to be discussed and possibly modified to better protect the site(s).

Visual

The guideline for visual assessment specialist studies as set out by South Africa's Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) and written by Bernard Oberholzer (2005) recommends that visual inputs are integrated with the project planning and design process, so that the findings and recommended mitigation measures can inform the final design, and hopefully the quality of the project. According to Oberholzer (2005), a visual assessment should consider the following concepts:

- 'visual' implies the full range of visual, aesthetic, cultural and spiritual aspects of the environment that contribute to the area's sense of place;
- both the natural and cultural landscape (and their interrelatedness) should be considered;
- all scenic resources, protected areas and sites of special interest, should be identified with their relative importance in the region;
- the value of visual/aesthetic resources should be defined through public involvement;
- landscape processes (including geological, vegetation and settlement patterns) give the landscape its particular character or scenic attributes; and
- quantitative criteria such as 'visibility' and qualitative criteria such as aesthetic value or sense of place should be considered.

Section 3. Regional setting

The area proposed for the SKA Phase 1 project is contained within the Karoo Central Astronomy Advantage Area 1 (KCAAA1) in the Bo-Karoo (Upper Karoo) which in turn is a part of the Great Karoo, a vast semi-arid area of the Northern Cape Province. This area falls within the southern Bushmanland regions of the Northern Cape, on the north-western margins of the Main Karoo Basin.

The word Khoekhoe from which is derived the word 'Karoo' means 'hard' or 'dry', which broadly describes this harsh arid, semi-desert region (Raper, 1989). The Karoo is richly littered with heritage resources, ranging from geological and meteorological heritage sites, to palaeontological and archaeological resources covering millions of years of history. More recently, built heritage in terms of architecture, and cultural heritage resources have contributed to a landscape of high heritage significance. The Karoo is considered a relatively remote part of South Africa, with a low population density, comprising mostly farming communities.

Research suggests that the Karoo formed part of the heartland occupied by the Later Stone Age /Xam San between the end of the 18th century and the beginning of the 19th century. The thoroughfare of different cultural groups, such as the Trek Boers and Xhosa refugees, across this area during colonial times resulted in competition for scarce resources between these groups and the /Xam and other San groups ultimately underwent genocide. Vast unpublished manuscripts exist, which detail the Karoo /Xam peoples' understanding of their environment, folklore and belief systems (Prins, 2008). The San people left traces of their presence throughout the Karoo, mainly in the form of rock art (painted and engraved) and cultural material such as stone tools and other artefacts.

Karoo scenery is typically characterised by flat-topped *koppies*, extensive sandy to gravelly *vlaktes* (flats) and water courses that flow only in response to summer rain storms. The main uplands comprise the Kareeberge range towards the south, between Williston and Carnarvon, while numerous small to large pans are found in the north between Brandvlei and Van Wyksvlei. River valleys and undulating uplands tend to have a higher sensitivity than the open plains for some categories of heritage, mainly due to the associated access to water (Orton, Almond, Clarke and Fisher, 2016). Water access increases erosion, which in turn can expose buried palaeontological resources. The region is drained by various tributaries of the Orange River, most notably the Sakrivier, and features scattered relics of a much more extensive, largely defunct drainage network from Late Tertiary (Neogene) times when climates were more tropical and pluvial. Characteristic anthropogenic features of the Karoo include gravel roads, fencing and wind pumps.

Typical heritage features expected to occur in the study area include, *inter alia*, Karoo- style architecture, namely corbelled houses; kraals, Early-, Middle- and Later Stone Age artefacts such as stone tools and engravings/rock art; graves; a wide variety of fossils of the renowned Karoo fossil record; meteorites and geologically significant landforms.

The large scale of the study area, (approximately 21 908km²), means that landforms are the dominant features in terms of scenic resources, the character of the landscape being largely determined by the geology. The generally low, sparse vegetation means that the landforms and rock formations tend to

be more pronounced in the Karoo than in other parts of South Africa. Using a geomorphological approach, 3 broad landscape types can be identified within the study area, each with its own scenic characteristics, as described in Table 1 below, and illustrated in Figure 1 and Figure 2.

Table 1. Study area landscape types (See Appendix E)

Landscape Type	Characteristics	Significant Visual Features
A. Southern plain: Beaufort Group, Adelaide Formation mudstones, sandstones and shales.	Broad plain intruded in places by dolerites, and incised in the southwest corner of the study area by the Sak River and the Brak River. The elevation varies from 1100 to 1400 m.	Generally dry river courses and minor dolerite koppies. Koppies are visually sensitive, and the plains visually exposed. Travellers on the R63 Route and a number of farmsteads are the main visual receptors.
B. Mountainous terrain: Ecca Group, Canarvon Formation sandstones and shales with dolerite intrusions.	The harder, more weather-resistant sandstones and dolerites are responsible for the koppies and ridges, including the Kareeberge, with elevations ranging from 1300 to 1500 m. This is the most scenic part of the study area.	Scenic dolerite ridges and koppies, with a few small poorts. The ridge skylines are visually sensitive, while the varied topography is more visually absorptive than the plains. There are a small number of farmsteads, mainly in the more fertile valleys near sources of water.
C. Northern plain: Ecca Group, Tierberg Formation shales.	Broad and largely featureless plain at an elevation of 1000 m, with some dolerite outcrops and several pans. Patches of alluvium, sand and calcrete occur to the north.	Fairly featureless, except for minor dolerite koppies and a series of linked pans, and dry river courses. Visually exposed. A number of farmsteads are widely spread in the area.

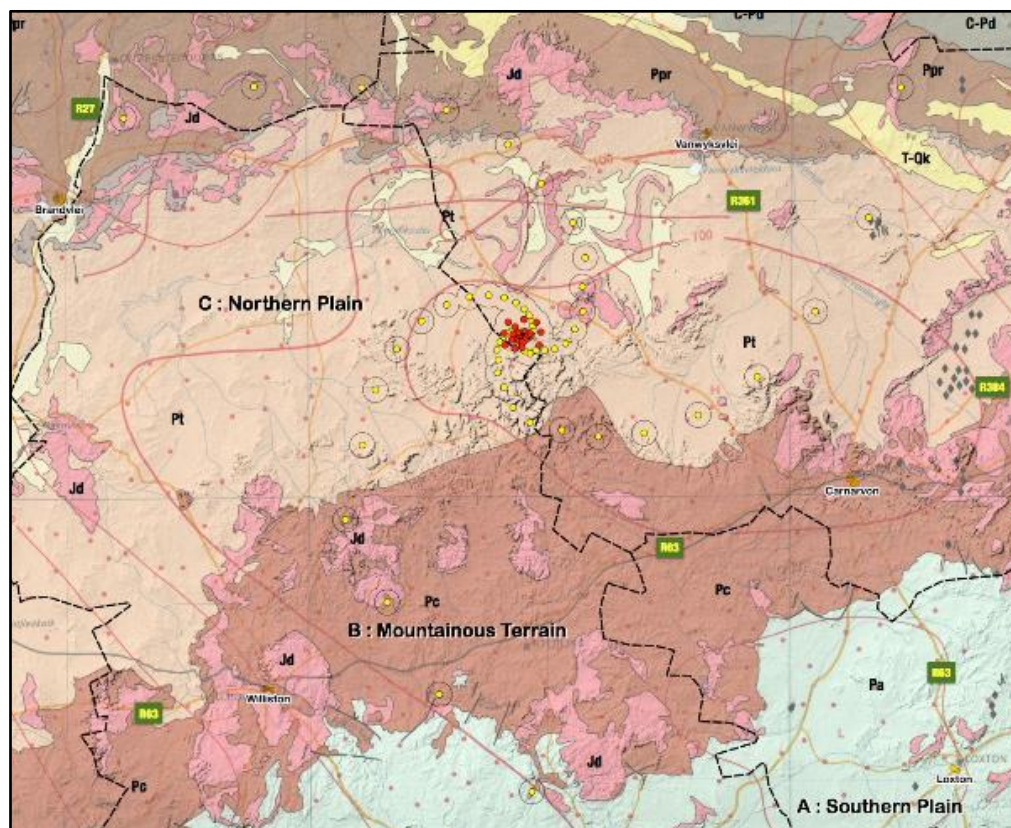


Figure 1. Geology and Landscape Types of the study area as described in Table 4. Proposed layout of proposed SKA dish antennae (yellow dots) and MeerKAT (red dots) (See Appendix E)

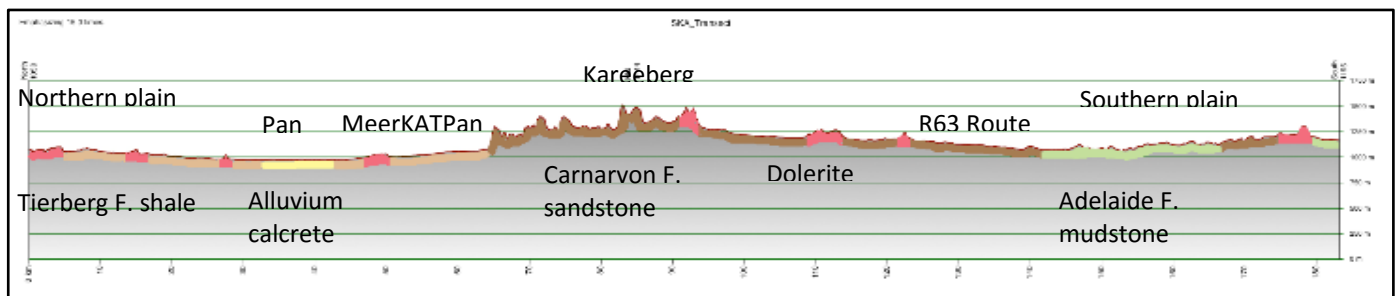


Figure 2. Typical transect through the SKA site indicating correlation between geology and scenic landscape types. (See Appendix E)

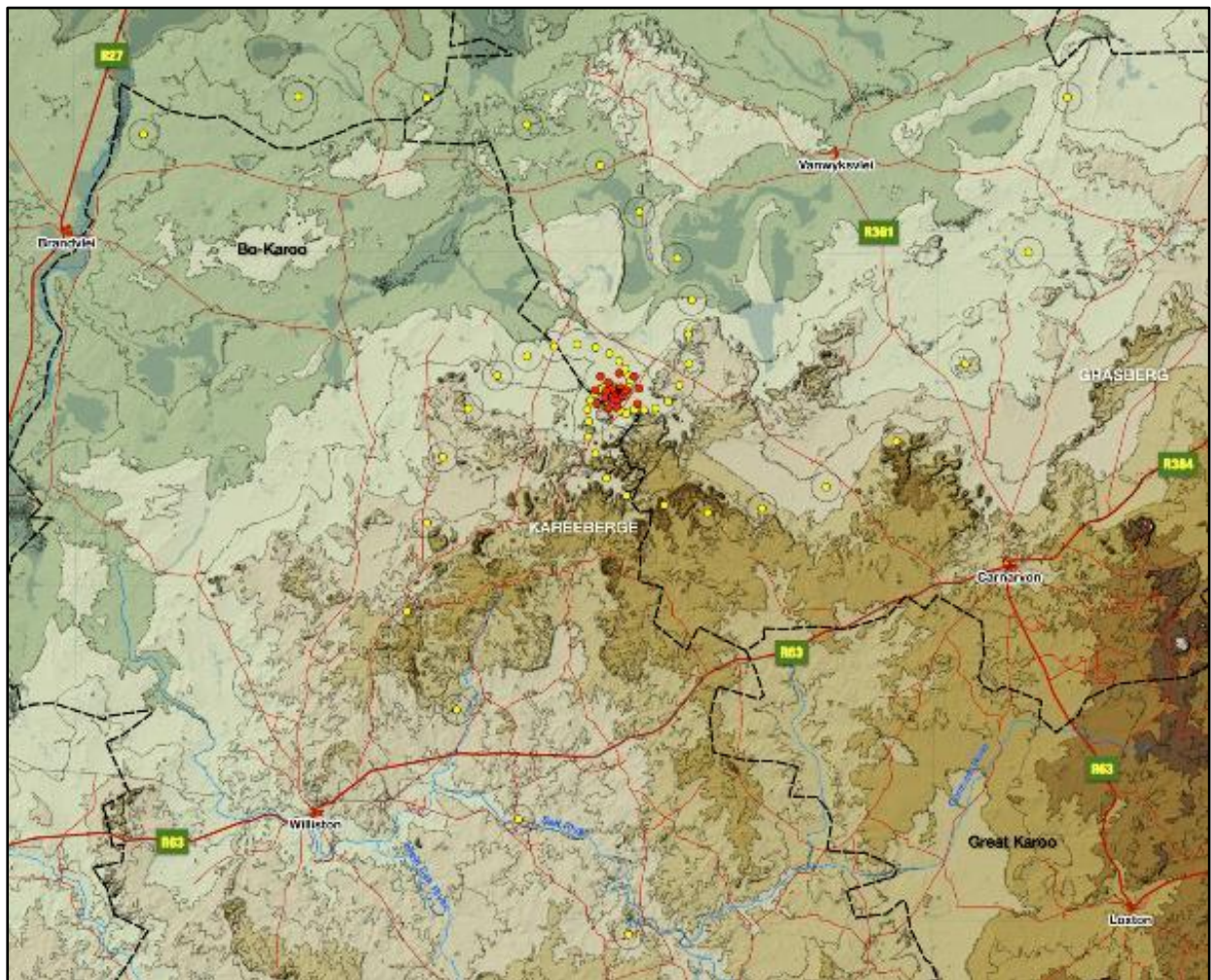


Figure 3. Physiography of the study area indicating high elevations in brown and low-lying areas in green. Proposed layout of proposed SKA dish antennae (yellow dots) and MeerkAT (red dots) See Appendix E.

Section 4. Assessment methodology

4.1 Heritage Screener

The Heritage Screener is designed to provide a high level, but detailed, assessment of the available information on heritage resources within a proposed development area. The intention of the Heritage Screener is to provide sufficient contextual information to enable developers and heritage authorities to make informed decisions regarding the nature of any additional heritage studies that may be required at a later phase of the project.

Extraction and mapping of sites

The Heritage Screener for this project involved a desktop study and data extraction which took place in November 2015. The main source of data relates to Heritage Impact Assessments (HIAs) and sites recorded on the South African Heritage Resources Information System (SAHRIS). SAHRIS was set up by the South African Heritage Resources Agency (SAHRA) in 2012 to act as the National Inventory required under s. 39 of the NHRA. All HIAs previously undertaken within KCAAA1 were considered and all heritage resources identified within these reports were extracted into SAHRIS and accurately mapped. SAHRIS currently includes records of:

- Sites identified during research surveys
- All permit applications submitted to SAHRA after 2003. Details and documents for these applications have been captured by the Archaeology, Palaeontology and Meteorites Unit at SAHRA. Older permit applications have been digitised and uploaded to SAHRIS but have not yet been extracted into the relevant content types.
- All heritage cases and heritage reports (including HIAs) submitted to SAHRA from 1990 to the present, to Heritage Western Cape from 2004 to 2009, to Amafa/Heritage KwaZulu-Natal from 2012 to the present and most cases for the Eastern Cape Provincial Heritage Resources Authority from 2011 to the present.

A meeting was also held with Dr Janette Deacon in Stellenbosch to identify additional sources of information which are currently not available on SAHRIS. Dr Deacon is an expert on rock engravings, heritage management and Stone Age archaeology with vast experience of sites in the Northern Cape. Dr David Morris, an archaeologist based at the McGregor Museum in Kimberley, was also contacted about his knowledge of possible sites located within the study area. All the sites mentioned by Dr Deacon and Dr Morris, as well as sites recorded in the HIAs on SAHRIS were digitally extracted, plotted and checked using SAHRIS and our GIS tools. In addition, the South African San Council was contacted and provided with 30 days to comment regarding heritage however no comments were lodged during this time (or subsequently).

Natural features likely to contain archaeological sites were also included in the Heritage Screener. Karoo dolerite outcrops, typically containing rock engravings in this area, rivers and wetlands, which often form focal points where Stone Age material and historical settlements are encountered, were considered high priority areas. The possible direct impact footprint was defined by a 200m radius

around the center of each proposed SKA station, which was based on the 100 x 100m surface area of the stations and the potential for the centre to move up to 120m in any direction. If this footprint is not underlain by Karoo dolerite and/or is not within 100m of any water feature (i.e. rivers and wetlands), it has been considered as having low priority. Any footprints that were identified as being likely to impact on heritage resources due to their proximity to geographical features such as dolerite outcrops, kloofs or rivers, have been moved.

A brief regional assessment of palaeontological heritage within the core and three spiral arms of the area proposed for the SKA Phase 1 project (further called SKA Phase 1 study area) was conducted, based on

- Google earth satellite images;
- 1: 250 000 geological map sheets 3020 Sakrivier, 3022 Britstown, 3120 Williston and 3122 Victoria West;
- Key palaeontological literature;
- The author's (Almond 2016) palaeontological database (See also review of Northern Cape fossil heritage by Almond & Pether 2008);
- Previous palaeontological impact assessments (PIAs) in the broader region (SAHRIS, John Almond, personal database);

Survey Coverage

Each HIA and permit report was assessed in terms of survey coverage and classified into one of three levels of coverage, namely low, medium or high. The palaeontological component of these HIAs have been separated from the rest of the heritage studies as they are related to the fossil sensitivity of the geological formations.

The coverage for HIAs, excluding PIAs, was divided as follows:

Low coverage (**red**) refers to:

- Desktop studies where no field assessment of the area was undertaken.
- Reports where the sites are listed and described but no GPS coordinates were provided.
- Reports from the 1990s/early 2000s, with GPS coordinates with low accuracy ratings.
- Reports where the entire property was mapped, but only a small/limited area was surveyed (less than 20%).
- Reports which are not properly mapped.

Medium coverage (**orange**) refers to:

- Reports for which a field survey was undertaken but the area was not extensively covered. This may apply to instances where some impediments did not allow for full coverage, such as thick vegetation.
- Reports for which the entire property was mapped, but only a specific area was surveyed thoroughly. This is differentiated from low ratings listed above when these surveys cover between 20% and 50% of the property.

High coverage (**green**) refers to:

- Reports where the area highlighted in the map was extensively surveyed as shown by the GPS track coordinates and/or site distribution.
- Permit reports and specific assessments (e.g. of one building or archaeological site).
- Instances where the area is highly disturbed and no HIA would be necessary.

PIAs were assigned a coverage based on the outcome of the study already undertaken:

Low coverage (**red**) refers to:

- At the end of a desktop or scoping study the palaeontologist recommended that a full assessment PIA be done, inclusive of a field survey.

Medium coverage (**orange**) refers to:

- The palaeontologist recommended that a Palaeo Chance Finds procedure be included in the Environmental Management Plan (EMP).

High coverage (**green**) refers to:

- The area has been fully assessed in a field-based PIA and no further palaeontological studies are required, but monitoring and/or mitigation may be requested (this will be listed in the specific recommendations for each polygon).

Grading of Heritage Resources

Many of the sites uploaded to SAHRIS, particularly those found during research surveys, do not yet have formal or provisional gradings (field ratings). This is because they have either been sourced from research surveys or simply have not had any provisional grades suggested as part of the impact assessments. Grading of sites is necessary for heritage management as it informs the conservation of generally protected sites and it is a legal requirement for the formal protection of sites.

Grading can only be approved by heritage resources authorities, although it is requested that practitioners provide suggested gradings (or field ratings) in HIA reports. Where available, the grading level recommended by the relevant heritage practitioner was captured on SAHRIS. For ungraded sites, the site type was used to assign a provisional grading level. Structures are perhaps the most problematic in this regard because of the great variation in preservation of buildings, particularly in rural areas. The grading of heritage sites which form part of the National Estate is done according to s. 7 of the NHRA as follows:

- (a) **Grade I:** Heritage resources with qualities so exceptional that they are of special national significance;
- (b) **Grade II:** Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and
- (c) **Grade III:** Other heritage resources worthy of conservation.

SAHRA is the national authority and manages Grade I sites; Provincial Heritage Resources Authorities (PHRAs) manage Grade II sites. The NHRA also makes provision for the devolution of powers to

manage Grade III sites down to local municipal level but only one municipality, the City of Cape Town Metropolitan Municipality, has thus far obtained limited powers to manage Grade III heritage resources from Heritage Western Cape. In the Northern Cape, SAHRA has not devolved the management of archaeology and palaeontology to provincial level. Only Grade II and Grade III built environment sites are managed by the PHRA, Ngwao Boswa Kapa Bokoni (NBKB) while SAHRA manages applications in terms of sections 35, 36 and 38 of the NHRA.

Examples of Grade I (National Heritage Sites) include the Mapungubwe Cultural Landscape and Lake Fundudzi in Limpopo, the Sarah Baartman Burial Site and Robert Sobukwe's grave in the Eastern Cape, the Union Buildings and Voortrekker Monument in Pretoria and the Houses of Parliament in Cape Town.

Grade II sites can be declared as Provincial Heritage Sites under s. 27 of the NHRA after the competent PHRA has established their significance. Many of the current Provincial Heritage Sites were declared as National Monuments under the National Monuments Act, No 28 of 1969. These sites automatically became Provincial Heritage Sites when the NHRA came into effect in 1999. A total of about 3630 sites around the country have been declared as Provincial Heritage Sites (PHSs). Most of these are built environment sites such as the Castle of Good Hope in Cape Town and hundreds of Cape Dutch homesteads in the Cape Winelands. Some other examples include Mapoch's Caves in Limpopo, Umhlatuzana Rock Shelter in KwaZulu-Natal, Canteen Kopje in the Northern Cape and Baboon Point/Cape Deseada near Eland's Bay in the Western Cape.

For this report it was decided to use the Heritage Western Cape Short Guide to and Policy Statement on Grading issued in 2012. This policy partly reflects SAHRA's Minimum Standards for Archaeological and Palaeontological Impact Assessments (2007) which divides sites at local level (Grade III) into high, medium and low significance.¹

Grade IIIa sites are of such high local significance that they should be protected and retained. There are thousands of examples of Grade IIIa buildings across the country and these sites should be included in the heritage register of each municipality according to s. 30 of the NHRA. Any alterations must be regulated through a permit process with the relevant heritage authority. Human remains are treated with high significance and graves generally fall within this category. While relocation of graves takes place from time to time, relocation should always be considered as the last resort. Rock art sites, caves with archaeological deposits and fossil localities are commonly ascribed a Grade IIIa rating.

For conservation and management purposes, a buffer zone of 150m is proposed around rock art sites and 60m around burial grounds and graves and monuments and memorials.

Grade IIIb sites are heritage resources rated to have medium local significance. They should preferably be retained where possible, but, where developments cannot be realigned or moved, mitigation is normally appropriate. Archaeological and palaeontological sites falling

¹ The new Heritage Western Cape Policy was issued in March 2016. However, since the heritage of the Northern Cape is not regulated by the same policy we have set the grading categories according to SAHRA's requirements.

into this category include sites which cannot be sufficiently recorded or understood during a Phase 1 survey alone or which require dating, excavation and/or other techniques to analyse the sites. Grade IIIb buildings have some significance and add certain heritage qualities to their immediate area.

For conservation and management purposes, a buffer zone of 50m is proposed around Grade IIIb sites, unless they are rock art sites which have a proposed buffer set to 150m.

Grade IIIc sites are of low local significance. These resources must be recorded satisfactorily before destruction is allowed. In many instances the recording and description of the site undertaken during a HIA is sufficient and further recording or mitigation is not normally required. These sites include stone artefact scatters such as small stone knapping sites, and fossils of low significance which do not require recovery. In the case of the built environment, Grade IIIc structures can normally be demolished under a permit from the relevant heritage authority.

For conservation and management purposes, a buffer zone of 30m is proposed around all Grade IIIc sites unless they are rock art sites which have a proposed buffer set to 150m.

In instances where no official or field grading existed, the proposed preliminary grading was assigned according to the type of site:

- Burial Grounds and Graves: Grade IIIa
- Rock Art: Grade IIIa
- Monuments and Memorials: Grade IIIb
- Settlements: Grade IIIa
- Archaeological deposit: Grade IIIb
- Palaeontological: Grade IIIb
- Structures: Grade IIIb
- Artefact scatters: Grade IIIc

The significance of these sites may at times be under or over rated, although the number of these cases is expected to be minimal.

4.2 Visual baseline and interpretation

Landscape Description

The baseline of the landscape can be defined as the combination of existing features, character, quality and extent of the landscape. The baseline study of the landscape involves the identification of landscape types and characteristics together with scenic significance. Given the large geographical scale of the project and the sparse vegetation, geomorphology tends to be a major factor in determining landscape character and scenic resources.

Landscape Sensitivity (landscape interpretation)

The sensitivity of a landscape is linked to the ability of a landscape to absorb changes induced by the proposed development without changes to its characteristics and scenic significance.

The sensitivity of the landscape is determined through the interpretation of natural and scenic resources, which have aesthetic and economic value to the local community and the region. Resources include features of topographic, geological or cultural interest, which contribute to the area's overall 'sense of place'. Protected landscapes and heritage sites tend to increase the value and therefore the sensitivity of landscapes. Sensitivity is further determined by SKA dishes within settlements, as well as along arterial and scenic routes, and at tourist destinations, such as guest farms and resorts.

Landscape integrity

The integrity of the landscape is based on the concept that visual quality is dependent on the scenic or rural quality and intactness of the landscape, as well as absence of other visual intrusions.

Landscape impacts (or visual impact on the landscape)

The United Kingdom's guidelines for landscape and visual impact assessment (GLVIA, 2002) define "landscape impacts" as changes in the elements, characteristics, character and qualities of the landscape as the result of development (GLVIA, 2002). These effects can be positive or negative, and result from removal of existing landscape elements, addition of new elements, or the alteration of existing elements.

Visibility

Visibility is determined by distance between the proposed facilities and the viewer. Distance radii are used to quantify visibility of the proposed facilities. Based on fieldwork and the visual model of the dish antenna in Figure , possible degrees of visibility are listed below.

- High visibility: Prominent feature within the observer's viewframe 0 – 500 m
- Mod-high visibility: Relatively prominent within observer's viewframe 500 m – 1 km
- Moderate visibility: Noticeable within observer's viewframe 1 - 2.5 km
- Marginal visibility: Visible within the broader landscape 2.5 – 5 km

Visual exposure

Visual exposure refers to the relative visibility of a project or feature in the landscape (Oberholzer, 2005). Exposure and visual impact tend to diminish exponentially with distance. The exposure is classified as follows:

- High exposure: dominant or clearly noticeable
- Moderate exposure: recognisable to the viewer
- Low exposure: not particularly noticeable to the viewer

Visual exposure is determined by the viewshed, being the geographic area within which the project would be visible, the boundary tending to follow ridgelines in the landscape.

Visual intrusion

Visual intrusion indicates the level of compatibility of the proposed project with the characteristics of the landscape. This is related to the regional setting and integrity of the landscape (Oberholzer, 2005). It can be ranked as follows:

- High – results in a noticeable change or is discordant with the surroundings;
- Moderate – partially fits into the surroundings, but is clearly noticeable;
- Low – minimal change or blends in well with the surroundings.

Visual absorption capacity

The visual absorption capacity of the landscape is the potential of the landscape to screen the proposed project. It depends on the topography and type of vegetation that naturally occurs in the landscape, as well as on the type of the development also plays a role.

Viewer sensitivity

GLVIA (2002) defines “viewer sensitivity” as the assessment of the receptivity of viewer groups to the visible landscape elements and visual character and their perception of visual quality and value. The sensitivity of viewer groups depends on their activity and awareness within the affected landscape, their preferences, preconceptions and their opinions.

Sense of place

Sense of place is defined by (Oberholzer, 2005) as: 'The unique quality or character of a place... [It] relates to uniqueness, distinctiveness or strong identity.' It describes the distinct quality of an area that makes it memorable to the observer. Figure 10.17 shows localities of sites visited during the photographic survey.

4.3 Fieldwork

Heritage investigation

Each spiral arm and the core were mapped along with the proposed access roads to the survey team's GPS devices. Previously recorded heritage sites were also included to guide the fieldwork. The CSIR was responsible for engaging with landowners regarding access, however once in the field, CTS had limited success in accessing private property.

The field survey was conducted by vehicle and on foot by a team of 3 archaeologists and 1 palaeontologist, from the 8th - 12th March 2016 (see Figure 4 for track paths followed). Given the large lateral area covered by the SKA Phase 1, much time was spent driving along existing access roads. Buildings visible from the road were recorded as the team moved from area to area before setting out on foot on properties where permission had been granted by the landowners.

The fieldwork surveys were conducted through a combination of vehicle and foot survey. Where possible, the footprints of proposed SKA satellite stations were surveyed on foot to identify possible

heritage resources. Foot surveys were also extended to historical farmsteads and their associated infrastructure, as well as potentially sensitive areas such as water courses, dolerite boulders and outcrops for rock engravings, valleys/kloofs and hills/koppies. The archaeological team spent a total of 3.5 days in the field and the palaeontologist managed to complete a 5-day field assessment.

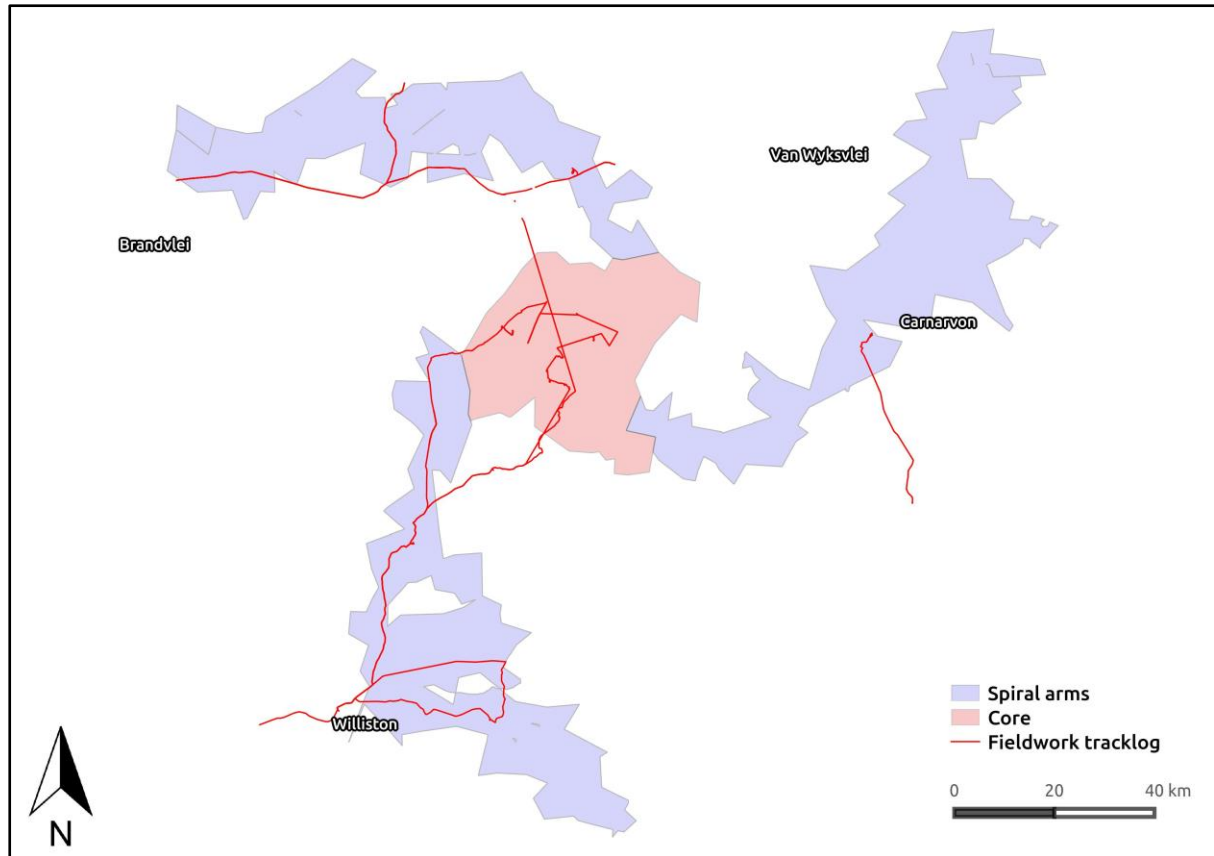


Figure 4. Track logs of Heritage Field Assessment in relation to the SKA Phase 1 Footprint

The palaeontological survey was conducted independently from the archaeological survey. The reconnaissance-level palaeontological field assessment focused mainly on readily-accessible exposures of bedrock and superficial sediments along major and minor public roads within the SKA Phase 1 region. This assessment is therefore not based directly on the impact area of the proposed SKA stations themselves but rather on the relevant geological formations that are found in the area.

The palaeontological survey aimed to visit examples of the various geological formations present in the study area. These observations provided insights about areas where there were no readily accessible exposures and the findings were extrapolated to enable a determination of the significance of the formations occurring across the study area. Specific sites were not plotted as these carry no meaning in this context where entire geological formations should be seen as having the same significance throughout.

Heritage resources were plotted in the field using Garmin Etrex GPS devices and photographed using digital cameras. Site recording forms were digitally completed in the SAHRIS Site Recording App for Android devices. Sites located during the March 2016 field survey were given the prefix HER-SKA [number] and can thus be differentiated from previously recorded sites in the lists provided. Where

heritage resources could be seen from the road (e.g. historical farmsteads, kraals), but permission to access the property had not yet been granted, these sites were accurately positioned using satellite imagery after the fieldwork.

All photographs and site records were uploaded to SAHRIS and checked to ensure they were correctly mapped and labeled. Layers showing the GPS track logs, sites and observations were manipulated using QGIS in order to produce high resolution maps of the study area, the development proposal and the various heritage sensitivity layers.

Constraints regarding authorisation from landowners to access their properties (156 farms could not be accessed), limited budget and time, and the large area required for the placement of the SKA stations resulted in the fieldwork obtaining only a sense of the heritage resources expected in the study area rather than achieving a comprehensive survey of sites that will be affected by the proposed development. This high level assessment of impacts to heritage resources will be supplemented by a more detailed site specific HIA process that satisfies the requirements of SAHRA in terms of section 38(3) at a later stage.

Visual investigation

The location and context of the study area are indicated in Figure . A site visit was carried out on the 10th and 11th March 2016, during which time a brief meeting was held with Dawie Fourie at the SKA offices on Meysdam Farm. The route of the field trip is indicated in Figure 6. Several public gravel roads were travelled to get an idea of the terrain in which the proposed dish antennae would be located within the various spirals. Photographs were also taken from key viewpoints representing potential receptors. The late summer season of the site visit did not have a bearing on the visual assessment.

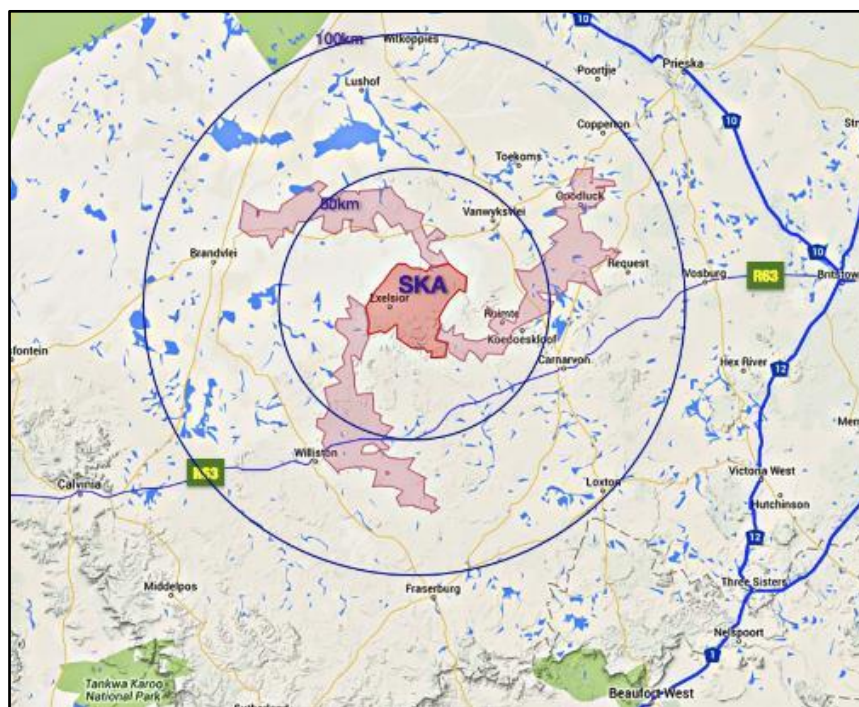


Figure 5. Location of SKA site in relation to towns, routes, Tankwa Karoo National Park and Karoo National Park (See Appendix E)

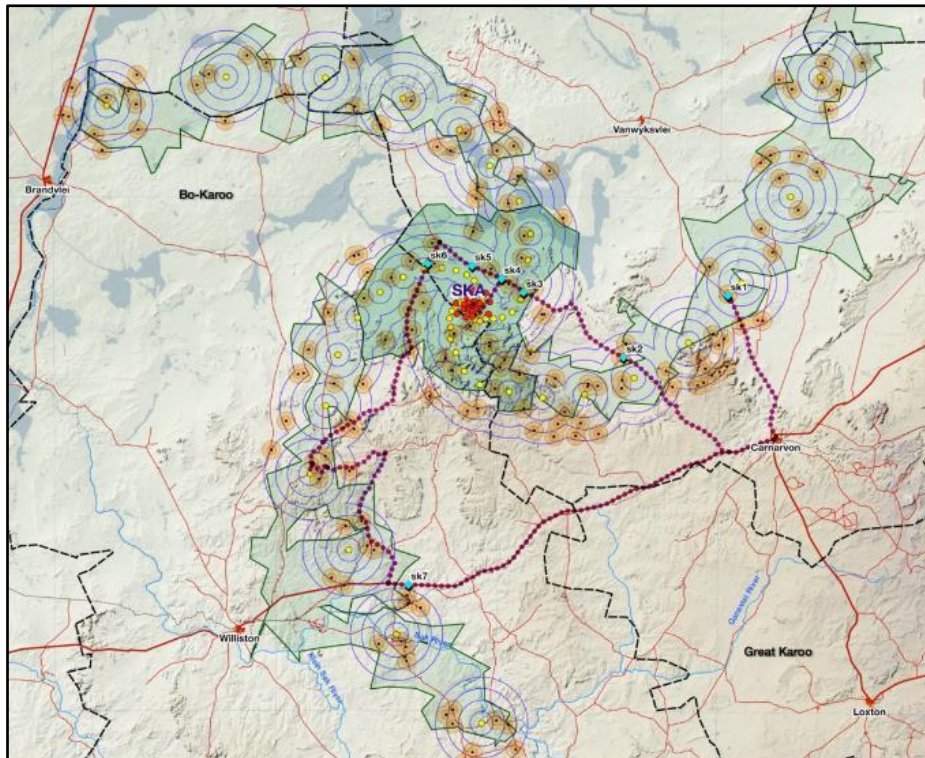


Figure 6. Proposed layout of proposed SKA dish antennae (yellow dots), MeerKAT (red dots) and the route of the field trip (purple dotted line). Farmsteads are indicated as black dots within orange circle. (See Appendix E)

Exploratory Fieldwork Assessment

The exploratory fieldwork assessment takes into consideration:

1. **Nature of impact:** direct impacts are caused directly by the activity and generally occur at the same time and at the place of the activity; indirect impacts occur as a result of the activity but may not manifest when the activity is undertaken or may occur at a different place; and cumulative impacts result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
2. **Status of the impact:** positive (overall benefits from impact, if any), negative (overall adversely affected), or neutral (overall not affected).
3. **Potential Intensity:** fatal flaw (irreversible human health damage (mortality); loss of species (fauna and/or flora)); high (severe alteration of natural systems, patterns or processes such that they temporarily or permanently cease, severe impact on livelihood and/or quality of life); medium (notable alteration of natural systems, patterns or processes; where the environment continues to function but in a modified manner); or low (negligible or no alteration of environmental functions, natural systems, patterns or processes). The concept of “potential intensity” is an acknowledgement at the outset of the potential significance of the impact. In this case, even a limited extent or duration will still be significant and the risk can only be reduced by reducing the likelihood of the impact occurring). The concept of “irreplaceable loss of a resource” is taken into account in the Potential Intensity of an impact.
4. **Spatial Extent:** the impact footprint, i.e. whether the impact will be local and limited to the immediate area of development, or whether the impact may be realised regionally, nationally or even internationally.

5. **Duration:** the lifetime (timeframe) during which the impact will be experienced. The concept of “reversibility” is reflected in the duration i.e. the longer the impact endures the less likely it will be reversible.
6. **Reversibility:** highly reversible (most favourable assessment); moderate reversibility; low reversibility; or irreversible (least favourable assessment as the impact is permanent.)
7. **Irreplaceability of resource loss caused by impacts:** high irreplaceability of resources (project will destroy unique resources that cannot be replaced); moderate irreplaceability of resources; low irreplaceability of resources; or resources are replaceable (the affected resource is easy to replace/rehabilitate).
8. **Probability:** likelihood of the impact occurring (and not the likelihood of the aspect to happen).
9. **Degree of confidence in predictions:** high, medium or low based on the availability of information and specialist knowledge.
10. **Significance:** overall evaluation of the significance of the potential impact, taking into consideration all above ratings and based on the following formula:

$$\text{Significance rating} = \text{Impact magnitude} * \text{Probability}$$

$$\text{Impact Magnitude} = \text{Potential Intensity} + \text{duration} + \text{extent}$$

4.4 Key project components to be assessed in a later phase

Heritage

Key features that need to be assessed for likely impact to archaeological resources during the more detailed heritage impact assessment phase are the stations located close to water sources and the stations located close to dolerite boulders, as well as those within 5km of towns, declared or officially graded sites and scenic routes. See Section 7 for further Conclusions and Recommendations.

The movement of people out of the SKA core has a dual impact in heritage terms. On one hand, decreased public access to the area has a positive impact on the integrity and conservation of archaeological and palaeontological sites. On the other hand, it is often found that, once structures are no longer used, they become derelict and fall into disrepair. In this way, significant examples of the vernacular architecture of the Northern Cape could be lost. Proposed projects for the ongoing recording, monitoring and maintenance of heritage resources within the SKA area are described below.

- **Recording Projects**

- *Recording of archaeological sites, palaeontological localities, burial grounds and graves*

Protection of the SKA Core area provides an opportunity to extensively survey a large area in order to gain an understanding of how people in the past have used the land. Without the pressure of imminent human impact, archaeologists and palaeontologists can develop a complete and in-depth understanding of a large region of the Northern Cape, and how past communities used this landscape.

- *Recording of Indigenous Knowledge Systems and oral histories of communities in the SKA Core area*

Indigenous Knowledge Systems (IKS) are derived from local knowledge sources and are unique to a given culture or society. Indigenous Knowledge contrasts with the international knowledge system generated by universities, research institutions and private firms. Communities that have lived in this area of the Northern Cape for generations have their own IKS specific to the region. This IK must be recorded before it is lost.

- *Recording of vernacular architecture*

Much vernacular architecture exists within the SKA core area, from matjieshuise, to corbelled buildings, from farm werfs to farm worker housing. This myriad of architectural typologies forms part of the vernacular architecture of the Northern Cape. Each structure requires documentation and recording.

- **Monitoring Projects**

- *Regular monitoring of archaeological sites, palaeontological localities, burial grounds and graves*

Climate, and other impacting factors, can have an effect on the integrity of archaeological sites, palaeontological localities, burial grounds and graves. The regular monitoring of these resources will mean that any changes are identified, and impacts to the integrity of the sites can be managed.

- *Regular monitoring of vernacular architecture*

Once structures are no longer used, they become derelict and fall into disrepair. In this way, significant examples of the vernacular architecture of the Northern Cape could be lost. Regular monitoring of significant structures within the SKA Core area will allow for the conservation of these heritage resources.

- **Maintenance Projects**

- *Ongoing maintenance of vernacular architecture through skills development such as: mudbrick baking, thatching, building corbelled houses etc.*

The skills required to construct corbelled houses and maintain vernacular structures made of mudbrick and thatch are slowly being lost. These valuable skills can be developed and transferred to unskilled youth through a skills development program. This program can then work in tandem with the monitoring program for the vernacular structures described above to ensure the regular maintenance of these heritage resources.

Visual

The visually significant components of the SKA Phase 1 project that could have a visual effect on scenic resources or SKA dishes within the study area are listed in Table 2 below.

Based on the SKA Land Acquisition Programme (LAP), there will be no residents within the core area of the SKA Phase 1 project after December 2017 and thus no permanent viewers of high sensitivity within the core area will be affected by the proposed development. In the spiral arms of the SKA Phase 1, the identification of visual impacts and the severity of the visual impacts on the local visual receptors can only be determined once the specific location of the SKA dishes on the land parcels in the spiral

arms is finalized. The siting of individual SKA dishes on any farm will be determined by the location of the existing farm werf infrastructure ie. The dishes will be placed at a suitable distance from the residents of the farm so that impact is minimized.

Table 2. SKA Phase 1 components

Activity / facility	Footprint	Height	Visual implications and comments
Total project area	approximately 154 x 137 kilometers (km)	n/a	Core area and 3 spiral arms
Total number of dish antennae (Phase 1)	Meerkat: 64 SKA dishes SKA Phase 1: 133 dishes		MeerKAT: red on map SKA Phase 1: yellow on map
Dish antennae size	13.5 diameter	19.5 meters (m)	Platform 5 x 5 m Fenced area 100 x 100 m (1 ha)
Access roads	6 – 8 m wide	n/a	Gravel roads
33 kV powerline to construction camps, KAPB 22 kV powerlines to the 3 spiral arms and core area	9 m wide servitudes over private property	15 m	Underground cables in the core area. Steel pylons 5 to 30 km from core. Twin wooden poles 30 km outwards. Powerlines underground within 500 m of dish antenna.
Electrical substations and distribution kiosks	Type B mini substations ± 3 m ²	± 1.5 m	21 existing mini substations at MeerKAT
3 construction camps in the core area	Footprints not known		Bergsig, Swartfontein, Losberg and Meysdam farms

According to Oberholzer (2005), the visibility of the project is mainly based on the distance from the project to selected viewpoints. An indication of the scale of a typical SKA dish, seen at a range of viewing distances, is given in Figure below. This provides some idea of the visibility of the dish, which in turn informs visual sensitivity mapping. The visibility of internal access roads and powerlines would be less significant, but could add to the overall industrial-type visual effect in a rural landscape. In the case of the residents in the spiral arms, the SKA dishes would be highly visible if the infrastructure is dominant or clearly noticeable within the landscape (the SKA dish is located less than 1 km from the visual receptor); moderately visible if the infrastructure is recognisable to the viewer (for example if the SKA dish is located at a distance of 1 to 2 km from the visual receptor); and marginally visible if the infrastructure is not particularly noticeable to the viewer (the SKA dish is located further than 2 km from the viewer). The negotiations to be undertaken by the SKA LAP team with the owners of the land parcels in the spiral arms will further assist with the identification of receptors/viewers who will be affected by the SKA dishes, and their perception/sensitivity to visual impacts.

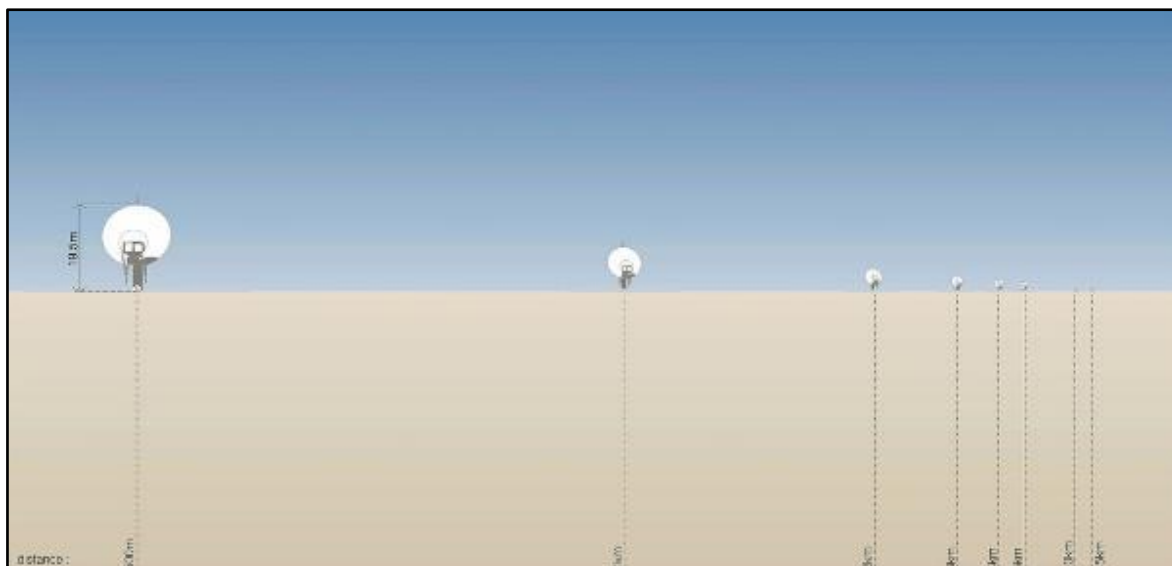


Figure 7. Visibility of dish antenna at a range of distances. The dishes would be only marginally visible beyond 5 km.

4.5 Data sources

A description of data sources on which the heritage and visual assessment were based, and from which sensitive features were extracted, is given in Table a and 2b below.

Table 3a. Data Sources for the heritage assessment

Data title	Source and date of publication	Data Description
Palaeosensitivity Map (PSM)	SAHRA & The Council for Geoscience, September 2013, accessed on SAHRIS	Significance of geological formations based on the CGS 1:250 000 geological formations of South Africa
Fossil Heritage Layer Browser	SAHRA, October 2014, accessed on SAHRIS	List of fossil heritage known from geological formations, as well as approximate age of the formations and their fossil sensitivity.
1:250 000 Geological Map Sheet 3120 - Williston	Department of Mineral and Energy Affairs, Geological Survey. Pretoria: 1989.	Geological map for the area surrounding Williston indicating the formations boundaries and the formations names - Dolerite areas were isolated and mapped against the position of SKA satellite stations
1:250 000 Geological Map Sheet 3020 - Sakrivier	Department of Mineral and Energy Affairs, Geological Survey. Pretoria: 1990.	Geological map for the area surrounding Sakrivier indicating the formations boundaries and the formations names - Dolerite areas were isolated and mapped against the position of SKA satellite stations
1:250 000 Geological Map Sheet 3022 - Britstown	Department of Mineral and Energy Affairs, Geological Survey. Pretoria: 1991.	Geological map for the area surrounding Britstown indicating the formations boundaries and the formations names - Dolerite areas were isolated and mapped against the position of SKA satellite stations
1: 250 000 geological map sheets. 3122 Victoria West	Department of Mineral and Energy Affairs, Geological Survey. Pretoria: 1991.	Geological map for the area surrounding Victoria West indicating the formations boundaries and the formations names - Dolerite areas were isolated and mapped against the position of SKA satellite stations
1:50 000 topographical map - digital version	Chief Directorate: Surveys and Mapping. Cape Town: 2003.	Scale maps providing full coverage of KCAAA1 area. The maps include the location of natural and anthropogenic features and depicts the elevation.
South African Heritage Resources Information System (SAHRIS)	SAHRA, 2012-present	Heritage Impact Assessments and site recordings. Single references of each report will be provided in a separate reference list in Appendix

Google Earth	Google Earth 7.1.5. 2015	Satellite photographs for identification of farmsteads and of areas with good exposures of potentially fossiliferous bedrock.
Natura Viva cc inhouse Palaeontology database	Dr. John Almond, Natura Viva cc, Cape Town. 2016	Extensive resource comprising numerous PIAs (many not available on SAHRIS), tabulations of fossil data associated with sedimentary formations in South Africa, unpublished reports (field excursions, research reports), library of scientific literature.
Rivers FEPAs	SANBI BGIS 2011	Rivers included in the SKA Phase 1 area mapped against the position of the SKA satellite stations
Wetlands FEPAs	SANBI BGIS 2011	Wetlands included in the SKA Phase 1 area mapped against the position of the SKA satellite stations
Wetlands Cluster FEPAs	SANBI BGIS 2011	Wetlands included in the SKA Phase 1 area mapped against the position of the SKA satellite stations
Guide to /Xam History and Rock Engravings at Springbokoog and the Strandberg.	Deacon, J. 2012.	Rock engraving sites identified at Springbokoog and the Strandberg and re-recorded or recorded by the South African Archaeological Western Cape Branch.
Master thesis of Rock Paintings of Williston	Hykkerud, M. J., Archaeology Master Thesis, University of Tromsø, 2006	The Rock Paintings of Williston

Table 3b. Data Sources for the visual assessment

Data title	Source and date of publication	Data Description
1:1 000 000 Geological Map of SA	Geological Survey, 1984.	Geological information, particularly dolerite landscape features.
1:500 000 topographical maps of South Africa	Surveys and Mapping (several sheets with various dates).	Topographical and cadastral information.
Water resources, land cover, vegetation types	South African National Biodiversity Institute (SANBI BGIS).	Shape files.
Topographic data set v3 (viewshed mapping)	NASA SRTM (Shuttle Radar Topographic Mission).	Topographic data with resolution of 30x30 m and vertical accuracy 10 m.

4.6 Assumptions and Limitations

Being strategic in nature and covering a large study area, the heritage and visual investigations make use of broad-scale baseline information, resulting in a number of assumptions and limitations listed in Table 4a and 4b below.

Table 4a. Heritage Assessment Assumptions and limitations

Limitation	Included in the scope of this study	Excluded in the scope of this study	Assumption
Unable to access certain properties as landowners failed to grant permission; locked gates.	Only 11 farms were visited. Public service roads and road reserves were surveyed.	A total of 156 farms could not be visited and only small areas of the visited farms were actually surveyed.	The authorisation needed from landowners to access their properties was not forthcoming in many cases, which heavily affected the survey's success. The very large area required for the placement of the SKA stations, particularly in the spiral arms, was also very challenging in this remote region of South Africa. The exploratory fieldwork only managed to obtain a sense of heritage resources expected in the study area rather than achieving a comprehensive survey of sites affected by the proposed development. Areas with similar topography and environment to those surveyed are likely to have similar types of heritage resources, thus extrapolations can be made to some extent.
Time availability	Due to the budget available, only 4 days were commissioned for the field assessment. One and a half were used for travel to the study area.	A complete survey of the area which would satisfy the requirement of a HIA.	Further field assessment will need to be conducted before the construction phase.
Large study area	A very small portion of the study area could be surveyed, given the short time allocated and the access issues encountered.	The majority of the study area was excluded from the field assessment.	Further field assessments will need to be conducted before the construction phase.
Data availability	Available HIAs and research data were used.	Field verification of all datasets and extensive local expert consultation were not undertaken. Data contained in most published and unpublished research papers were not extracted and the SARADA rock art database, which is not yet merged with SAHRIS, could not be used. Another key source of information is Pat Kramer's thesis on corbelled houses which has not yet been extracted.	Assessments undertaken by the heritage practitioners are correct and provide reliable accounts of what was identified on site during the limited field assessment.

Table 4b. Visual Assessment Assumptions and Limitations

Limitation	Included in the scope of this study	Excluded from the scope of this study	Assumption
Level of mapping detail	1: 500 000 topographical maps, and 1:1 000 000 geological survey maps.	1:50 000 topographical maps.	1:500 000 mapping was adequate for the large-scale study area.
Information on cultural landscapes		Separate study by Heritage Specialist.	Heritage assessment would be required in terms of the NHRA.
Information on game/guest farms and resorts.	No information.	Detailed survey of private reserves/game farms.	Assumed no private reserves or game farms affected.
Electrical sub-stations	Existing and proposed powerlines.		Only mini-substations and kiosks are required

Section 5. Heritage and Visual Sensitivity

5.1. Heritage Resources

Rock Art

Within the SKA Phase 1 study area, 26 rock engravings sites have been recorded, with many more sites likely to be encountered on the numerous dolerite outcrops (Figure). A rock art survey conducted within the current Williston spiral arm, as part of the fieldwork for a Masters dissertation by Martin Hykkerud in 2004, found 84 painted geometric tradition rock art sites made by Khoekhoe herders (Figure) (Hollad & Hykkerud, 2004; Hykkerud, 2006). Only 43 of the 84 sites were mapped as part of the Masters dissertation, of which all occur within the SKA Phase 1 zone, with the exception of one site.



Figure 8. Rock engraving of an ostrich on a dolerite boulder (Site HER-SKA025) on the farm Van Reenens Plaas 1491.

Built Environment

The SKA Phase 1 installation and its associated infrastructure will not impact directly on any of the core historical areas in Williston or Brandvlei. The other towns within the KCAAA1 area with historical core areas, such as Carnavon, fall outside of the SKA Phase 1 zone. The possible built environment impacts are therefore generally limited to buildings found in rural farmsteads, particularly corbelled buildings, and they are most likely to be indirect (contextual) rather than direct (physical) impacts. However, inappropriate renovation and adaptive reuse of historical structures can cause irreparable damage, while demolition of structures to clear the area would remove a significant historical layer from the landscape. Additionally, the exodus of local farmers may result in historically significant built environment resources falling in disrepair due to lack of maintenance.

At least eight corbelled houses are located within the SKA Phase 1 area (Figure 10). Although all of them have been assigned a Grade II significance, only three of them have been formally declared PHSs.



Figure 9. Reproduction of a rock art photograph from Hykkerud 2006: Geometric tradition finger-painted rock art from near Williston.



Figure 10. Corbelled house (Site HER-SKA024) on the farm Van Reenen's Plaas 1221, now abandoned.

Graves

Graves are mainly found in demarcated historical farmstead cemeteries (Figure 11) or informal graves associated with farm workers, former inhabitants of abandoned settlements or miners anonymously buried. Ten formal and informal graves have been identified in the SKA Phase 1 area, and more were recorded just outside of the study area. Cemeteries that are not formally fenced also occur and can belong either to labourers or to long-abandoned settlements. Most of the graveyards are currently not maintained and isolated precolonial graves are generally completely unmarked and cannot be identified at the surface.



Figure 11. An abandoned formal cemetery (Site HER-SKA030) at Grootfontein farmstead with several stone-built graves; probably made this way because of very shallow soil.

Archaeological Resources

The majority of the archaeological sites listed on SAHRIS in the study area are Early, Middle (HER-SKA002 and 054) and Later Stone Age artefact scatters recorded during previous HIAs. Most of these heritage resource sites, which include stone artefacts and cultural materials such as ostrich eggshells and pottery (WILLIS009), are often clustered around water features and dolerite outcrops. Some of these sites are directly related to rock engravings (HER-SKA013, 044). Most of them are of low archaeological significance but a few of the sites are of higher significance and will require mitigation if impacted. It is anticipated that stone artefact scatters are most likely to be impacted directly by SKA satellite installations.

Fifteen stations were earmarked during the heritage screener as having possible impacts on dolerite formations which may contain rock engravings while 13 stations are near wetlands and rivers that typically contain denser concentrations of Stone Age scatters. The stations in the SKA Phase 1 study area affected by Karoo dolerite are shown in Figure 12. The stations affected by rivers and wetlands are shown in Figure 13.

The various cultural heritage layers encountered within the SKA Phase 1 area start with occasional large Early Stone Age tools such as hand axes which date from at least 2 million years ago. Middle Stone Age sites dating between 300 000 and 30 000 years ago are usually found in deflated palaeosurface contexts or in relatively stratified deposits around the many pans characteristic of the area. Later Stone Age sites from the last 30 000 years are more common and stone tools made by San hunter-gatherers and Khoekhoen herders have been found relatively *in situ* on the Kalahari sands or in close association with the many rock engraving sites made at dolerite outcrops.

The study area is perhaps most infamous for the terminal period of the Later Stone Age when the colonial frontier was expanding across the region. The region between Kenhardt, Brandvlei and Vanwyksvlei was home to the group of /Xam and a few of the San who survived systematic persecution by European settlers at the Cape in the late 19th century were incarcerated at the Breakwater Prison in Cape Town. An ethnography of their language and culture was recorded by Wilhelm Bleek and Lucy Lloyd in the late 19th century, of which the volumes of text and drawings compiled during the work with their informants are frequently referenced in some of the many publications related to the interpretation of San rock art of southern Africa (Bleek & Lloyd, 1911; Lewis-Williams, 1981). These ethnographic records have significantly improved the understanding of San rock art. See Appendix C for the full Heritage Screener.

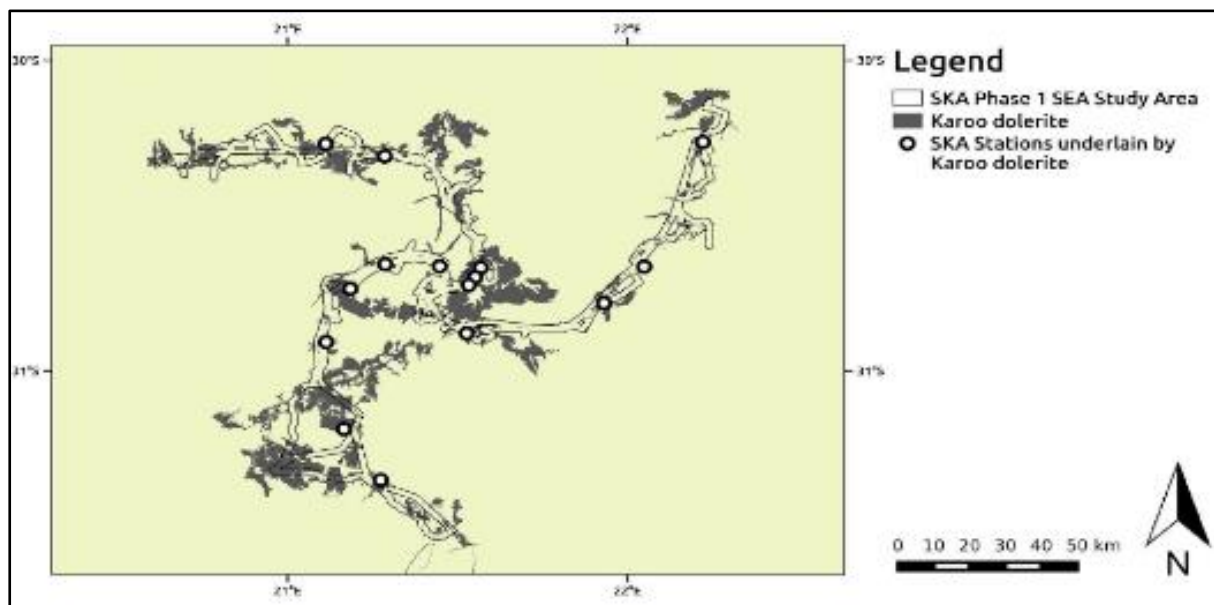


Figure 12. SKA Phase 1 SEA study area, with SKA stations affected by Karoo dolerite. Dolerite outcrops are sensitive for possible engraved rock art sites.

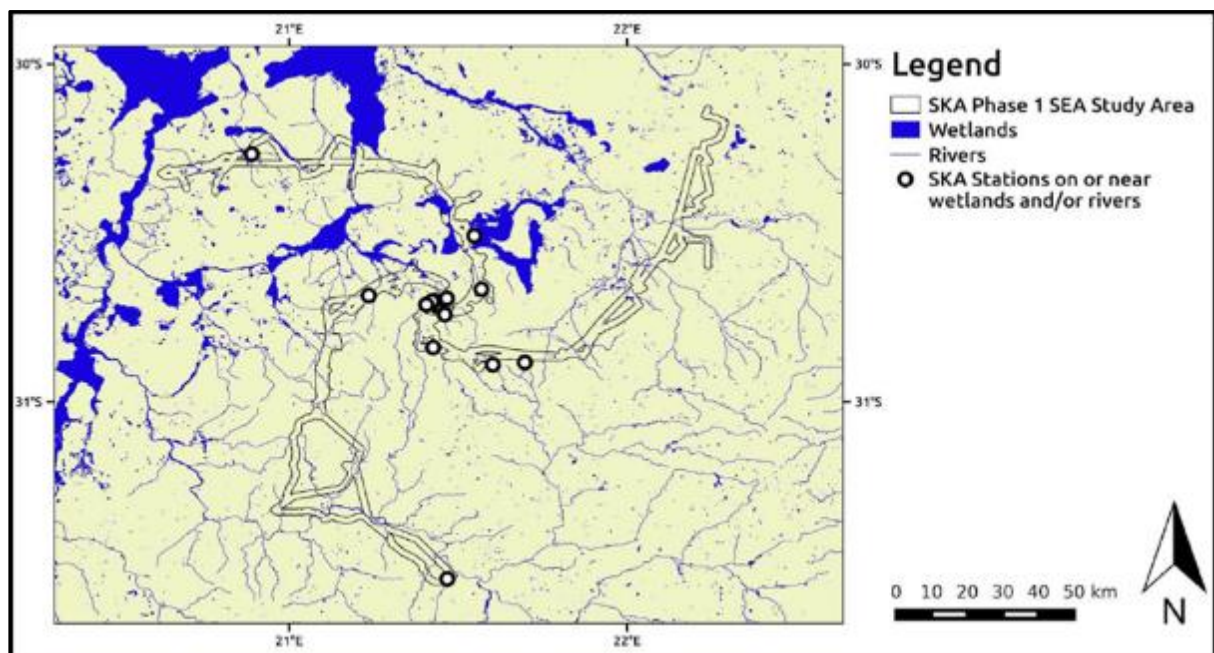


Figure 13. SKA Phase 1 SEA study area, with rivers, wetlands and affected SKA stations indicated.

Palaeontological Resources

Most of the SKA Phase 1 study area is underlain by arenites and shales (Figure 14) while some of the proposed development area is underlain by rocks of *very high* and *high* palaeontological sensitivity.

In terms of bedrock geology, the SKA project area is close to the north-western margin of the Main Karoo Basin of South Africa and is underlain by largely undeformed (flat-lying) sediments of the Karoo Supergroup of Early to Middle Permian age (Le Roux & Keyser 1988, Siebrits 1989, Viljoen 1989, Prinsloo 1989, Johnson et al. 2006).

The Karoo formations represented here include: (1) the Prince Albert, Whitehill, Tierberg and Waterford Formations which are assigned to the Eccu Group and were deposited within, or on the margins of, a very extensive inland sea or lake on southwestern Gondwana, and (2) sediments of the Abrahamskraal Formation of the Lower Beaufort Group (Adelaide Subgroup) that were deposited in rivers and shallow floodplain ponds or lakes. Preceding the final break-up of Gondwana the thick pile of Karoo Supergroup sediments was locally intruded and baked by hot doleritic magmas, now known as the Karoo Dolerite Suite, in the Early Jurassic Period. See Appendix D for the detailed Palaeontological Report.

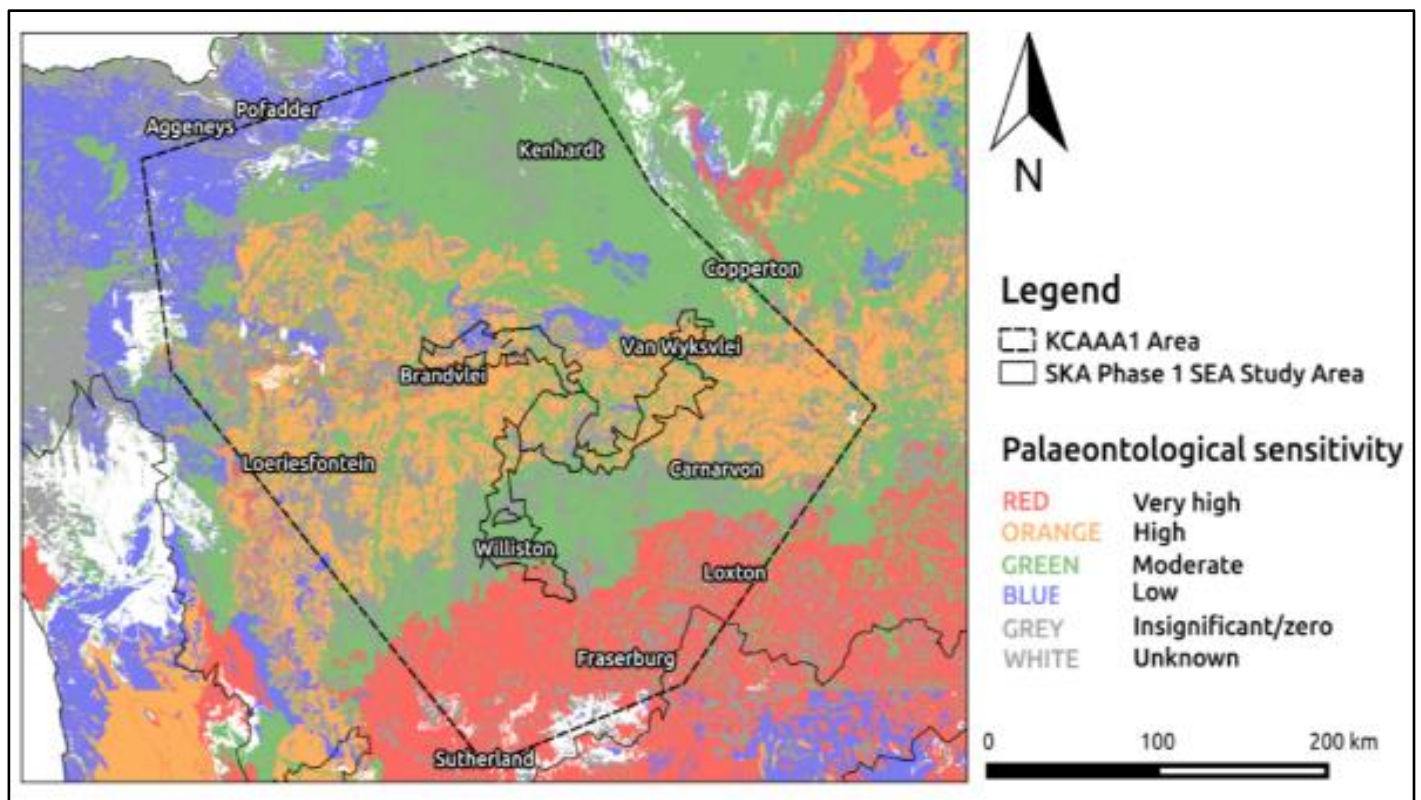


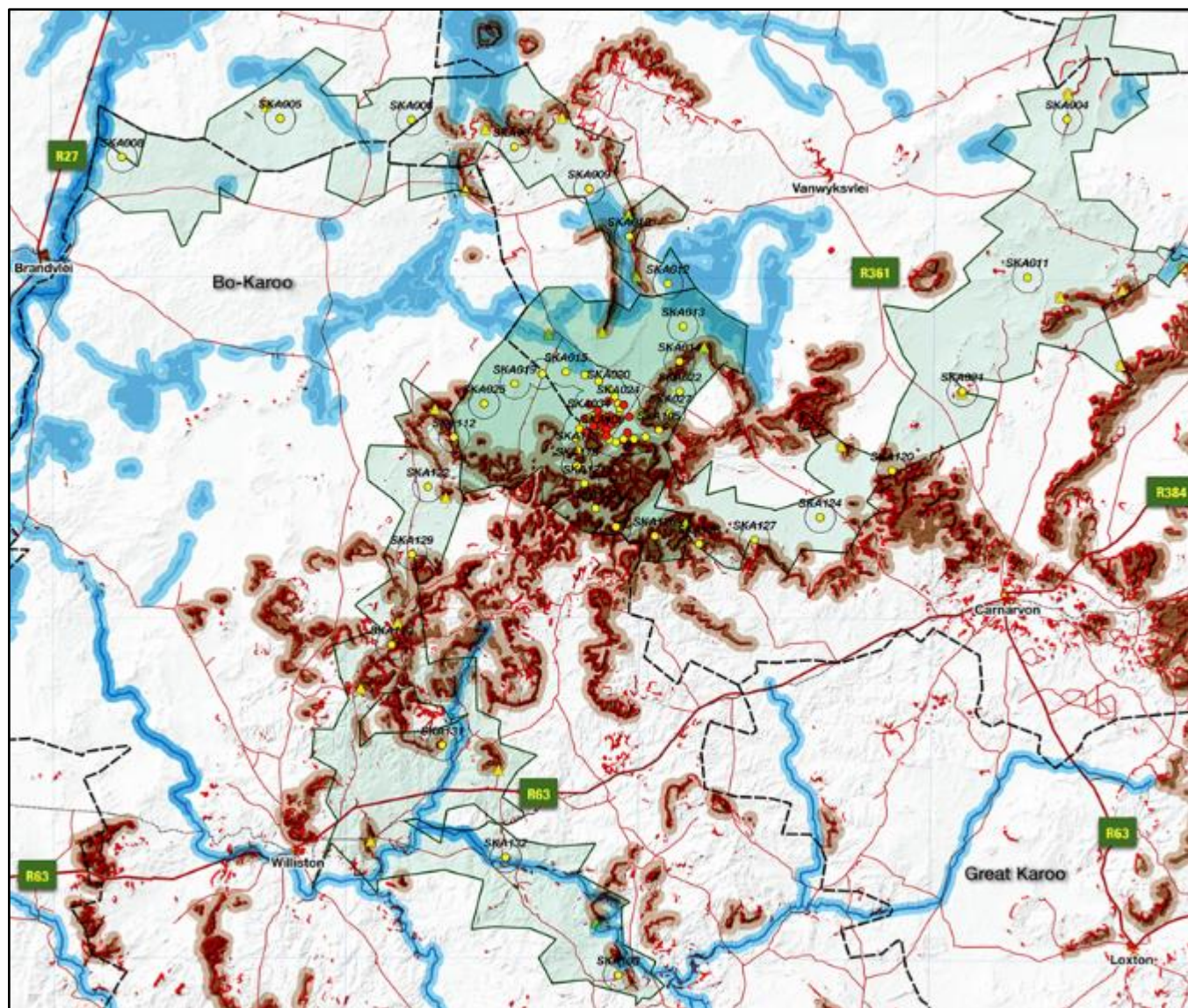
Figure 14. Palaeosensitivity map indicating very high sensitivity in the south, generally moderate sensitivity around the SKA Phase 1 study area and generally low to moderate sensitivity in the northern portion of the KCAAA1.

5.2. Visual resources

In order to determine visual sensitivity, potentially vulnerable *scenic resources* and *sensitive receptors* have been identified, as listed in Table below, together with notes on the factors that influence their visual significance. Scenic resources and sensitive receptors are indicated on Figure 15 and Figure 16, including recommended visual buffers. Some of the proposed dishes are within these buffer areas. (See Appendix E for more detailed maps, which are also available as shape files).

Table 5. Scenic resources and sensitive receptors.

Scenic Resource	Contributing Factors
Topographic features	Visual features that provide interest or contrast in the Karoo landscape such as mountain peaks, ridges, steep cliffs, and dolerite rock outcrops (visually sensitive skylines), within the study area.
River courses and pans	Water courses and pans, even when dry, provide interest in a generally featureless landscape.
Cultural landscapes	Cultivated land, often along rivers provide rural scenic value and may have historical or cultural significance. These include farmsteads and the corbelled houses. (See Heritage study).
Sensitive receptors	(includes residents, commuters, visitors and tourists)
Protected landscapes	There are no known protected landscapes within the study area. (These would be sensitive to visual intrusions).
Private reserves, game farms, resorts	No information available for the study area. (These would be sensitive to visual intrusions).
Human settlements	Includes towns, villages and farmsteads. Canarvon, Williston, Brandvlei and van Wyksvlei are too far away to be visually affected by the SKA. However a number of farmsteads would be visually affected.
Provincial and district roads	Arterial routes, which serve local and regional users for commuting, recreation and tourism, could be visually sensitive within their view corridors.
Scenic routes and passes	A number of small passes and <i>poorts</i> in the study area may have historical, recreational and tourism value.
Passenger rail lines	Serve both commuting and tourism functions and are sensitive to visual intrusions along view corridors. The rail line between Carnarvon and Williston does not appear to be in use.



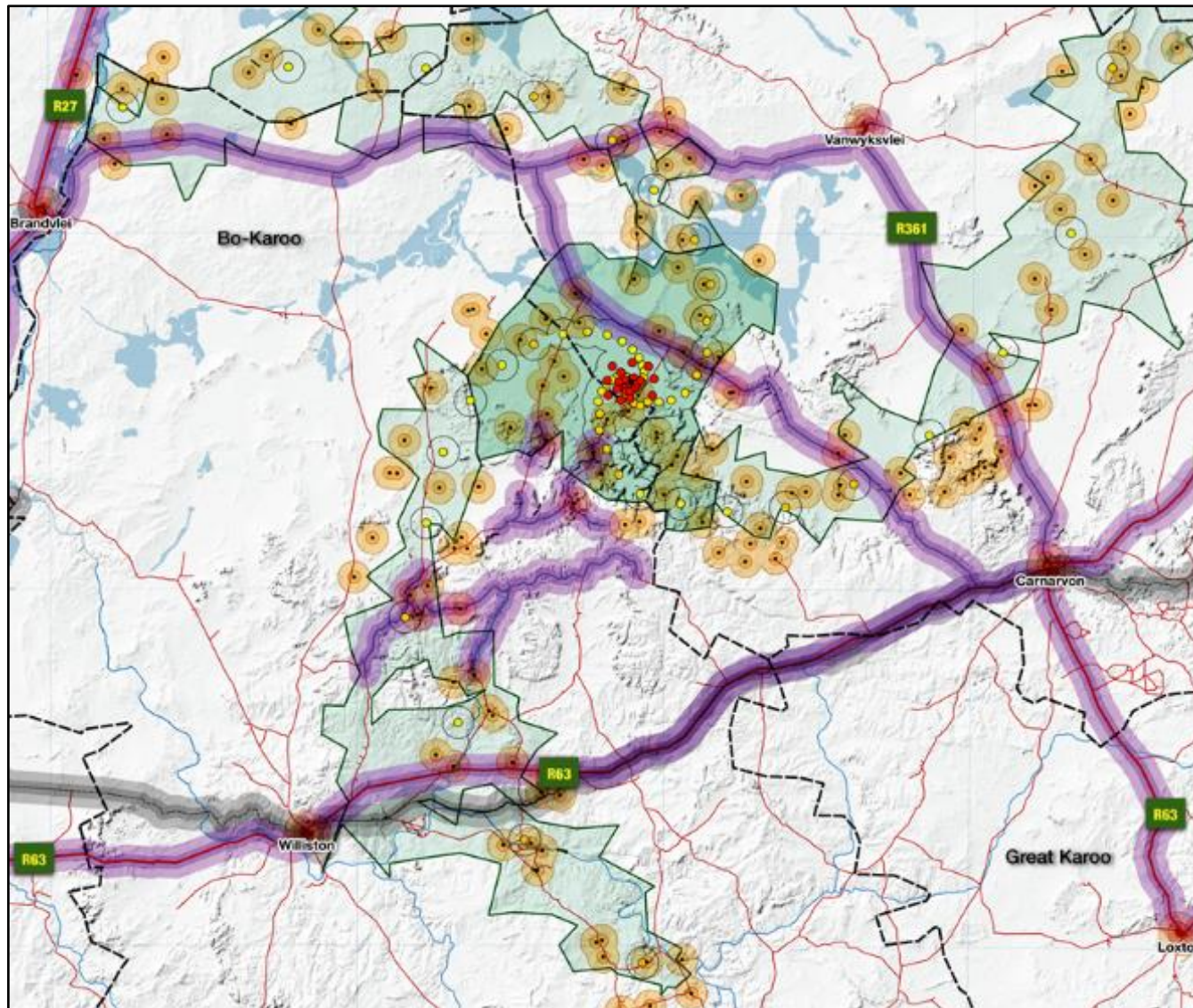


Figure 16. Sensitive receptors including routes (purple) and farmsteads (orange), with buffers. (See Appendix E)

5.3. Heritage Sensitivity

A total of 105 sites were identified within the SKA Phase 1 area from the heritage screener and field survey:

- Grade II sites: 6 (5.7%)
- Grade IIIa sites: 42 (40%)
- Grade IIIb sites: 20 (19.1%)
- Grade IIIc sites: 37 (35.2%)

It is expected that this number of sites will increase significantly once more thorough field assessments are conducted. Of these sites, 95% were deemed as having local significance (Grade III) with a relatively even split between sites of high local significance (~40%; mostly buildings) and medium or low local significance (~55%).

From the assessment of the potential heritage impacts of the proposed stations and infrastructure during the operational and the construction phases of the SKA project, it is expected that most of the impact will occur during the construction phase.

A detailed assessment of the potential impacts identified during the impact assessment based on the methodology described in section 4.3 is presented in Appendix A (Table -

Table) of this chapter for the construction and operational phases.

Three of the Grade II sites, which consist of corbelled buildings at Grootfontein, Arbeidsfontein and Stuurmansfontein, are declared PHSs (see tables in Appendix 10) and thus have the highest proclaimed significance in terms of the NHRA and should be considered as no-go areas (Table). No impacts on these sites are anticipated. The other Grade II sites are Hartogskloof, Groot Pardekloof and Abiquaputs mentioned in the Bleek & Lloyd texts (Deacon, 1986), which have been identified as having provincial significance (Grade II) but they have not been formally protected under s. 27 of the NHRA. They should, however, also be considered as no-go areas and a buffer of 1km is recommended around them.

Grade IIIa resources are of high local significance and should also be avoided as much as possible. Mitigation may only be considered as the least viable option. Burial grounds and graves may, at times, be relocated if impacts from construction cannot be rerouted, but because of the process entailed avoidance is strongly recommended. Grade IIIa sites include (with recommended buffer areas in metres):

- Burial grounds/graves/stone walling (60m)
- Rock paintings/engravings (150m)
- Historical (farm houses/ruins/ kraals) (150m)
- Stone Age (artefacts, deposit) (150m)
- Monuments/memorials (30m)

Buffer zones for sites with medium to low local significance have been applied as follows:

- Grade IIIb & IIIc rock art sites : 150m buffer setback
- Grade IIIb archaeological sites: 50m buffer setback
- All other Grade IIIc sites: 15m buffer setback

However, these buffer zones are not regarded as no-go areas and mitigation is acceptable. In certain circumstances, for example where an existing road runs within 150 m of a site, it would almost always be more desirable to continue using the existing road rather than constructing a new one.

The spatial extent of the impact was calculated considering the type and level of significance of the site. The impact on Grade II sites was considered as having an impact at regional level; impact on Grade IIIa sites of high local significance is expected have a local impact (< 5km from the site), whereas impact on Grade IIIb and IIIc sites is expected to have a site specific impact. Despite this, the loss of information for the scientific community may be felt at regional, national or even international level even if the significance of the site is at local level. This impact can, however, be mitigated by adhering to the mitigation measures and management actions stated in the environmental management plan which contribute to reducing the spatial extent of the impact.

The impact on palaeontological resources is normally considered positive if fossil material of significance is identified during construction and properly mitigated. The overall significance for the

formations identified within the SKA Phase 1 area has been given a rating of “not high” and the impact was deemed as neutral. In instances where the heritage resources are not expected to be impacted by the development, the nature of the impact was identified as neutral, except for the Abrahamskraal Formation which will require a field assessment if impacted upon. After mitigation (field survey and possibly Phase 2 for excavation and collection), the impact will be considered as low. This may change if the position of the proposed infrastructure is amended during the planning and construction phase and results in direct impacts on the heritage resources.

There is currently still a large degree of uncertainty about the final position of the ancillary infrastructure. Therefore medium confidence ratings were assigned when the impacts may occur on sites through the construction of such ancillary infrastructure, but since their position is not confirmed, the impact may not be certain. Until the final position of the proposed infrastructure is confirmed, it will not be possible to allocate a higher degree of confidence. High confidence ratings were assigned to impacts expected on sites in close proximity to the SKA stations as the positions of these installations are unlikely to move more than 100m. Indirect impact may occur on significant rock art engravings or paintings located near access roads. Increased traffic especially during the construction phase may cause additional dust which will affect the engravings/paintings and casual access by workers could result in the application of graffiti to the art panels.

Indirect impact during the operational phase is expected on farmsteads in the core area which may be expropriated for the establishment of the SKA Phase 1 stations. While it is expected that no direct impact will occur to them, the removal of their owners from the land will mean that a maintenance plan will need to be put in place by SKA to ensure that the structures and related infrastructure are not left to decay. Most of these farmsteads have been provisionally graded as Grade IIIa and therefore have high local significance (HER-SKA001, 030, 033, 040, 042, Williston006).

The distribution of the sites identified within the SKA Phase 1 area, through both the desktop work and the field survey, and the sensitivity of these heritage resources based on grading are shown below in -26. Detailed close-ups and maps can be found in the Heritage Screener report attached as Appendix C.

Tentative World Heritage List

According to the UNESCO World Heritage Tentative Listing;

“The area south of Upington was home to communities of the !Xam, a clan of the San (or Bushmen) who inhabited southwestern Africa for thousands of years until displaced by later settlement. Here some survivors became labourers on farms but their language and culture has disappeared. However, in the 1870's Dr Wilhelm Bleek and Miss Lucy Lloyd began recording the language, folktales and spiritual beliefs of a number of !Xam brought to prison in Cape Town. These individuals were amongst the last repositories of the language and belief system of the !Xam and Bleek and Lloyd's work links

many beliefs to known features in the landscape, providing a window of understanding into the blending of folklore and geography by the !Xam.

The information has enabled archaeologists to interpret the rich rock art legacy left by these and other San. The !Xam area in a unique way links the memory of a vanished people, their language and culture, spiritual connection to their environment and contribution to the meaning of Southern African rock art. It is a unique memorial to lost pre-colonial cultures in Africa. By comparison the area in the north of Upington is home to the \$Khomani who until recently were thought to have disappeared, in this instance due to their removal from ancestral lands in the mid-20th Century. In 1996 several elderly speakers of their language and carriers of the culture were identified. In 1999, activism by younger descendents led to restitution of land to the south of the Kgalagadi Trans-frontier Park, the original home of the community, and restoration of certain land use rights within the Park. Young members of the community have since worked with elders on cultural mapping of these lands and 'reconstruction' of a cultural landscape, not dissimilar to that of the !Xam. There is a strong revival of traditional practices and use of this landscape in a manner that enhances conservation thereof. The \$Khomani are the last surviving indigenous San community in South Africa and their living cultural landscape is an important aspect of national culture, one that contrasts well with the !Xam area to the south.

The two areas are the only San cultural landscapes that have enjoyed this level of attention and concerning which there is hence a fair depth of knowledge. Although covering extremely large areas the two components are in relative close proximity and are considered as a single nomination illustrating the heritage of a unique group of African cultures most of which have disappeared without record of the knowledge and practices they embodied."

Unfortunately, we were unable to locate a map identifying the exact boundaries of the area identified in the tentative listing for this proposed World Heritage Site.

Conclusion

Heritage resources, for the most part, are finite and irreplaceable. Impacts on heritage resources are therefore generally treated as negative, permanent and irreversible. However, mitigatory measures lessen the severity of the impacts. In the absence of development, the majority of the SKA Phase 1 area scored between low and medium potential impact/sensitivity (Figure 29).

Should the development of the SKA project be realised, none of the heritage resources identified within the SKA Phase 1 area are expected to be significantly impacted if the appropriate mitigation measures are implemented (Figure 29 to 31). All heritage resources have therefore scored between low and medium potential impact, with no highly significant potential impact being calculated.

However, it is important to note that the assessment completed was a high level assessment of likely impacts and was by no means exhaustive. It is also important to note that the high level assessment completed does not satisfy the requirements of section 38(3) of the NHRA. A more detailed site specific HIA is required for this project at a later stage.

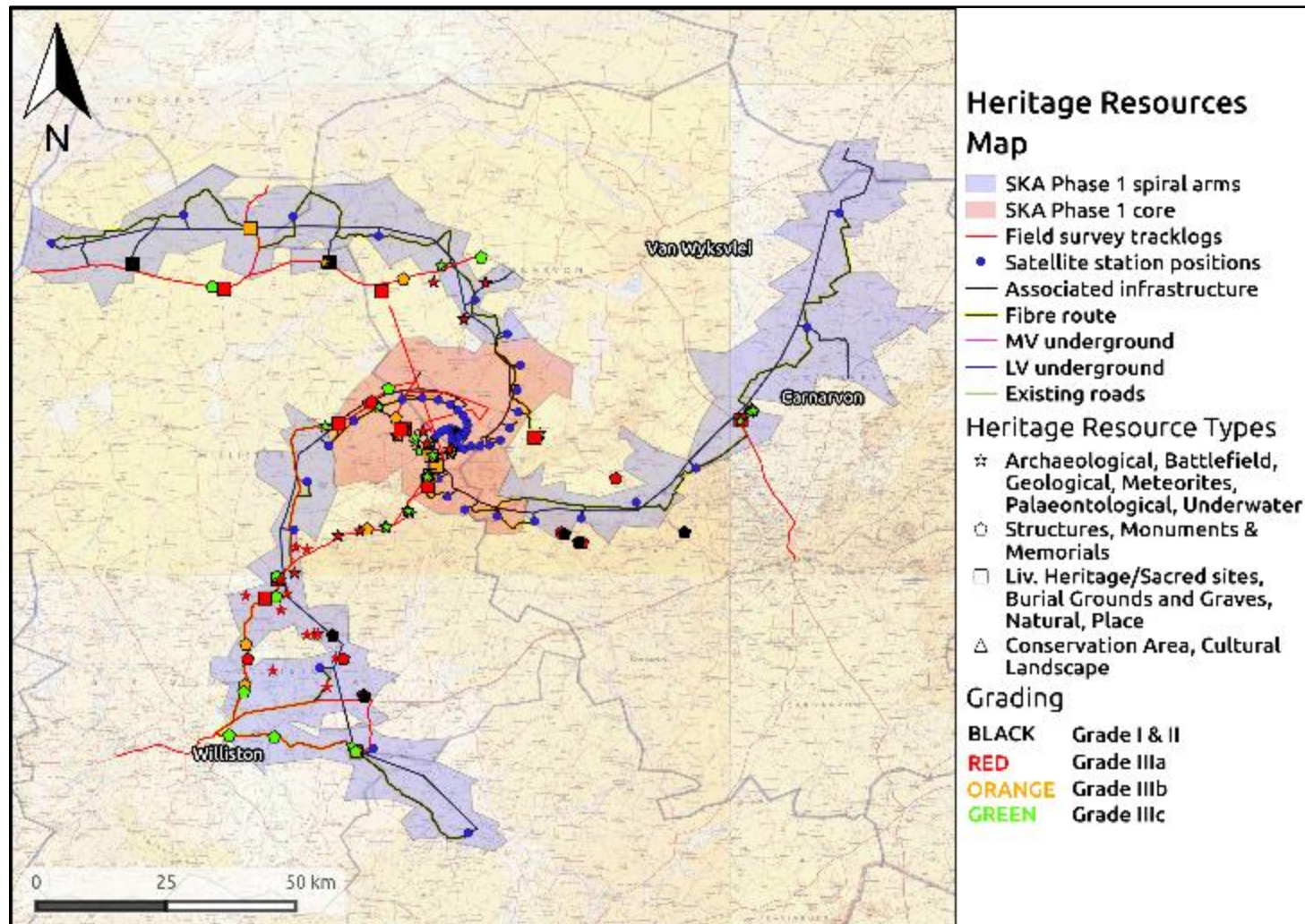
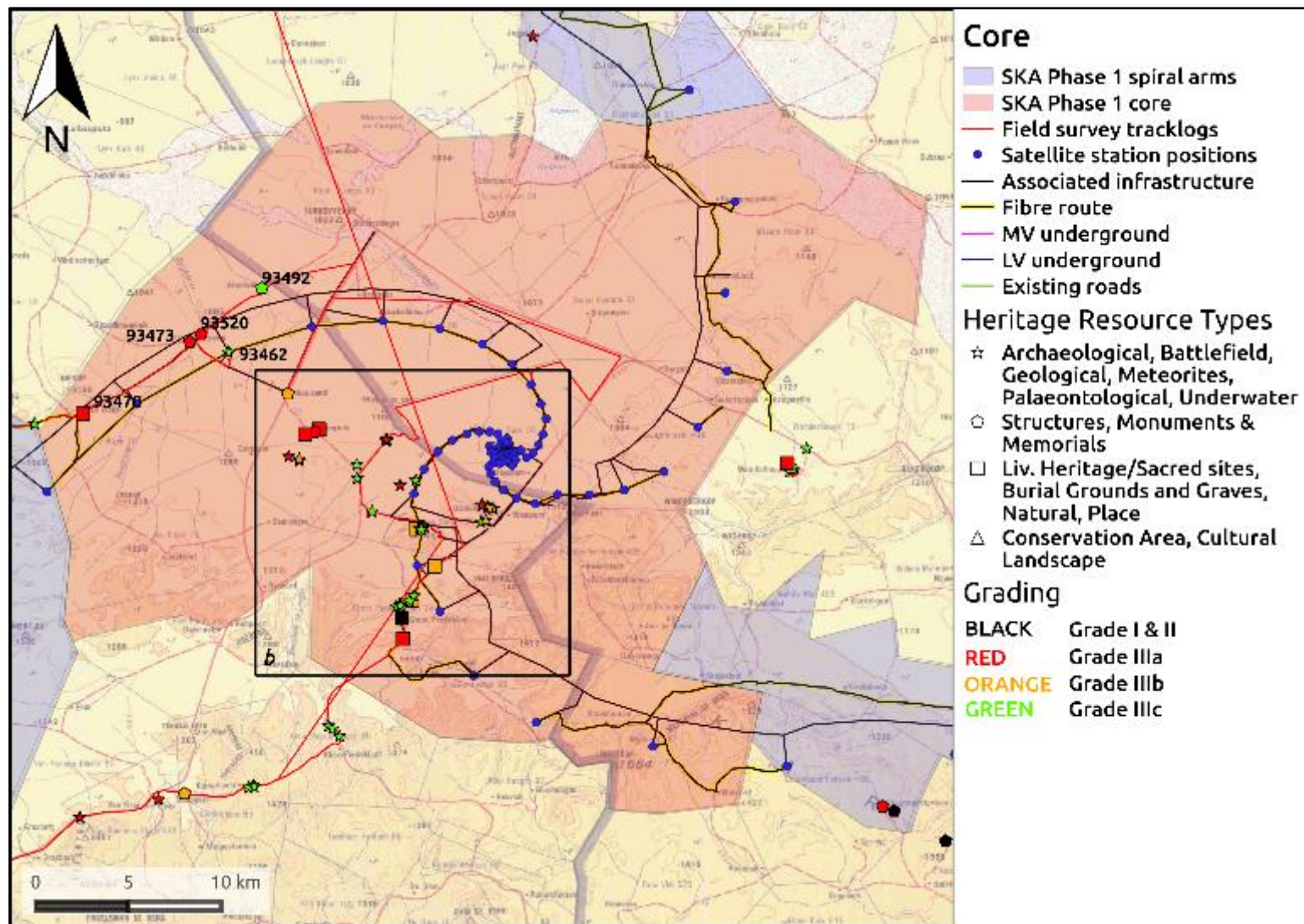


Figure 17. Overview of the SKA Phase 1 study area, indicating the sensitivity of heritage resources based on grading s extracted from heritage reports using the methodology described above.



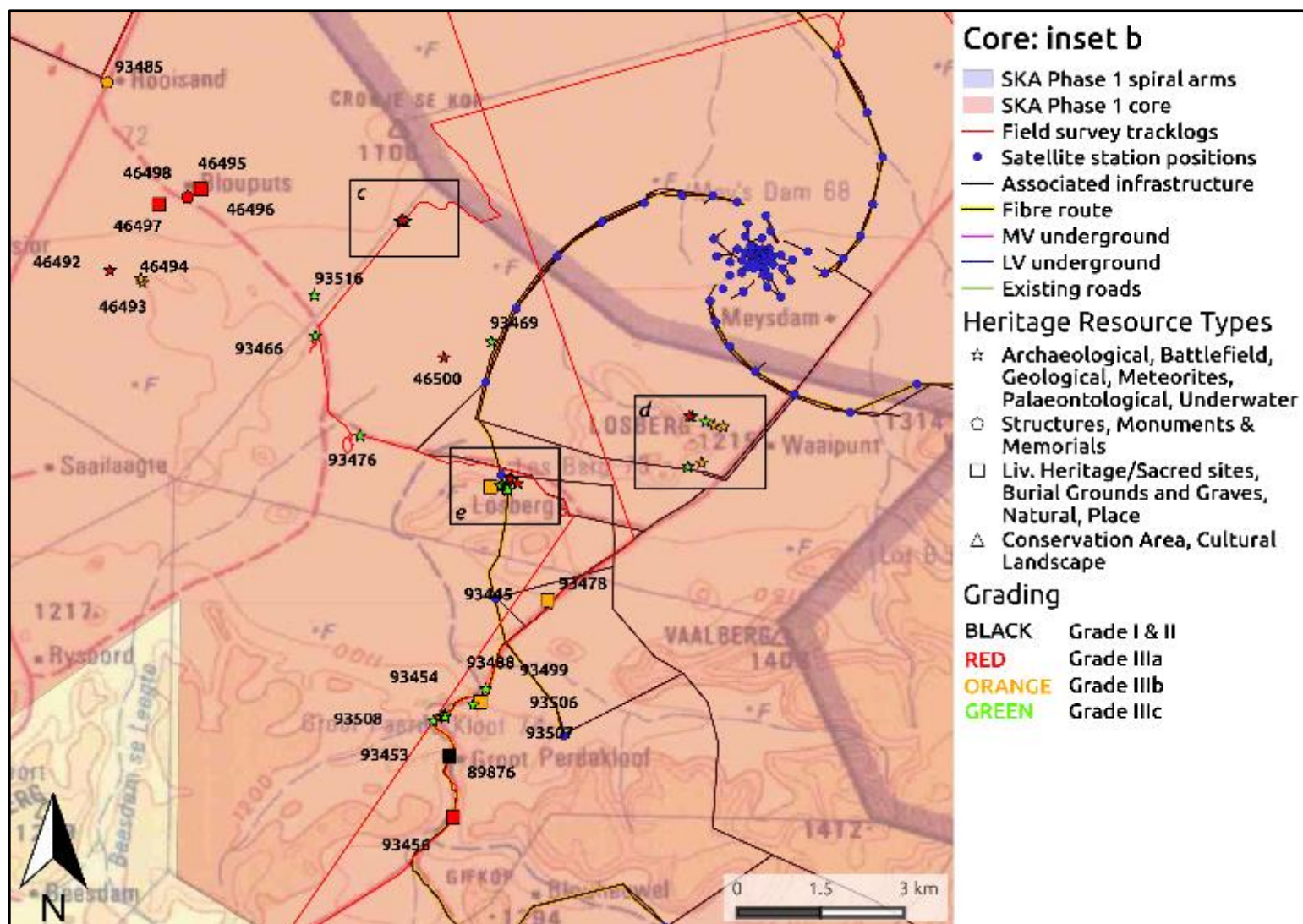


Figure 19. Inset map B. Close up topographical map of the Core area and the heritage resources recorded therein, indicating SAHRIS site Ids. See Figures 31-33 for insets c-e.

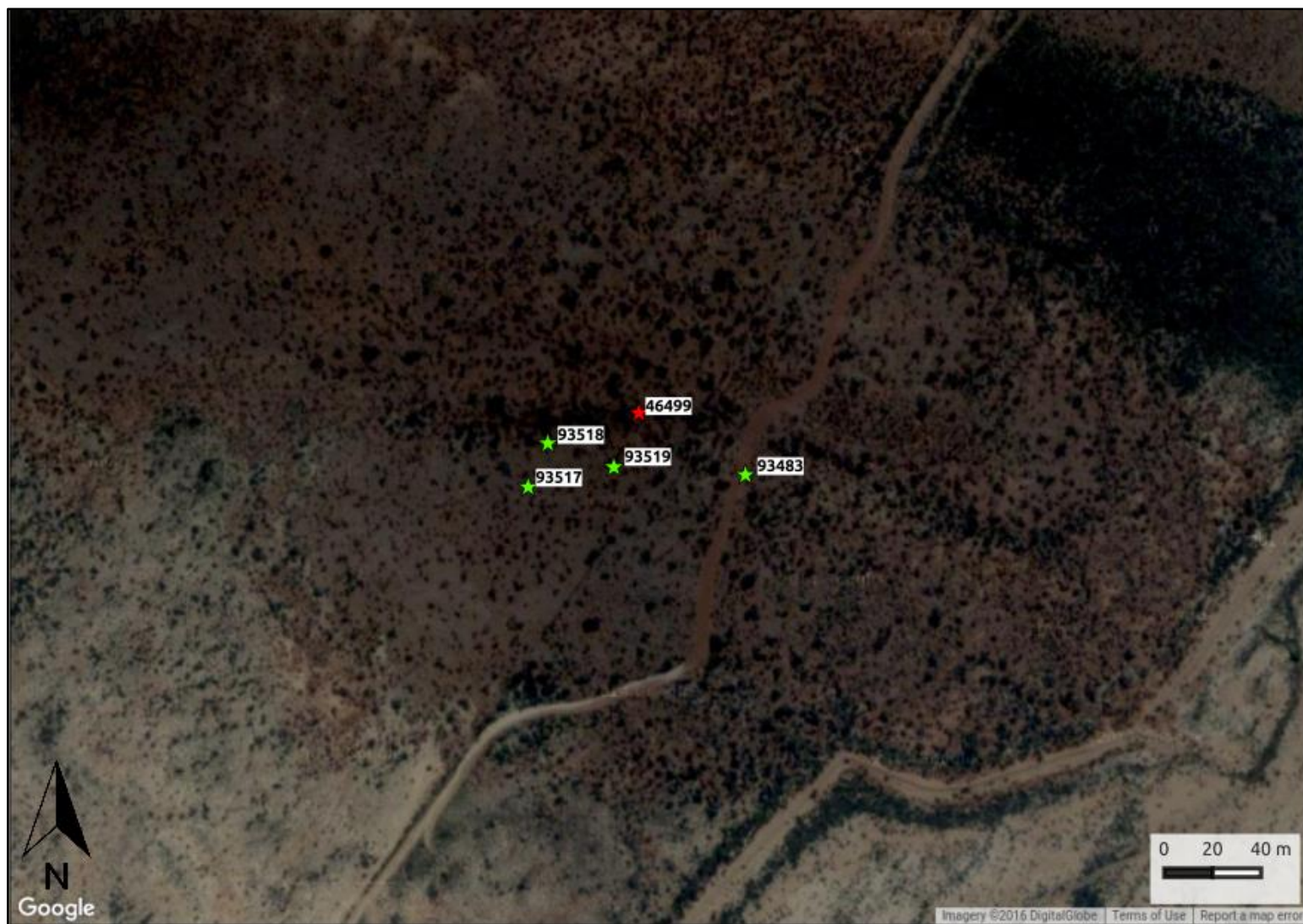


Figure 20. Inset map C: Close up satellite image of the Core area and the heritage resources recorded therein, indicating SAHRIS site Ids.

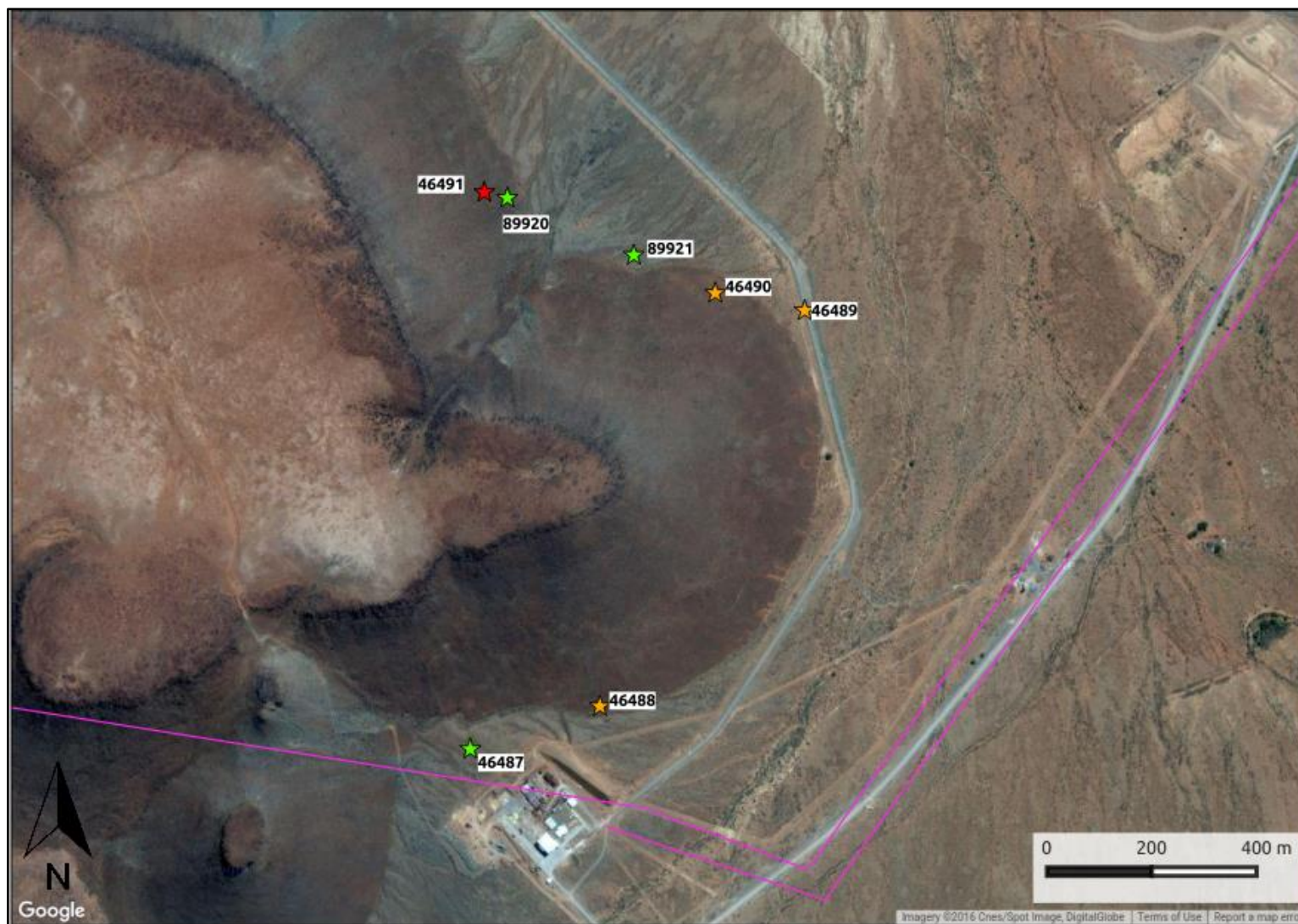


Figure 21. Inset map D: Close up satellite image of the Core area and the heritage resources recorded therein, indicating SAHRIS site Ids.

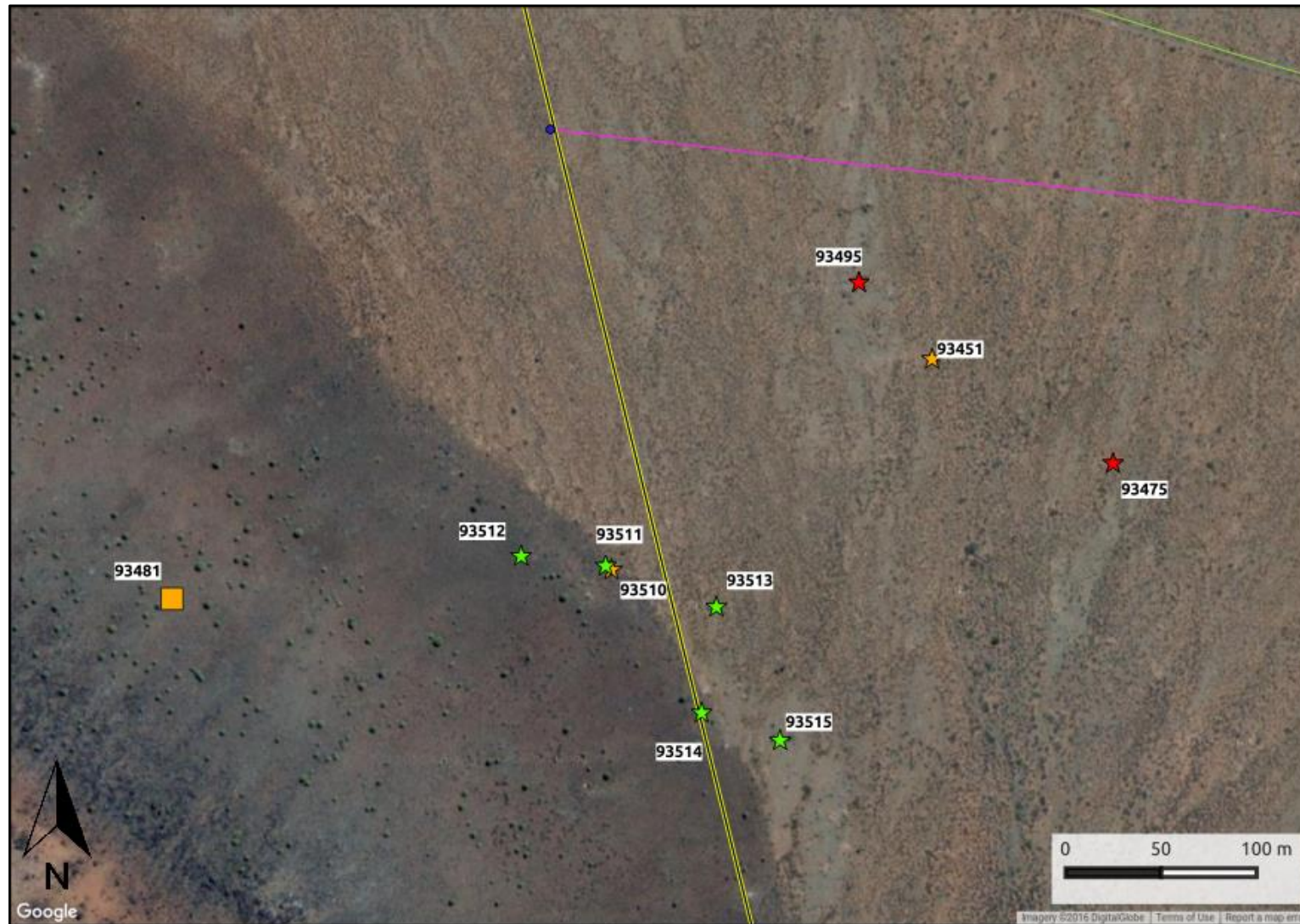


Figure 22. Inset map E: Close up satellite image of the Core area and the heritage resources recorded therein, indicating SAHRIS site Ids.

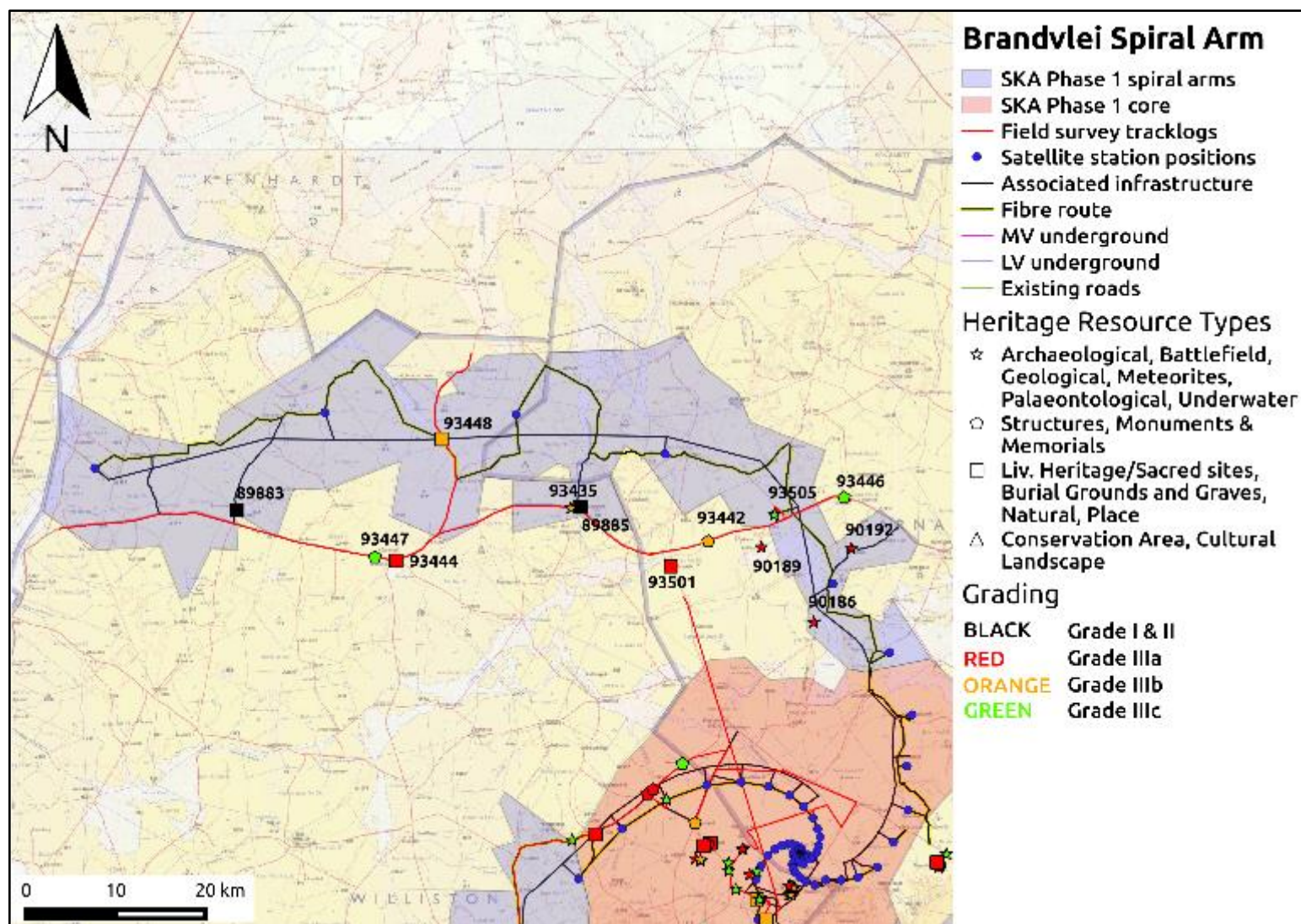


Figure 23. Close up topographical map of the Brandvlei Spiral arm and the heritage resources recorded therein, indicating SAHRIS site IDs.

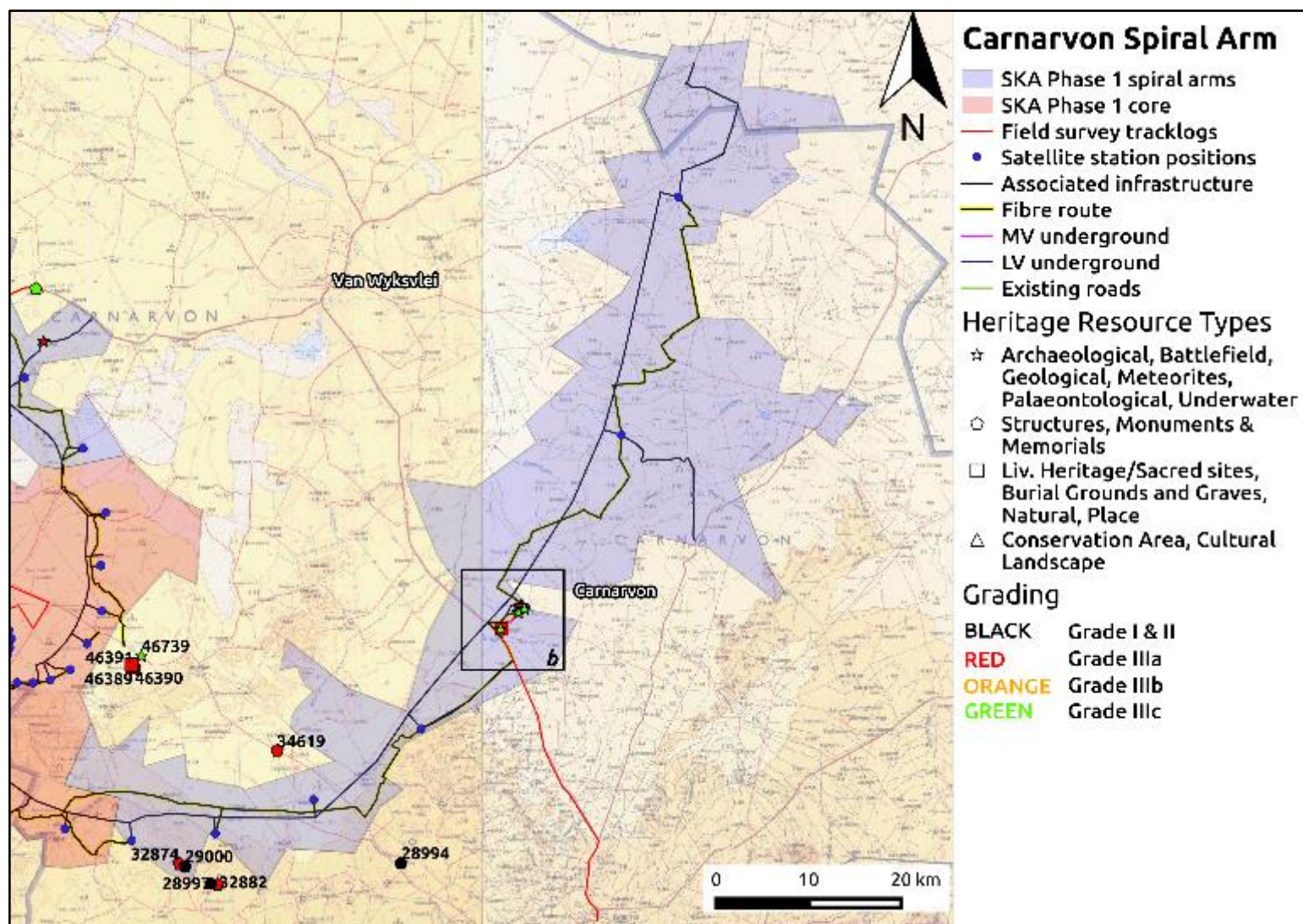


Figure 24. Close up topographical map of the Carnarvon Spiral arm and the heritage resources recorded therein, indicating SAHRIS site Ids. See Figure 36 for inset B.

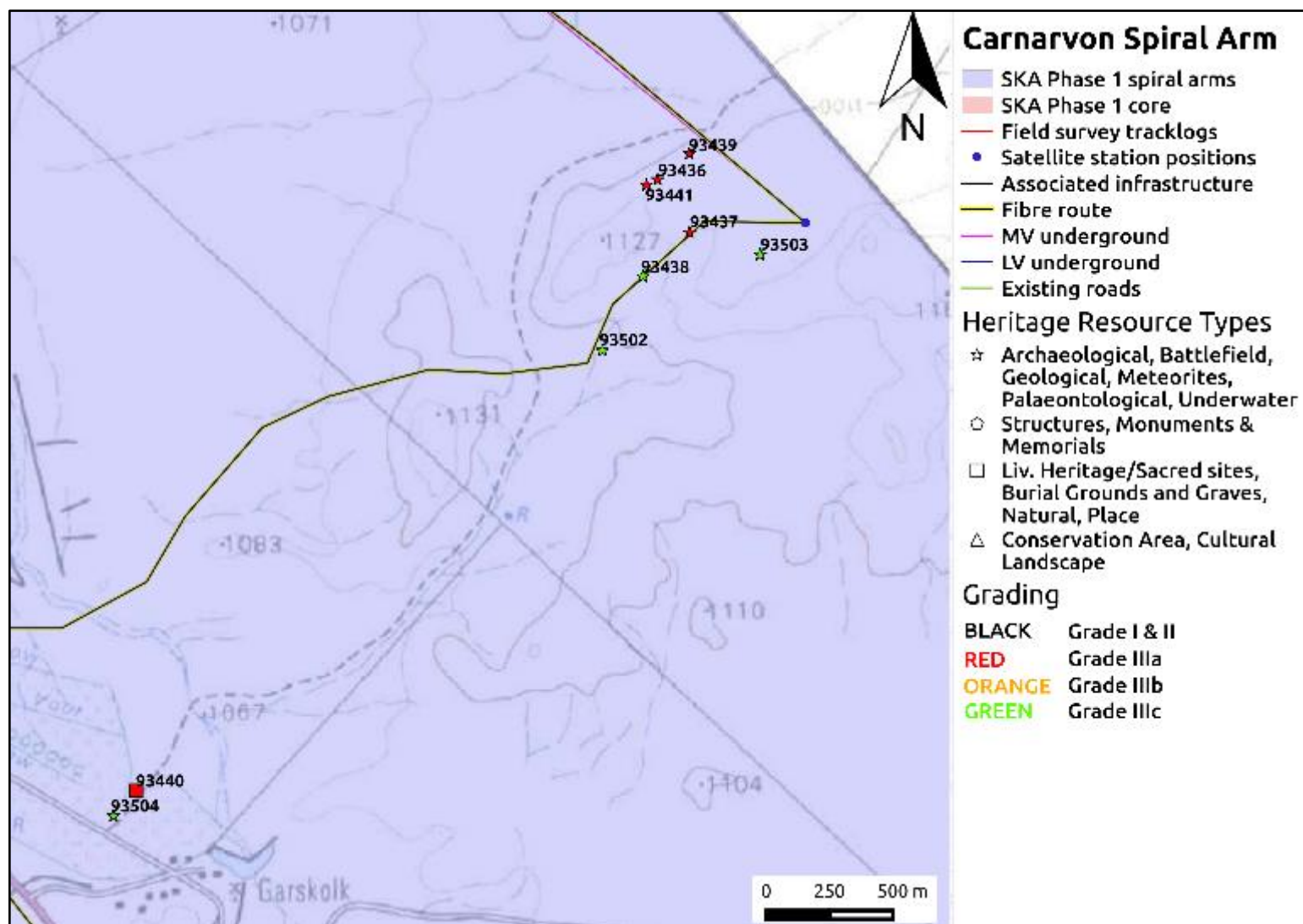


Figure 25. Inset map B. Close up topographical map of the Carnarvon Spiral arm and the heritage resources recorded therein, indicating SAHRIS site Ids.

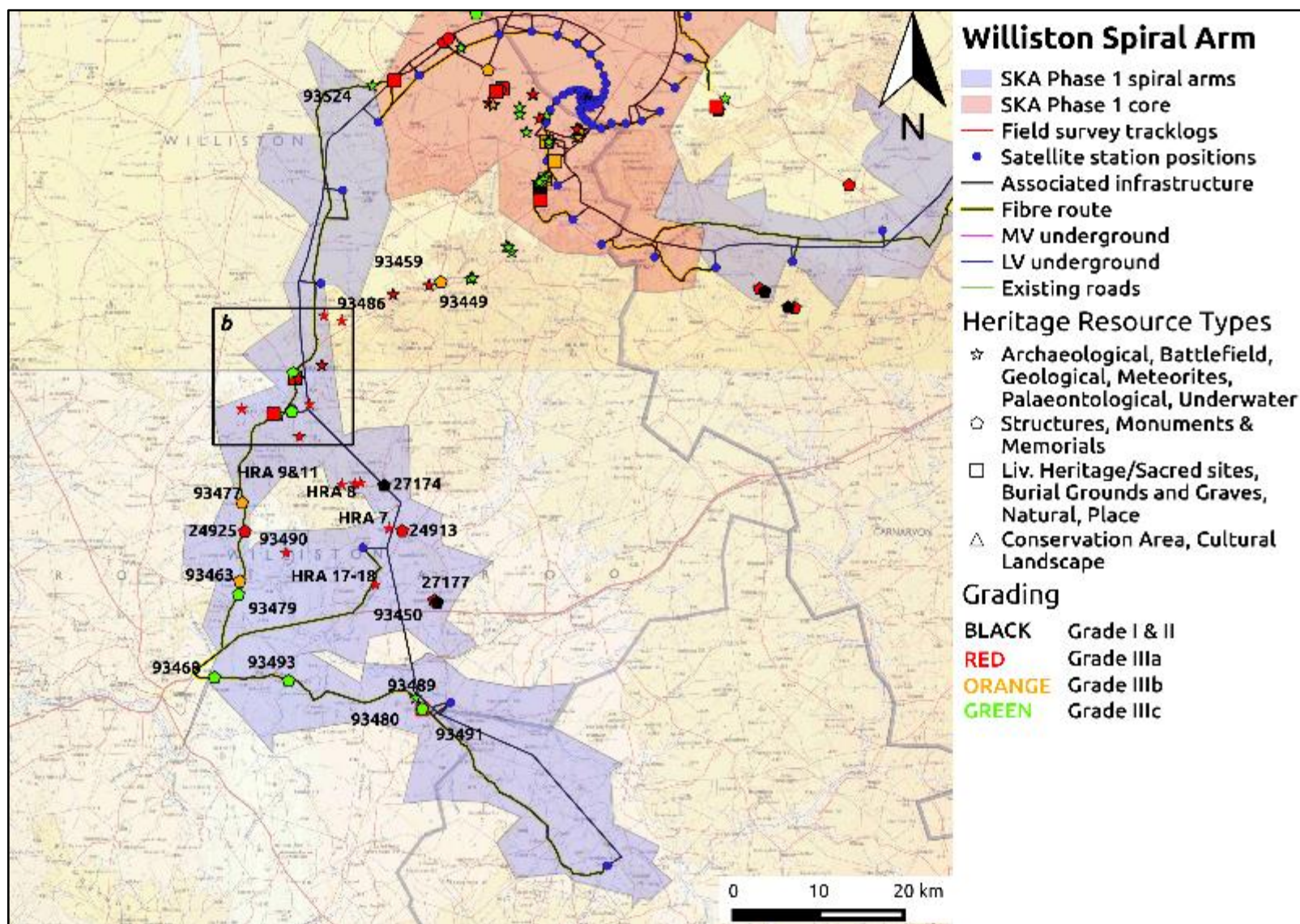


Figure 26. Close up topographical map of the Williston Spiral arm and the heritage resources recorded therein, indicating SAHRIS site Ids. See Figure 38 for inset B.

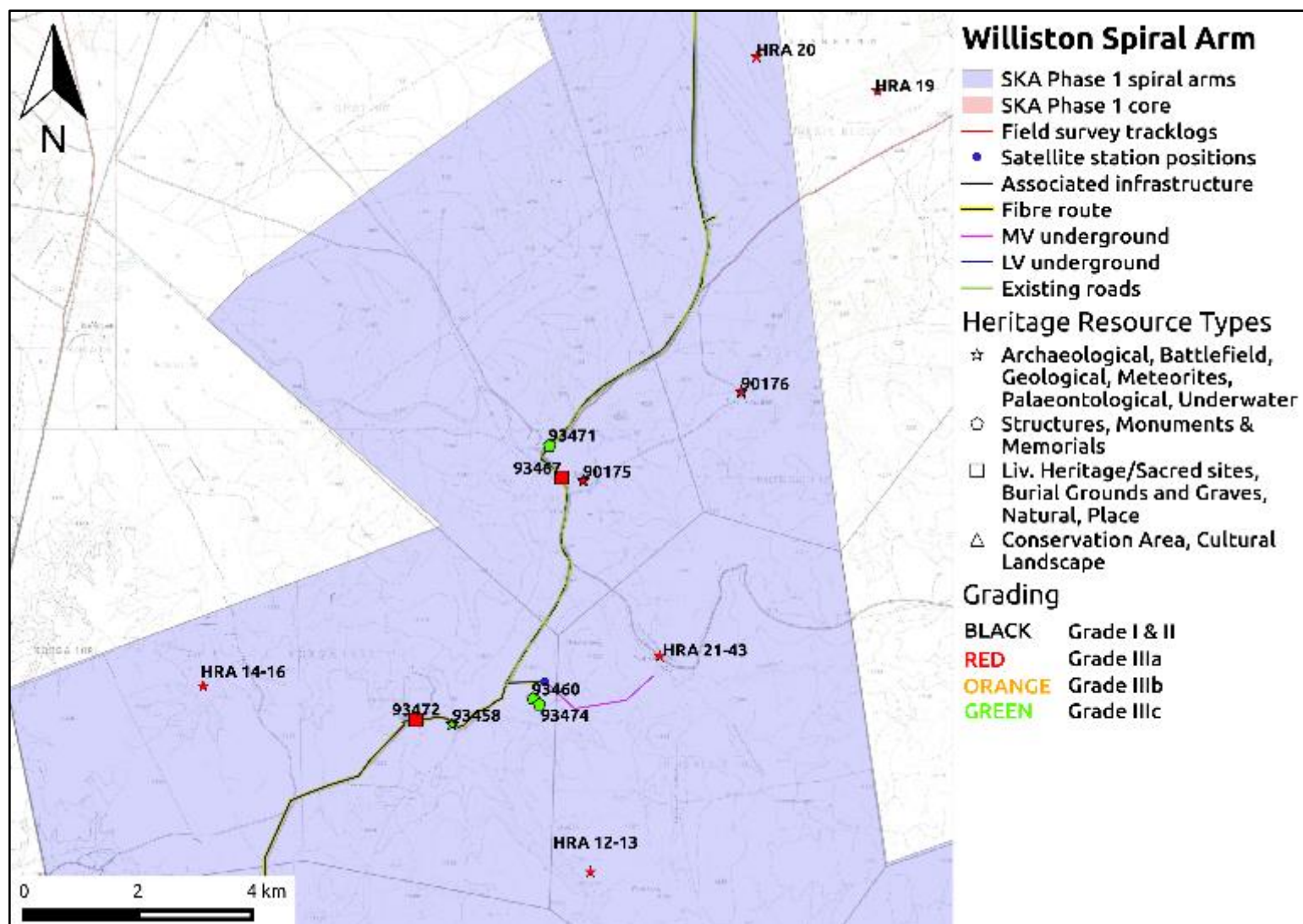


Figure 27. Inset map B. Close up topographical map of the Williston Spiral arm and the heritage resources recorded therein, indicating SAHRIS site Ids.

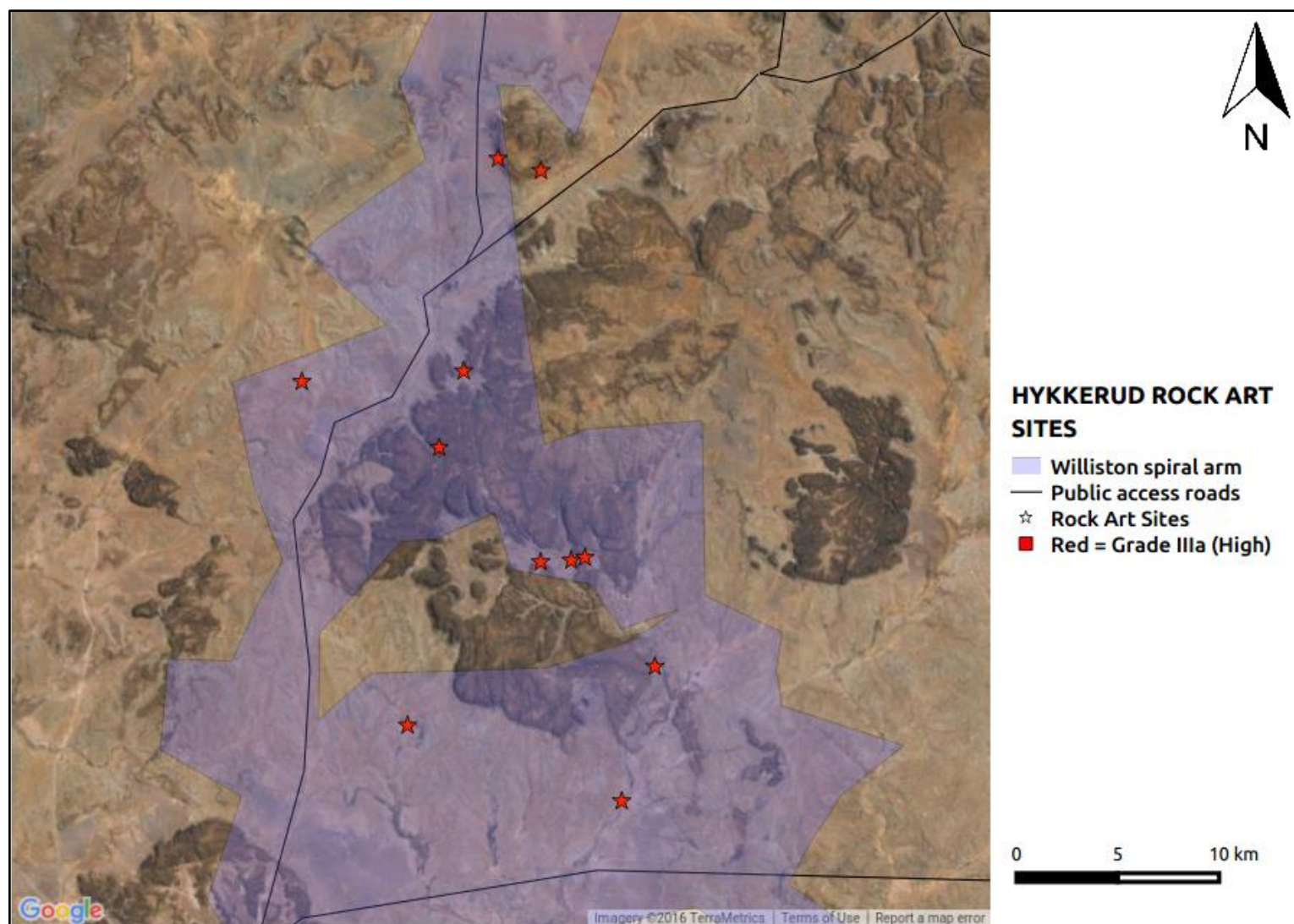


Figure 28. Close up satellite image of the Williston Spiral arm and the Hykkerud rock art sites recorded therein.

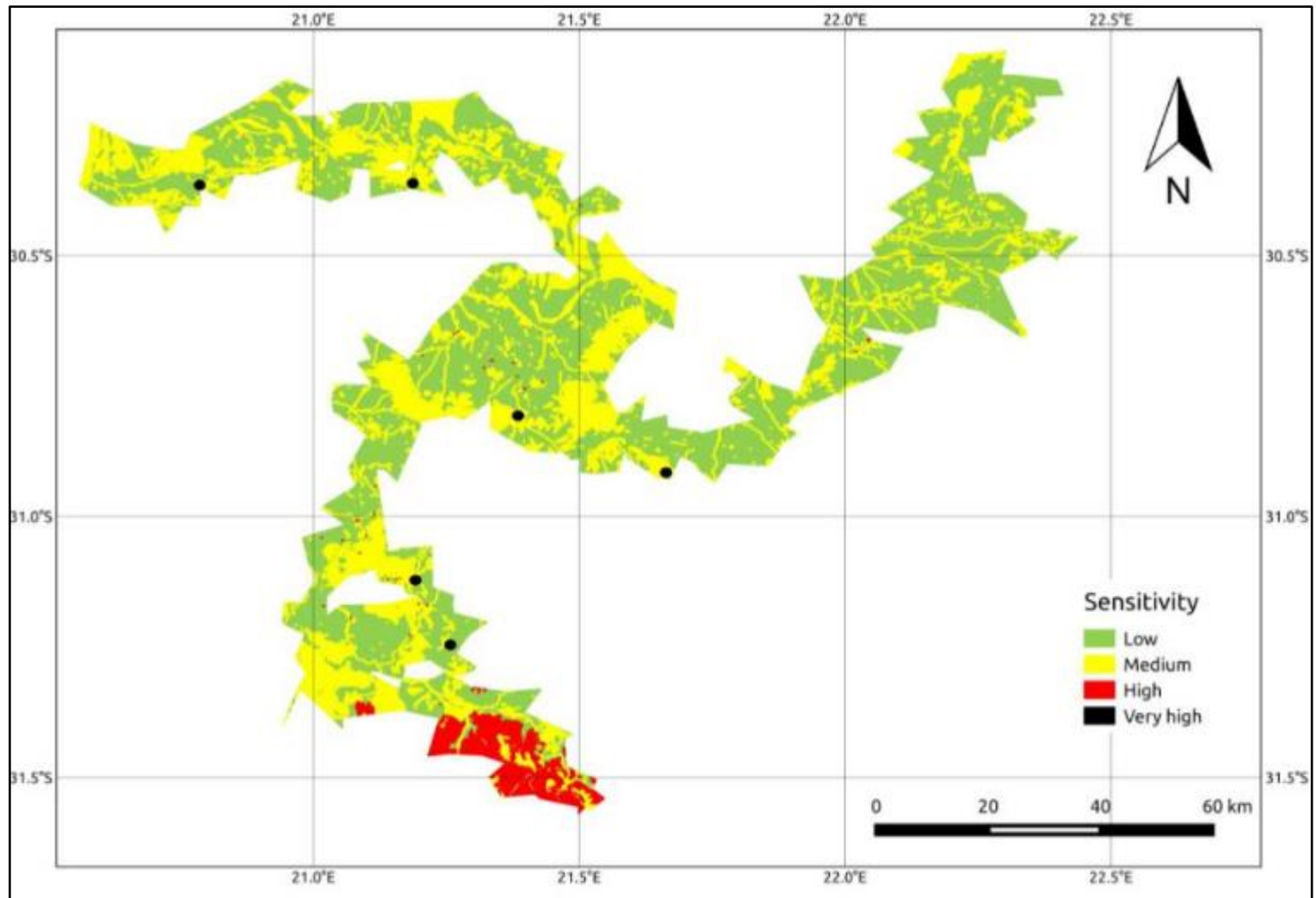


Figure 29. Four-tier sensitivity map based on natural features and sites identified without considering impact from development.

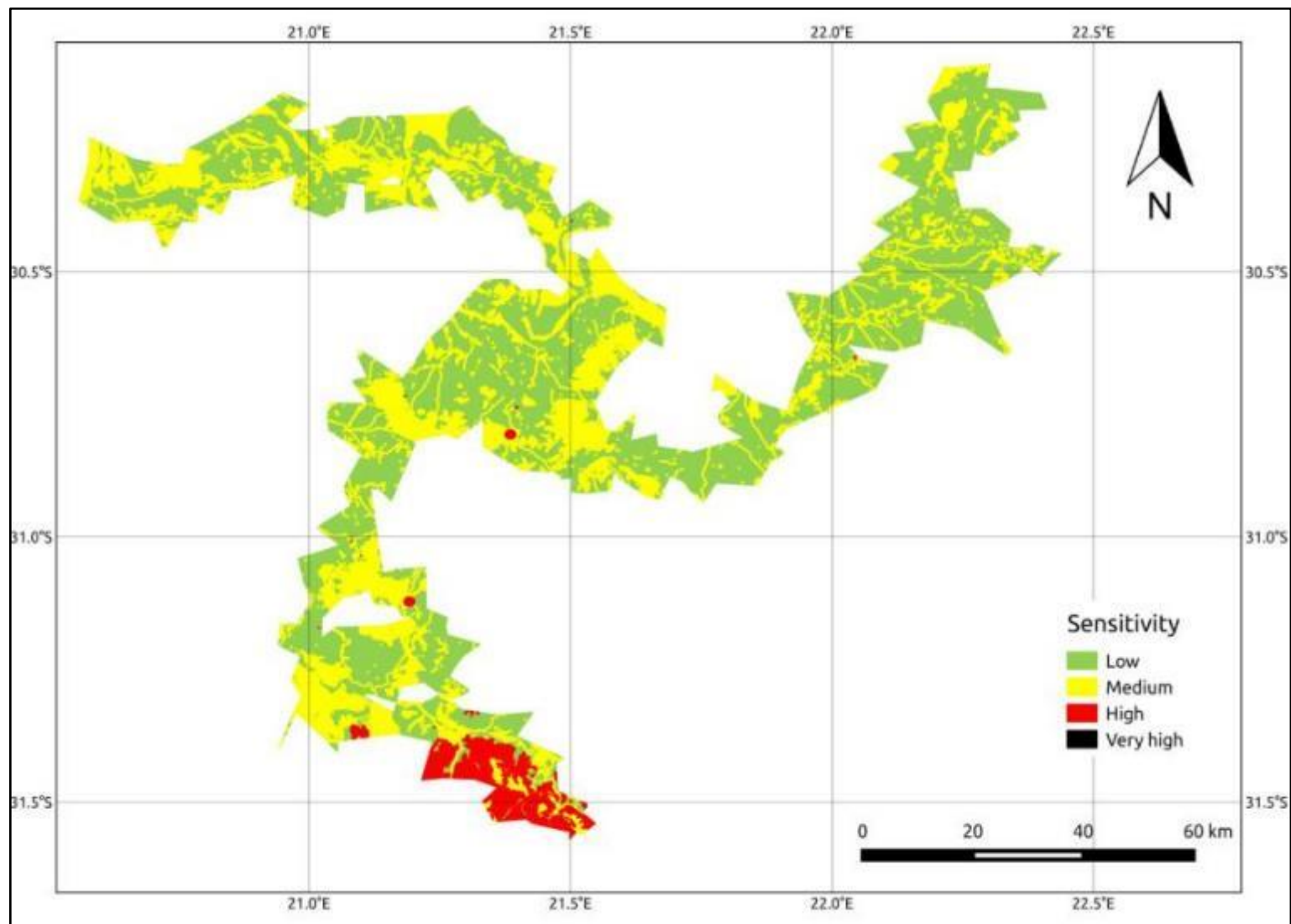


Figure 30. Four-tier sensitivity map of the impact on identified heritage features for the establishment of the SKA Phase 1 project without mitigation.

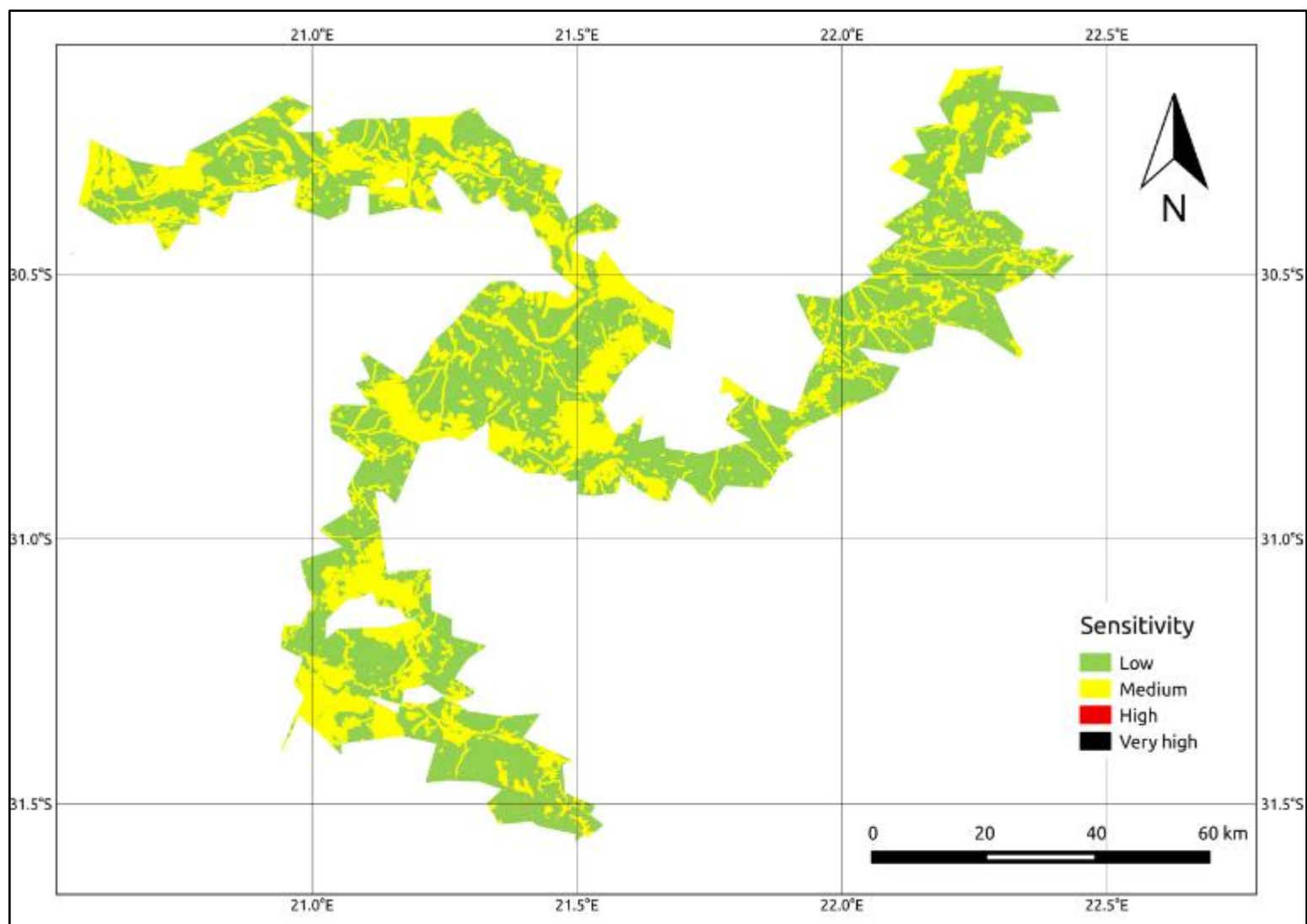


Figure 31. Four-tier sensitivity map of the impact on identified heritage features for the establishment of the SKA Phase 1 project after mitigation.

5.4. Visual sensitivity

Visibility

Potential visibility of the proposed SKA facility from selected viewpoints is given in Table 6 below, which indicates that the visibility of the SKA facilities would be generally moderate or marginal as seen from a number of viewpoints on the reconnaissance field trip. However, this represents only a random sample of viewpoints as all the potentially affected farmsteads could not be visited in the limited time available. The authors noted on the field trip that some of the farmsteads are vacant or abandoned. These should be recorded as potential visual impact would be less significant for these particular farmsteads.

Table 6. Viewpoints and Potential Visibility (See Appendix E)

View-point	Location	Co-ordinates	Distance	Visibility of SKA dish SKA dishese
SK1	R361 Route near Garskolk farm	30.689S, 22.018E	4.0 km	Not visible beyond ridge
SK2a	R295 from Carnarvon to SKA site, at Skietkolk Farm	30.811S, 21.784E	5.0 km	Not visible beyond ridge
SK2b	R295 from Carnarvon to SKA site, at Skietkolk Farm	30.811S, 21.784E	11.6 km	Marginally visible in distance
SK3a	R295 near Swartfontein Farm	30.685S, 21.558E	2.3 km	Not visible beyond ridge
SK3b	R295 near Swartfontein Farm	30.685S, 21.558E	1.6 km	Moderately visible in middle distance
SK4	R295 at Meysdam access road	30.659S, 21.509E	4.5 km	Marginally visible in middle distance
SK5	R295 looking towards MeerKAT	30.634S, 21.442E	2.3 km	Moderately visible in middle distance
SK6	R308 near Excelsior Farm	30.630S, 21.342E	1.5 km	Moderately visible in middle distance
SK7	R63 near Elandfontein Farm	31.255S, 21.301E	10.9 km	Not visible beyond ridge

Visual exposure

Some areas within the viewshed fall within a view shadow, and would therefore not be affected by the proposed SKA facilities. Given the size of the dish antenna, (which are significantly smaller than say wind turbines) the viewshed is fairly limited, as indicated in Figure . Some farmsteads, shown as black dots with orange circles, would however be affected.

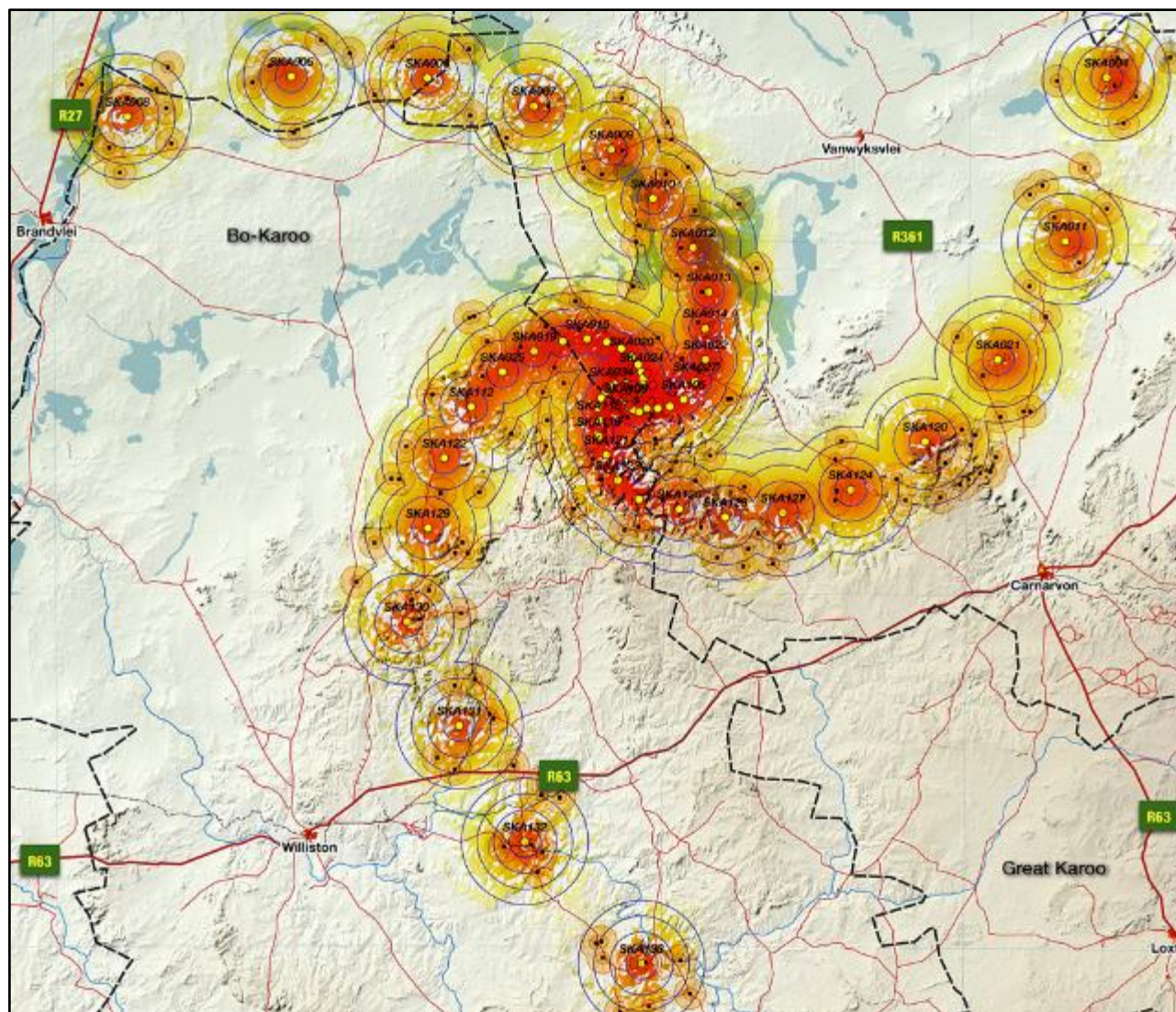


Figure 32. Viewshed of the dish antennae, from red indicating high visual exposure fading to yellow for low visual exposure. The rings represent 2.5 km distance radii from the dish antennae. A number of sensitive receptors, including farmsteads (shown as black dots with orange circles), are within 10 km of the proposed dish antennae. (See Appendix E)

Visual absorption capacity

The plains of study area are generally open and visually exposed, although parts of the spiral arms are in more mountainous terrain, which provides some visual enclosure and screening. The Karoo grassland and shrubland vegetation provide little in the way of visual screening.

Landscape integrity

Visual quality is dependent on the scenic or rural quality and intactness of the landscape, as well as absence of other visual intrusions. The study area has a distinctly wilderness/rural character, particularly in the areas containing the proposed spiral arms. The existing MeerKAT installation and powerlines have partly altered the landscape character at the centre of the SKA.

Cultural landscapes

Cultural landscapes include the presence of palaeontological or archaeological sites, heritage sites, historical farmsteads, gravesites and cultivated lands. These features form part of a separate study, but could increase overall visual sensitivity.

Sense of place

Sense of place is difficult to measure, but has value in terms of the Karoo's legendary vastness, serenity, quietness and dark skies at night. Although quietness is required for the SKA facility, the dish antennae and related infrastructure will add visual 'clutter' to the Karoo landscape. The construction phase will increase disturbance in the short term.

Visual sensitivity

The potential visual impacts on sensitive receptors relates mainly to farmsteads in the proposed spiral arms of the SKA. These can be determined to some extent from Figure 32 and the viewshed mapping in Figure . However not all the spiral arms were visited and therefore the visibility of dishes from each of the farmsteads could not be finally determined. As a general guideline, the visual effect of those dishes within 1 km of a farmstead could be significant, while those beyond 5 km would be marginal, depending on whether the farmsteads fall within the viewshed of the dishes.

Identified scenic resources and visually sensitive receptors within the study area, within high, moderate and low visual sensitivity zones, are given in Table 7 below. The levels of sensitivity are defined by distance radii from the feature or the receptor, where these are within the same viewshed. The sensitivity zones are indicated in Figure , where it can be seen that a number of farmsteads in the proposed spiral arms will be affected. The buffers indicated in **Error! Reference source not found.** were based mainly on the visual model of the dish antennae in Figure , and from the authors' experience with infrastructure projects elsewhere (Lawson and Oberholzer 2014, 2015).

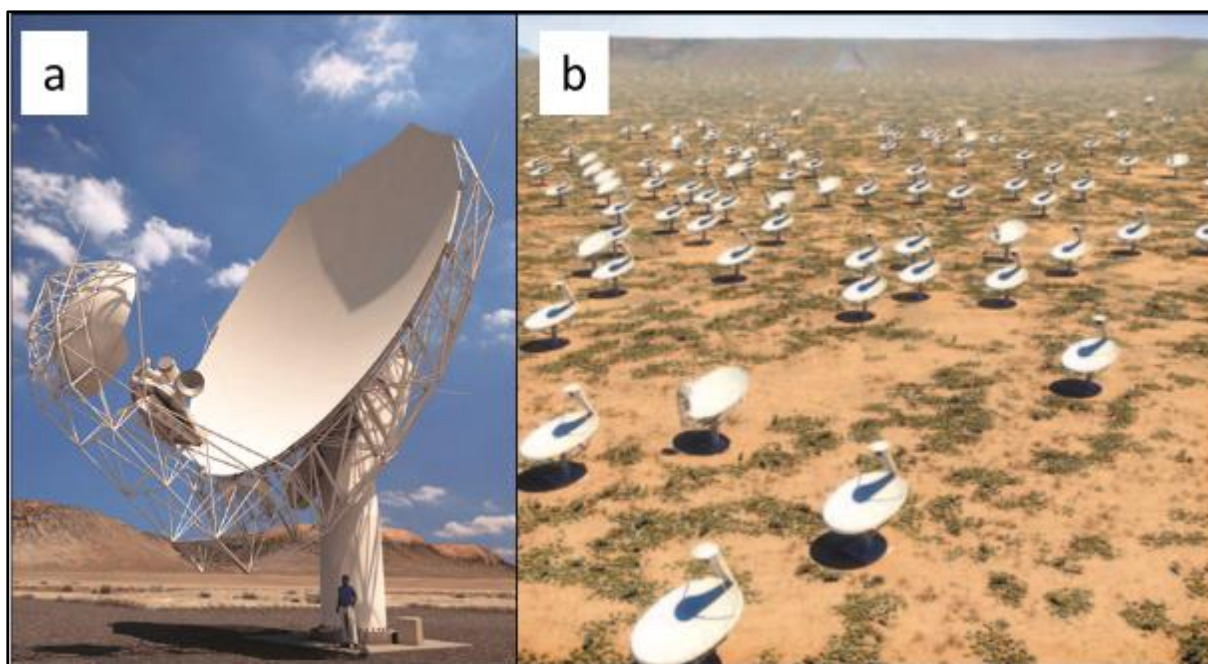


Figure 33. Illustration of Meerkat dish antenna. Height 19.5 m and dish 13.5 m diameter. Source: South Africa's MeerKAT Radio Telescope, Technical Fact Sheet, March 2014.

Table 7. Visual sensitivity mapping

	High visual sensitivity	Mod. visual sensitivity	Low visual sensitivity	Criteria
Scenic Resources				
Topographic features	feature	within 1 km radius	beyond 1 km radius	Special landscape features, particularly skylines. Peaks include a 500 m radius.
River courses, vleis, dams, pans	feature	within 1 km radius	beyond 1 km radius	Scenic/environmental value in an arid landscape. Rivers include a 500 m corridor.
Cultural landscapes (incl. cultivated lands)	feature	within 1 km radius	beyond 1 km radius	Rural scenic value and possible historical or heritage value.
Sensitive Receptors				
Private reserves incl. game farms, guest accommodation	within 1 km radius	within 2.5 km radius	beyond 2.5 km radius	Wilderness and scenic value. Sensitive visitor receptors. Important for local tourism industry.
Settlements incl. towns, villages, farmsteads	within 1 km radius	within 2.5 km radius	beyond 2.5 km radius	Visually sensitive residents and visitors, as well as effect on property values.
Provincial roads and scenic routes	within 1 km radius	within 2.5 km radius	beyond 2.5 km radius	Visually sensitive residents and visitors within view corridor. Subject to viewshed mapping.

Note: The distance radii are visual mapping categories and not setbacks or exclusion areas.

The potential visual impacts on scenic resources and sensitive receptors can be determined from Figure and Figure . Except for a few dishes in the mountainous central area and some river courses in the south, along with a number of farmsteads, it appears that the effects would not be significant and could be mitigated through careful siting of the dish antennae.

Table 8. Potential visual impacts for SKA Phase 1 (See also Figure 12).

Visual Impact (See also Table 9)	Visual sensitivity zone	Scenario	Extent	Timescale	Intensity (consequence)
Visual intrusion of industrial-type facilities on the landscape, altering the rural/wilderness character of the Karoo, and affecting sensitive receptors (residents and visitors).	High visual sensitivity zone	Dish antennae	Local	Long term	Substantial
		Access roads, powerlines, substations	Local	Long term	Mod-substantial
		Construction phase	Local	Short term	Mod-substantial
	Moderate visual sensitivity zone	Dish antennae	Local	Long term	Mod-substantial
		Access roads, powerlines, substations	Local	Long term	Moderate
		Construction phase	Local	Short term	Slight
	Low visual sensitivity zone	Dish antennae	Local	Long term	Moderate
		Access roads, powerlines, substations	Local	Long term	Slight
		Construction phase	Local	Short term	Slight

Cumulative Visual Impacts

Potential cumulative visual impacts could result from a combination of MeerKAT and SKA Phases 1 and 2 over time. Proposals for future phases of the SKA are not known at this stage and would need to be assessed for possible cumulative visual impacts as part of the rollout of the SKA.

Related infrastructure to the SKA project include the access roads and powerlines to each of the dish antennae, which seen together could result in additional cumulative visual impacts representing an industrialised landscape.

The risk assessment matrix presented in Table 9 below, includes risk levels ‘without’ and ‘with’ mitigation. The relevant mitigation measures are described in Chapter 15 of the Integrated Environmental Management Report. The table is based on the description of the SKA arrays and the identification of visually sensitive zones in the previous sections. These are combined with the potential intensity of the visual impacts (derived from Table), and the likelihood (probability) of the impact occurring, to provide an overall risk evaluation.

The dish antennae require an uninterrupted exposure to the horizon and their locations are based on technical requirements. As the dish antennae cannot easily be visually screened, mitigation is limited and confined to micro-siting. The related infrastructure (access roads, powerlines and substations) would have a lower risk than the dish antennae because of their smaller size visually. The construction phase would also have a lower risk because it is short term, but could continue with future phases of the SKA.

Table 9. Potential visual impacts for SKA Phase 1 (See Appendix E)

Impact	Visual zone	Scenario	Without mitigation			With mitigation		
			Intensity level	Likelihood	Risk	Intensity level	Likelihood	Risk
Potential visual intrusion of industrial-type facilities on the landscape, altering the rural/wilderness character of the Karoo, or affecting sensitive receptors	High visual sensitivity zone	Dish antennae	Substantial	very likely	high	Substantial	Likely	mod-high
		Related infrastructure	Moderate-substantial	very likely	mod-high	Moderate	Likely	moderate
		Construction phase	Moderate-substantial	very likely	moderate	Moderate	Likely	low-mod
	Moderate visual sensitivity zone	Dish antennae	Moderate-substantial	very likely	mod-high	Moderate	Likely	moderate
		Related infrastructure	Moderate	very likely	moderate	Slight	Likely	low-mod
		Construction phase	Slight	very likely	low-mod	Slight	Likely	low
	Low visual sensitivity zone	Dish antennae	Moderate	very likely	moderate	Slight	Likely	low-mod
		Related infrastructure	Slight	very likely	low-mod	Slight	Likely	low
		Construction phase	Slight	very likely	low	Slight	Likely	low

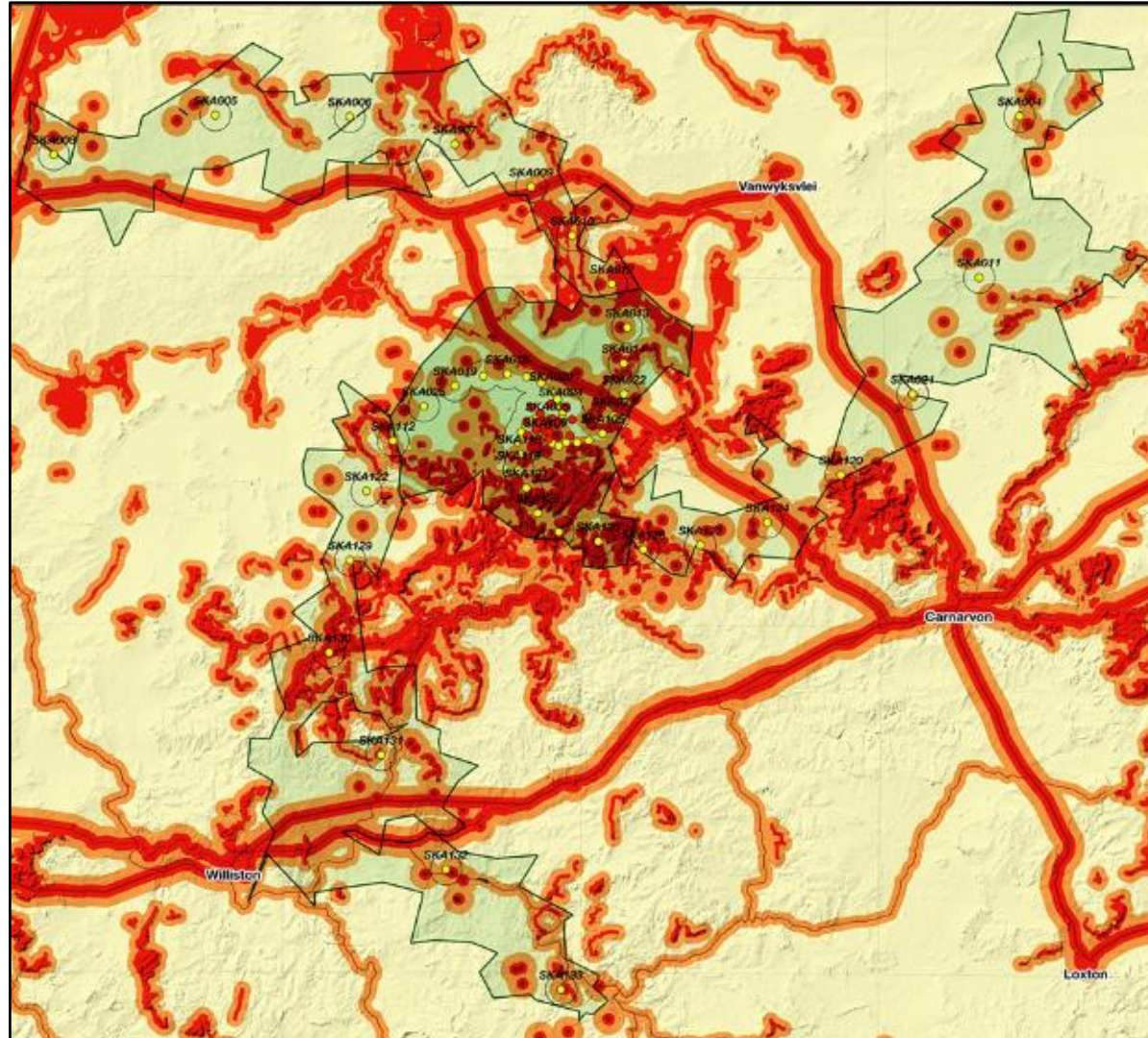


Figure 34. Synthesis map indicating visual sensitivity levels ranging from high visual sensitivity (red), moderate (orange) and low (yellow). Proposed dish antennae are indicated as yellow dots, several of which occur in the high visual sensitivity area based on the current layout. (See Addendum for detailed maps, which are also available as shape files). (See Appendix E)

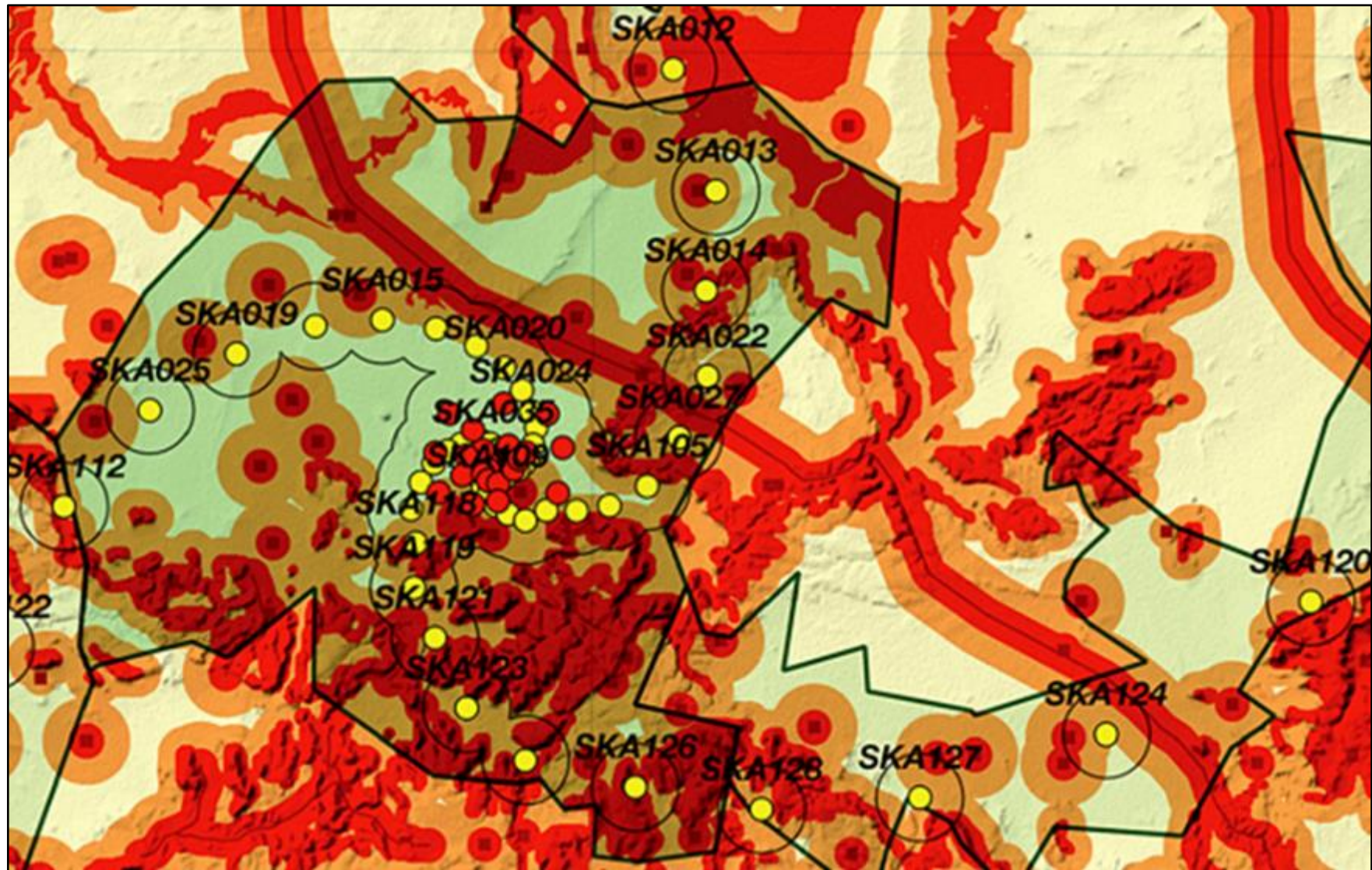


Figure 35. Detail of the core area, as illustrated and described in Figure 12. (See Appendix E)

Section 6. Permit requirements

Any demolitions or alterations to any structure older than 60 years will require a permit issued under section 34 of the NHRA by the PHRA, Ngwao-Boswa Jwa Kapa Bokone (NBKB). The permit application will also be submitted via SAHRIS and the permits would be issued in the name of the developer and/or landowner.

No impacts to Provincial Heritage Sites are expected. However, if the layouts or plans are changed such that impacts to these Provincial Heritage Sites are possible, a permit must be obtained from NBKB in terms of section 27 of the NHRA.

SAHRA currently requires a separate permit application process outside of section 38(8) for mitigation of archaeological and palaeontological sites requiring excavation or collection of material. The relevant archaeologist and/or the palaeontologist appointed by SKA must therefore apply to SAHRA for a permit under section 35 of the NHRA in these cases. Applications must be submitted via SAHRIS and the permits would be issued in the name of the heritage practitioner.

Section 7. Conclusions and Recommendations

The study area is very extensive and covers a wide range of heritage resources of different types, origin and significance. These heritage resources include Stone Age archaeological artefact scatters which are often located around water sources, rock engravings which are typically executed on dolerite boulders, several historical farmsteads which usually contain historical structures (farmhouses and corbelled buildings), formal and informal burial grounds and graves, stone walling and stone kraals and ruins.

The preliminary high level heritage assessment conducted for the SKA Phase 1 has provided a reliable characterisation of the range of heritage resources found within the study area (despite the limitations due to land access and fieldwork duration vs size of the study area) which can be extended into the unsurveyed areas of the study area. Appropriate suggested mitigation measures were provided for these classes of sites.

The SKA Phase 1 area contains a rich archaeological heritage collection, including ostrich eggshells and pottery located within the Williston spiral arm area, Early Stone Age tools such as hand axes, Middle Stone Age sites associated with deflated palaeosurfaces and stratified deposits, and Later Stone Age stone tools of the San hunter-gatherers and Khoekhoen herders. These scatters are generally of low local significance, but a rare few are of high local significance (e.g. WILLIS001 and HER-SKA013). In addition, 13 stations near water sources have been identified, which typically contain denser concentrations of Stone Age scatters. Additional archaeological resources in the SKA phase 1 area include numerous rock art sites of mainly pecked, scraped and incised rock engravings in association with dolerite outcrops, and 10 formal and informal graves of high local significance. Any

SKA infrastructure that may impact on the identified Grade IIIa heritage resources can be moved to less sensitive locations.

An equally rich cultural heritage collection was identified in the SKA Phase 1 area, which includes vernacular architecture such as the 8 corbelled buildings of high local significance, old buildings, streets and infrastructure in Carnarvon, Williston, Kenhardt and Van Wyksvlei, and a farmstead of potentially provincial significance. The characteristic landscape of the Karoo also contributes to the cultural heritage of the SKA Phase 1 area. The landscape features of the Karoo include panoramic views, mountains and hills, undulating plains with flat-topped koppies and extensive sandy to gravelly vlaktes, vast open spaces and clear starry nights. The extreme climate of the Karoo speaks to the hardy shrub and grassland vegetation by which it is characterized, together with dry riverbeds and exposed rocky outcrops which instill a valued sense of simplicity, remoteness and quietness (Orton et al. 2016 and Morris and Wilson, 2009).

Examination of geological maps combined with field observations within the SKA core and Phase 1 study area have shown that the region as a whole is one of "high to moderate" palaeontological sensitivity, with the southern section of the Williston Spiral Arm being of very high palaeontological sensitivity. The main geological units represented here include: offshore basinal muds to marginal marine sandy sediments of the Early to Middle Permian Eccu Group, continental (fluvial/lacustrine) mudrocks and sandstones of the Middle Permian Lower Beaufort Group, Early Jurassic basic intrusions of the Karoo Dolerite Suite and a wide range of Late Cenozoic superficial sediments such as alluvial, fan and colluvial deposits as well as soils and surface gravels.

Pending the potential discovery of substantial fossil remains (e.g. petrified wood, vertebrate bones and teeth, concentrations of fossil shells) at these sites before or during construction, further specialist palaeontological studies is not necessary for the stations themselves. However, the associated infrastructure (roads, fibre optics etc.) may impact potentially fossiliferous bedrocks of the Lower Beaufort Group (Abrahamskraal Formation). A field assessment by a professional palaeontologist for all infrastructure located in the Lower Beaufort Group is recommended.

Older, consolidated (e.g. calcretised) alluvial deposits associated with major ancient drainage systems such as the Sakrivier (e.g. raised terrace or pediment gravels) that are to be directly impacted by proposed associated infrastructure should be assessed before construction by a professional palaeontologist or specialist with broad-based Late Cenozoic palaeontological experience.

It is recommended that fieldwork verification is conducted by heritage specialists at all final station footprints which were not surveyed during this assessment prior to the construction of the SKA Phase 1 project and that the results of this detailed fieldwork form part of an HIA that satisfies the requirements of section 38(3) of the NHRA. All structures that fall within the development footprint should be assessed by a built heritage specialist to determine which buildings are worthy of conservation. This is applicable specifically to farmhouses within the SKA Core area as the ongoing maintenance of these buildings will become a direct responsibility of the SKA once the land is acquired.

The compilation of a Conservation Management Plan (CMP) for the all significant heritage resources, including relevant structures and burial grounds and graves, is recommended to assist in their ongoing

maintenance. The CMP will be included in the Environmental Management Plan and further recommendations for maintenance and conservation must be included in the revised version of the CMP, which is a dynamic document to be updated as necessary.

In conclusion, based on the two phased assessment, the SKA Phase 1 area is not likely to negatively affect National or Provincial Heritage Sites as long as the appropriate mitigation measures outlined in the attached heritage report are implemented.

Heritage Impacts:

7. A complete Heritage Impact Assessment is required that satisfies section 38(3) of the NHRA. This HIA should include the following:
 - a. A field assessment for archaeology of the locations of any infrastructure to be developed that impacts dolerite outcrops, Grade IIIA resources or is within 100m of a river bed. The results of this assessment may require that infrastructure be relocated.
 - b. A field assessment for palaeontology of the locations of any infrastructure to be developed that impacts the Beaufort Group and older, consolidated (e.g. calcretised) alluvial deposits
 - c. A record and assessment of the structures within the SKA footprint area to inform a Conservation Management Plan
8. A Fossil Finds Procedure must be implemented for the construction phase of the project that includes training for ECO's regarding fossil identification.
9. A Heritage Conservation Management Plan be drafted for the ongoing management of heritage resources within the SKA development footprint, including:
 - a. Maintenance of significant structures
 - b. Maintenance and access to burial grounds and graves
10. The mitigation measures proposed in the Impact Assessment Tables included in Appendix A to this chapter must be implemented.
11. The town of Carnarvon, and other historic towns, represent potentially important gateways to the SKA project, particularly for visitors to the area, and it is recommended that a major social, heritage and environmental programme be implemented as an on-going project to uplift the presently degraded portions of these townscapes. It is recognised that that some programmes have already been initiated, but that more needs to be done for the image of the town in consultation with Municipalities, the business community and NGOs.
12. The projects identified in section 4.4 of this assessment must be implemented.

Based on the strategic visual assessment carried out for the SKA Phase 1, the conclusions and recommendations are as follows:

Visual Impacts:

11. The general nature of the terrain for the proposed project, scenic resources and a number of potential sensitive receptors were identified.
12. The general location selected for the SKA 1 consists largely of flat plains, with some low sandstone and doleritic mountains in a sparsely populated area (mainly farmsteads).
13. The main scenic resources are concentrated in the mountainous terrain across the middle of the study area, where peaks, ridgelines, scarp edges, steep side slopes and dolerite rock outcrops are potentially visually sensitive, particularly in terms of structures on the skyline.
14. The proposed dish antennae, including those in the spiral arms, cover a relatively large area of approximately 154 by 137 km, some of the dishes being located in more mountainous terrain. The exposed nature of the landscape suggests that the dishes could be highly visible up to 1 km, but only marginally visible beyond 5 km.
15. There are no major settlements or roads, (except for the R63), in the study area, and the farmsteads are spread relatively far apart. Some of the farmsteads affected by the SKA appear to not be permanently inhabited.
16. The composite visual sensitivity map (Figure) indicates that high and moderately high visual sensitivity zones tend to be concentrated in the more mountainous terrain and near farmsteads. A number of the proposed dish antennae, and related infrastructure, are within these sensitivity zones. (See also Map 10 in the Addendum).
17. Given that the position of the dish antennae are determined by technical criteria, re-siting of the dishes may be limited. In cases where the proposed location of dishes coincides with visually sensitive landscape features or sensitive receptors, this can be partly overcome through micro-siting the dishes.
18. Particular attention needs to be paid to those dish antennae that are within 1 to 2.5 km of farmsteads, mainly in the proposed spiral arms, as highlighted in Figure . These should be subject to a more detailed visual assessment, including photomontages, once a final layout has been prepared.
19. The cumulative visual impacts of the Meerkat and SKA Phase 1 have been considered, but given the nature of the landscape, careful siting of the dishes and the minimal sensitive receptors, the overall project should not represent a fatal flaw in visual terms after mitigation.
20. A number of mitigation measures have been recommended, which could help to reduce the potential visual impacts relating to the project. Mitigations relating to the construction phase, including the location of the construction camps, should be included in the EMPr.

Appendix A. Heritage Impact Assessment Tables

Table A1. Impact assessment table for the Grade II heritage resources in the SKA Phase 1 study area, during the construction phase

SAHRIS site ID	27177	27174	29000	89883	89885	89876
Site no	9/2/107/0003	9/2/107/0005	9/2/019/0004	Abiquaputs	Hartogskloof	Groot Paardekloof
Full Site Name	Corbelled building, Arbeidersfontein, Williston District	Corbelled building, Grootfontein, Williston District	Corbelled house complex, Stuurmansfontein, Carnarvon District	Abiquaputs (place mentioned in Bleek and Lloyd manuscripts)	Hartogskloof (place mentioned in Bleek and Lloyd manuscripts)	Groot Paardekloof (mentioned in Bleek and Lloyd manuscripts)
Site Type	Building	Building	Building	Place	Place	Place
Grading	Grade II	Grade II	Grade II	Grade II	Grade II	Grade II
Latitude	-31.245752	-31.121828	-30.915783	-30.365246	-30.361937	-30.806733
Longitude	21.257514	21.191884	21.663084	20.786299	21.186933	21.384888
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	None	Direct	None	None	None	None
Nature of Impact	None	Direct	None	None	None	None
Distance	-	On the road	-	On the road	-	-
Comment	-	-	-	-	-	-
Mitigation	-	Avoid - ideally a 1km buffer zone should be respected around the site. If this is not possible, the heritage specialist must be consulted in order to identify possible solutions.	-	-	-	-
Status of the impact	Neutral	Negative	Neutral	Neutral	Neutral	Neutral

Potential intensity (before mitigation)	Low	High	Low	Low	Low	Low
Score	1	8	1	1	1	1
Impact after mitigation	Low	Medium	Low	Low	Low	Low
Score	1	4	1	1	1	1
Spatial Extent	3	3	3	3	3	3
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.1	0.5	0.1	0.1	0.1	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	9	16	9	9	9	9
Significance (impact magnitude * probability)	0.9	8	0.9	0.9	0.9	0.9

Table A2.Impact assessment table for the Grade II heritage resources in the SKA Phase 1 study area, during the operational phase

SAHRIS site ID	27177	27174	29000	89883	89885	89876
Site no	9/2/107/0003	9/2/107/0005	9/2/019/0004	Abiquaputs	Hartogskloof	Groot Paardekloof
Full Site Name	Corbelled building, Arbeidersfontein, Williston District	Corbelled building, Grootfontein, Williston District	Corbelled house complex, Stuurmansfontein, Carnarvon District	Abiquaputs (place mentioned in Bleek and Lloyd manuscripts)	Hartogskloof (place mentioned in Bleek and Lloyd manuscripts)	Groot Paardekloof (mentioned in Bleek and Lloyd manuscripts)
Site Type	Building	Building	Building	Place	Place	Place
Grading	Grade II	Grade II	Grade II	Grade II	Grade II	Grade II
Nature of Impact	None	Indirect	None	None	None	None
Distance	-	On the road	-	-	-	-
Mitigation	-	-	-	-	--	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	4	4	4	4	4	4
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.1	0.5	0.1	0.1	0.1	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	10	10	10	10	10	10

Significance (impact magnitude * probability)	1	5	1	1	1	1
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Table 4. Impact assessment table for the Grade IIIa heritage resources in the SKA Phase 1 study area, during the construction phase

SAHRIS site ID	93440	93437	93439	93436	93441	93456
Site no	HER-SKA001	HER-SKA003	HER-SKA004	HER-SKA005	HER-SKA006	HER-SKA016
Full Site Name	Garst Kolk Farmstead	Garst Kolk rock engraving 01	Garst Kolk rock engraving 02	Garst Kolk rock engraving 03	Garst Kolk rock engraving 04	Graveyard on Visser's Kloof
Site Type	Burial Grounds and Graves, Deposit, Building	Rock Art	Rock Art	Rock Art	Rock Art	Burial Grounds and Graves
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Latitude	-30.684077	-30.66428	-30.66148	-30.662411	-30.662603	-30.81829
Longitude	22.02158	22.0444	22.04439	22.04308	22.042624	21.38557
Impact by SKA satellite	None	Direct	None	None	None	None
Impact by SKA Infrastructure	None	None	Direct	None	None	Direct
Nature of Impact	None	Direct	Direct	None	None	Direct
Distance	-	6m from satellite	90m from existing road	150m from existing road	-	3m from existing road
Comment	-	-	-	-	-	-
Mitigation	-	Avoid - this is located only 6m from the road - upgrade may impact the site significantly. Full recording and fencing during upgrading of the road is necessary	Avoid - located on a koppie - no impact is expected	Avoid - located on a koppie - no impact is expected	-	The site is already fenced off and established. If upgrade of the road is necessary, the road should not expand any further closer to the graveyard.
Status of the impact	Neutral	Negative	Negative	Neutral	Neutral	Negative
Potential intensity (before mitigation)	Low	High	High	High	Low	High
Score	1	8	8	8	1	8
Impact after mitigation	Low	Low	Low	Low	Low	Low

Score	1	1	1	1	1	1
Spatial Extent	2	2	2	2	2	2
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.5	0.5	0.5	0.5	0.5	0.5
Degree of Confidence	Medium	High	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	8	15	15	15	8	15
Significance (impact magnitude * probability)	4	7.5	7.5	7.5	4	7.5

SAHRIS site ID	93454	93450	93467	93473	93470	93495
Site no	HER-SKA013	HER-SKA041	HER-SKA027	HER-SKA055	HER-SKA056	HER-SKA044
Full Site Name	Eland engraving with artefacts	Banksfontein corbelled house	Friesland informal graveyard	Farmstead ruins	Farmstead	De Hoek rock engraving 01
Site Type	Artefacts, Rock Art	Structures	Burial Grounds and Graves, Building	Ruin > 100 years, Building, Stone walling	Deposit, Ruin > 100 years, Building, Burial Grounds and Graves, Stone walling	Rock Art, Artefacts
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Latitude	-30.7992	-31.243739	-31.00777	-30.650545	-30.69116	-30.75452
Longitude	21.38362	21.254007	21.08155	21.26511	21.20475	21.39637
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	Direct	None	Direct	Direct	Direct	Indirect
Nature of Impact	Direct	None	Direct	Direct	Direct	Indirect

Distance	30m from existing road	-	5m from existing road	25m from existing road	25m from existing road	140m from existing road
Comment	-	-	-	-	-	-
Mitigation	Avoid	-	Avoid - if road is to be upgraded, a fence must be erected around the cemetery for the construction phase of the project. Relocation is the least preferred option	Avoid - upgrade of road may indirectly impact on structure - workmen should be aware not to damage the structures	Avoid	Avoid
Status of the impact	Negative	Neutral	Negative	Negative	Negative	Negative
Potential intensity (before mitigation)	High	Low	High	Medium	Medium	Medium
Score	8	1	8	4	4	4
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	2	2	2	2	2	2
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.25	0.25	0.5	0.25	0.25	0.25
Degree of Confidence	Medium	Medium	High	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	15	8	15	11	11	11
Significance (impact magnitude * probability)	3.75	2	7.5	2.75	2.75	2.75

SAHRIS site ID	93475	93472	93490	93480	93520	46491
Site no	HER-SKA045	HER-SKA030	HER-SKA031	HER-SKA040	HER-SKA053	KAT005
Full Site Name	De Hoek rock engraving 02	Grootfontein farmstead with associated infrastructure	Brownslaagte corbelled house	Langbaken farmstead	Farm werf	KAT_Prins 005
Site Type	Rock Art	Burial Grounds and Graves, Ruin > 100 years, Stone walling	Ruin > 100 years, Stone walling	Burial Grounds and Graves, Building, Stone walling	Deposit, Stone walling, Building	Rock Art
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Latitude	-30.75537	-31.04596	-31.170708	-31.358751	-30.646332	-30.742724
Longitude	21.39776	21.054772	21.019528	21.239287	21.271484	21.43008
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	Indirect	Direct	Direct	Indirect	None	None
Nature of Impact	Indirect	Direct	Direct	Indirect	None	None
Distance	140m from fibre optic cabling	15m from existing road	86m from existing road	110m from existing road	-	-
Comment	-	-	-	-	-	-
Mitigation	Avoid	Avoid - since it is very close to the road, any upgrade must ensure that the site is not impacted upon. Since the graves are not close to the road, fencing is not necessary.	Avoid	Avoid - no impact is expected on the farmstead and its components. The possible upgrade of the road should avoid affecting this site.	-	-
Status of the impact	Negative	Negative	Negative	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	High	Medium	High	High	Low	Low
Score	8	4	8	8	1	1

Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	2	2	2	2	2	2
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.1	0.75	0.5	0.25	0.1	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	15	11	15	15	8	8
Significance (impact magnitude * probability)	1.5	8.25	7.5	3.75	0.8	0.8

SAHRIS site ID	46492	46495	46496	46497	46498	46499
Site no	WILLIS001	WILLIS004	WILLIS005	WILLIS006	WILLIS007	WILLIS008
Full Site Name	WILLISTON001	WILLISTON004	WILLISTON005	WILLISTON006	WILLISTON007	WILLISTON008
Site Type	Artefacts	Burial Grounds and Graves	Burial Grounds and Graves	Building	Burial Grounds and Graves	Artefacts
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Latitude	-30.71533	-30.6999	-30.70002	-30.70143	-30.70286	-30.70586
Longitude	21.32102	21.33793	21.3383	21.33566	21.33029	21.37615
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	None	None	None	Direct	None	None
Nature of Impact	None	None	None	Direct	None	None
Distance	-	-	-	26m from existing road	-	-

Comment	-	-	-	--	-	-
Mitigation				Avoid		
Status of the impact	Neutral	Neutral	Neutral	Negative	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Medium	Low	Low
Score	1	1	1	4	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	2	2	2	2	2	2
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.1	0.1	0.1	0.25	0.1	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	8	8	8	11	8	8
Significance (impact magnitude * probability)	0.8	0.8	0.8	2.75	0.8	0.8

SAHRIS site ID	46500	90192	32874	24913	24925	90175
Site no	WILLIS009	GTK 001	9/2/019/4	Banksfontein	Brownslaagte	OEST001
Full Site Name	WILLISTON009	Groot Kolk 001	Corbelled House Complex Stuurmansfontein	Corbelled building at Banksfontein	Corbelled building at Brownslaagte	Oest 001
Site Type	Artefacts	Rock Art	Building	Structures	Structures	Rock Art
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Latitude	-30.7317	-30.40415	-30.913114	-31.169872	-31.170635	-31.008265

Longitude	21.38389	21.50278	21.656633	21.214219	21.01935	21.085551
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	None	Direct	None	None	Indirect	None
Nature of Impact	None	Direct	None	None	Indirect	None
Distance	-	100 m from existing road	-	-	100m from existing road	-
Comment	-	-	-	-	-	-
Mitigation	-	Avoid	-	--	Avoid	-
Status of the impact	Neutral	Negative	Neutral	Neutral	Negative	Neutral
Potential intensity (before mitigation)	Low	High	Low	Low	High	Low
Score	1	8	1	1	8	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	2	2	2	2	2	2
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.1	0.5	0.1	0.1	0.5	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	8	15	8	8	15	8
Significance (impact magnitude * probability)	0.8	7.5	0.8	0.8	7.5	0.8

SAHRIS site ID	90176	90186	201601	201602	201603	201604
Site no	DSK001	JTP001	HRA 1-6	HRA 7	HRA 8	HRA 9 & 11
Full Site Name	Dassiekloof 001	Jagt Pan 001	Hykkerud rock art sites 1 to 6	Hykkerud rock art sites 7	Hykkerud rock art sites 8	Hykkerud rock art sites 9 and 11
Site Type	Rock Art	Rock Art	Rock Art	Rock Art	Rock Art	Rock Art
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Latitude	-30.994261	-30.478004	-31.19334772	-31.16721613	-31.12011671	-31.12077241
Longitude	21.114588	21.458967	21.07043742	21.19796173	21.15537457	21.13947492
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	None	None	None	None	None	None
Nature of Impact	None	None	None	None	None	None
Distance	-	-	More than 1 km from proposed infrastructure	430 m from proposed infrastructure	More than 2 km from proposed infrastructure	More than 3 km from proposed infrastructure
Comment	-	-	-	-	--	-
Mitigation	-	-	Avoid	Avoid	Avoid	Avoid
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Medium	Low	Low
Score	1	1	1	4	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	2	2	2	2	2	2
Duration	Permanent	Permanent	Long term	Long term	Long term	Long term
Duration	5	5	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.1	0.1	0.1	0.1	0.1	0.1

Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	8	8	7	10	7	7
Significance (impact magnitude * probability)	0.8	0.8	0.7	1	0.7	0.7

SAHRIS site ID	201605	201606	201607	201608	201610	201611
Site no	HRA 10	HRA 12-13	HRA 14-16	HRA 17-18	HRA 20	HRA 21-43
Full Site Name	Hykkerud rock art sites 10	Hykkerud rock art sites 12 to 13	Hykkerud rock art sites 14 to 16	Hykkerud rock art sites 17 to 18	Hykkerud rock art sites 20	Hykkerud rock art sites 21 to 43
Site Type	Rock Art	Rock Art	Rock Art	Rock Art	Rock Art	Rock Art
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Latitude	-31.119	-31.07	-31.041	-31.227	-30.941	-31.036
Longitude	21.1624	21.0868	21.0156	21.1808	21.1174	21.0996
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	None	None	None	None	None	Indirect
Nature of Impact	None	None	None	None	None	Indirect
Distance	More than 1 km from proposed infrastructure	More than 3 km from proposed infrastructure	More than 2 km from proposed infrastructure	300 m from proposed infrastructure	More than 1 km from proposed infrastructure	160 m from proposed infrastructure
Comment	-	-	-	-	-	-
Mitigation	Avoid	Avoid	Avoid	Avoid	Avoid	Avoid - buffer of 150m around site
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Negative
Potential intensity (before mitigation)	Low	Low	Low	Medium	Low	High
Score	1	1	1	4	1	8

Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	2	2	2	2	2	2
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.1	0.1	0.1	0.5	0.1	0.5
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	7	7	7	10	7	14
Significance (impact magnitude * probability)	0.7	0.7	0.7	5	0.7	7

Table A4. Impact assessment table for the Grade IIIa heritage resources in the SKA Phase 1 study area, during the operational phase

SAHRIS site ID	93440	93437	93439	93436	93441	93456
Site no	HER-SKA001	HER-SKA003	HER-SKA004	HER-SKA005	HER-SKA006	HER-SKA016
Full Site Name	Garst Kolk Farmstead	Garst Kolk rock engraving 01	Garst Kolk rock engraving 02	Garst Kolk rock engraving 03	Garst Kolk rock engraving 04	Graveyard on Vissers Kloof
Site Type	Burial Grounds and Graves, Deposit, Building	Rock Art	Rock Art	Rock Art	Rock Art	Burial Grounds and Graves
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Nature of Impact	None	Indirect	None	None	None	None
Distance	-	6m from satellite	90m from existing road	150m from existing road	-	3m from existing road
Mitigation	-	If the road is not situated more than 50m away, annual monitoring for the condition of the rock art to assess whether it has been affected by the dust is required. The amount of traffic on the road will impact on the conservation of the site. It is however expected traffic on these roads to be minimal.	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Medium	Low	Low	Low	Low
Score	1	4	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	3	3	3	3	3	3

Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.5	0.5	0.5	0.5	0.5	0.5
Degree of Confidence	Medium	High	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	9	12	9	9	9	9
Significance (impact magnitude * probability)	4.5	6	4.5	4.5	4.5	4.5

SAHRIS site ID	93454	93450	93467	93473	93470	93495
Site no	HER-SKA013	HER-SKA041	HER-SKA027	HER-SKA055	HER-SKA056	HER-SKA044
Full Site Name	Eland engraving with artefacts	Banksfontein corbelled house	Friesland informal graveyard	Farmstead ruins	Farmstead	De Hoek rock engraving 01
Site Type	Artefacts, Rock Art	Structures	Burial Grounds and Graves, Building	Ruin > 100 years, Building, Stone walling	Deposit, Ruin > 100 years, Building, Burial Grounds and Graves, Stone walling	Rock Art, Artefacts
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Nature of Impact	Indirect	None	None	Indirect	Indirect	None
Distance	30m from existing road		5m form existing road	25m from existing road	25m from existing road	140m from existing road
Mitigation	If the road is not situated more than 50m away, annual monitoring for the condition of the rock art to assess whether it has been affected by the dust is required. The amount of traffic on the road will	-	-	A conservation architect should draw up a management plan for its maintenance as part of the SKA properties	A conservation architect should draw up a management plan for its maintenance as part of the SKA properties	-

	impact on the conservation of the site. It is however expected traffic on these roads to be minimal.					
Status of the impact	Neutral	Neutral	Neutral	Neutral	Negative	Neutral
Potential intensity (before mitigation)	Medium	Low	Low	Medium	Medium	Low
Score	4	1	1	4	4	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	3	3	3	3	3	3
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.25	0.25	0.5	0.25	0.25	0.25
Degree of Confidence	Medium	Medium	High	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	12	9	9	12	12	9
Significance (impact magnitude * probability)	3	2.25	4.5	3	3	2.25

SAHRIS site ID	93475	93472	93490	93480	93520	46491
Site no	HER-SKA045	HER-SKA030	HER-SKA031	HER-SKA040	HER-SKA053	KAT005
Full Site Name	De Hoek rock engraving 02	Grootfontein farmstead with associated infrastructure	Brownslaagte corbelled house	Langbaken farmstead	Farm werf	KAT_Prins 005

Site Type	Rock Art	Burial Grounds and Graves, Ruin > 100 years, Stone walling	Ruin > 100 years, Stone walling	Burial Grounds and Graves, Building, Stone walling	Deposit, Stone walling, Building	Rock Art
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Nature of Impact	None	None	None	None	Indirect	None
Distance	140m from fibre optic cabling	15m from existing road	86m from existing road	110m from existing road	-	-
Mitigation	-	-	-	-	A conservation architect should draw up a management plan for its maintenance as part of the SKA properties	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Negative	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Medium	Low
Score	1	1	1	1	4	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	3	3	3	3	3	3
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.1	0.75	0.5	0.25	0.1	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	9	9	9	9	12	9
Significance (impact magnitude * probability)	0.9	6.75	4.5	2.25	1.2	0.9

SAHRIS site ID	46492	46495	46496	46497	46498	46499
Site no	WILLIS001	WILLIS004	WILLIS005	WILLIS006	WILLIS007	WILLIS008
Full Site Name	WILLISTON001	WILLISTON004	WILLISTON005	WILLISTON006	WILLISTON007	WILLISTON008
Site Type	Artefacts	Burial Grounds and Graves	Burial Grounds and Graves	Building	Burial Grounds and Graves	Artefacts
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Nature of Impact	None	None	None	Indirect	None	None
Distance	-	-	-	26m from existing road	-	-
Mitigation	-	-	-	A conservation architect should draw up a management plan for its maintenance as part of the SKA properties	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Medium	Low	Low
Score	1	1	1	4	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	3	3	3	3	3	3
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.1	0.1	0.1	0.25	0.1	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	9	9	9	12	9	9

Significance (impact magnitude * probability)	0.9	0.9	0.9	3	0.9	0.9
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SAHRIS site ID	46500	90192	32874	24913	24925	90175
Site no	WILLIS009	GTK 001	9/2/019/4	Banksfontein	Brownslaagte	OEST001
Full Site Name	WILLISTON009	Groot Kolk 001	Corbelled House Complex Stuurmansfontein	Corbelled building at Banksfontein	Corbelled building at Brownslaagte	Oest 001
Site Type	Artefacts	Rock Art	Building	Structures	Structures	Rock Art
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Nature of Impact	None	None	None	None	None	None
Distance	-	100 m from existing road	-	-	100m from existing road	-
Mitigation	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	3	3	3	3	3	3
Duration	Permanent	Permanent	Permanent	Permanent	Permanent	Permanent
Duration	5	5	5	5	5	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.1	0.5	0.1	0.1	0.5	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium

Magnitude (potential intensity +duration +extent)	9	9	9	9	9	9
Significance (impact magnitude * probability)	0.9	4.5	0.9	0.9	4.5	0.9

SAHRIS site ID	90176	90186	201601	201602	201603	201604
Site no	DSK001	JTP001	HRA 1-6	HRA 7	HRA 8	HRA 9 & 11
Full Site Name	Dassiekloof 001	Jagt Pan 001	Hykkerud rock art sites 1 to 6	Hykkerud rock art sites 7	Hykkerud rock art sites 8	Hykkerud rock art sites 9 and 11
Site Type	Rock Art	Rock Art	Rock Art	Rock Art	Rock Art	Rock Art
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Nature of Impact	None	None	None	None	None	None
Distance	-	-	More than 1 km from proposed infrastructure	430 m from proposed infrastructure	More than 2 km from proposed infrastructure	More than 3 km from proposed infrastructure
Mitigation	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	3	1	3	3	3	3
Duration	Permanent	Permanent	Long term	Long term	Long term	Long term
Duration	5	5	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.1	0.1	0.1	0.1	0.1	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium

Magnitude (potential intensity +duration +extent)	9	7	8	8	8	8
Significance (impact magnitude * probability)	0.9	0.7	0.8	0.8	0.8	0.8

SAHRIS site ID	201605	201606	201607	201608	201610	201611
Site no	HRA 10	HRA 12-13	HRA 14-16	HRA 17-18	HRA 20	HRA 21-43
Full Site Name	Hykkerud rock art sites 10	Hykkerud rock art sites 12 to 13	Hykkerud rock art sites 14 to 16	Hykkerud rock art sites 17 to 18	Hykkerud rock art sites 20	Hykkerud rock art sites 21 to 43
Site Type	Rock Art	Rock Art	Rock Art	Rock Art	Rock Art	Rock Art
Grading	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa	Grade IIIa
Nature of Impact	None	None	None	None	None	None
Distance	More than 1 km from proposed infrastructure	More than 3 km from proposed infrastructure	More than 2 km from proposed infrastructure	300 m from proposed infrastructure	More than 1 km from proposed infrastructure	160 m from proposed infrastructure
Mitigation	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	3	3	3	3	3	3
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability	High irreplaceability
Probability score	0.1	0.1	0.1	0.5	0.1	0.5
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium

Magnitude (potential intensity +duration +extent)	8	8	8	8	8	8
Significance (impact magnitude * probability)	0.8	0.8	0.8	4	0.8	4

Table A5. Impact assessment table for the Grade IIIb heritage resources in the SKA Phase 1 study area, during the construction phase

SAHRIS site ID	93435	93448	93451	93478	93488	93463
Site no	HER-SKA007	HER-SKA008	HER-SKA046	HER-SKA011	HER-SKA012	HER-SKA033
Full Site Name	Wolfwerf stone walling and ruins	Jan Louws Kolk stone kraal	De Hoek rock engraving 03	Quiver tree forest	Quiver tree forest	Zandputs kraal and farmstead
Site Type	Ruin > 100 years, Stone walling	Stone walling, Deposit, Burial Grounds and Graves	Rock Art	Natural	Natural	Stone walling, Building
Grading	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb
Latitude	-30.363269	-30.2936	-30.75488	-30.777342	-30.79658	-31.223181
Longitude	21.175718	21.02477	21.39677	21.403395	21.390703	21.013112
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	Direct	Direct	Indirect	Indirect	Indirect	Direct
Nature of Impact	Direct	Direct	Indirect	Indirect	Indirect	Direct
Distance	30m from existing road	On the road	100m from existing road	115m from existing road	45m	55m from the road
Comment	-	-	-	-	-	-
Mitigation	Avoid - fence off during construction phase if necessary	Avoid - the site is located in very close proximity of the existing road, the fibre optic cable route and additional proposed infrastructure. If avoidance with a 25m buffer zone is not possible, then detail recording of the site is required	Avoid	Avoid	The forest is on the ridge, no impact will occur on the forest	The farmstead is located next to the road. Upgrade of the road should not interfere with the farmstead. If any impact on the farmstead is expected, recorded in full by a historical architect is recommended to assess the full significance of the site
Status of the impact	Negative	Negative	Negative	Negative	Negative	Negative
Potential intensity (before mitigation)	Medium	Medium	High	Medium	Medium	Low
Score	4	4	8	4	4	1

Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Permanent	Permanent	Permanent	Long term	Long term	Long term
Duration	5	5	5	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.25	0.75	0.5	0.5	0.5	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	10	10	14	9	9	6
Significance (impact magnitude * probability)	2.5	7.5	7	4.5	4.5	0.6

SAHRIS site ID	93477	93481	93485	93510	46488	46489
Site no	HER-SKA042	HER-SKA043	HER-SKA051	HER-SKA071	KAT002	KAT003
Full Site Name	Vaalhoek/Bloemfontein Farmstead	De Hoek quiver tree forest	Rooisand house	Rock engraving - eland with flat horns	KAT_Prins 002	KAT_Prins 003
Site Type	Building	Natural	Building	Rock Art	Artefacts	Artefacts
Grading	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb
Latitude	-31.140177	-30.756007	-30.679897	-30.755871	-30.751533	-30.74475
Longitude	21.015923	21.392612	21.320515	21.395016	21.432383	21.436467
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	Direct	Indirect	Direct	Direct	Indirect	Indirect
Nature of Impact	Direct	Indirect	Direct	Direct	Indirect	Indirect

Distance	Adjacent to the road	270m from fibre optic cable route	12m	28m from fibre cable route	180m from fibre optic cable route	-
Comment	-	-	on koppie	unless roads, proximity to satellite	-	-
Mitigation	The farmstead is located next to the road. Upgrade of the road should not interfere with the farmstead.	Avoid	Avoid	Avoid. The site must be fenced off during the construction phase to avoid any unwanted damage to the site.	Avoid if possible, otherwise record site in detail before destruction. It is expected that avoidance will be possible given the distance between the site and the fibre optic route	
Status of the impact	Negative	Negative	Negative	Negative	Negative	Negative
Potential intensity (before mitigation)	Low	Medium	Medium	High	Medium	Low
Score	1	4	4	8	4	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Medium reversibility	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.5	0.25	0.5	0.5	0.25	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	6	9	9	13	9	6

Significance (impact magnitude * probability)	3	2.25	4.5	6.5	2.25	0.6
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SAHRIS site ID	46490	46493	46494	93790	93791	93792	93479
Site no	KAT004	WILLIS002	WILLIS003	HER-SKA082	HER-SKA083	HER-SKA084	HER-SKA034
Full Site Name	KAT_Prins 004	WILLISTON002	WILLISTON003	Artefact Scatter	Rock engraving	Artefact Scatter	Francois Esterhuizen memorial stone
Site Type	Stone walling	Artefacts	Stone walling	Artefacts	Rock Art	Artefacts	Monuments and Memorials
Grading	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb
Latitude	-30.74445	-30.71763	-30.71681	-30.808617	-30.735133	-30.268717	-31.23742
Longitude	21.434683	21.32717	21.32686	21.12405	21.1836	22.218817	21.01144
Impact by SKA satellite	None	None	None	None	Indirect	None	Indirect
Impact by SKA Infrastructure	None	None	None	Indirect	Direct	None	Direct
Nature of Impact	None	None	None	Indirect	Direct	None	Direct
Distance	-	-	-	100m from existing road	90m from satellite station and 35m from MV underground	-	On the road
Comment	-	-	-	-	-	-	-
Mitigation	-	-	-	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid - if not possible the site needs to be mitigated sufficiently by an archaeologist	-	If this is not possible, relocation in the area, in consultation with the family must be undertaken.
Status of the impact	Neutral	Neutral	Neutral	Negative	Negative	Neutral	Negative
Potential intensity (before mitigation)	Low	Low	Low	Medium	High	Low	Medium
Score	1	1	1	4	8	1	4

Impact after mitigation	Low	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Permanent	Long term
Duration	4	4	4	4	4	5	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.1	0.1	0.1	0.1	0.5	0.1	1
Degree of Confidence	Medium	Medium	Medium	High	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	6	6	6	9	13	7	9
Significance (impact magnitude * probability)	0.6	0.6	0.6	0.9	6.5	0.7	9

Table A6. Impact assessment table for the Grade IIIb heritage resources in the SKA Phase 1 study area, during the operational phase

SAHRIS site ID	93435	93448	93451	93478	93488	93463
Site no	HER-SKA007	HER-SKA008	HER-SKA046	HER-SKA011	HER-SKA012	HER-SKA033
Full Site Name	Wolfwerf stone walling and ruins	Jan Louws Kolk stone kraal	De Hoek rock engraving 03	Quiver tree forest	Quiver tree forest	Zandputs kraal and farmstead
Site Type	Ruin > 100 years, Stone walling	Stone walling, Deposit, Burial Grounds and Graves	Rock Art	Natural	Natural	Stone walling, Building
Grading	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb
Nature of Impact	None	None	None	None	None	None
Distance	30m from existing road	On the road	100m from existing road	115m from existing road	45m	55m from the road
Mitigation	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Permanent	Permanent	Permanent	Long term	Long term	Long term
Duration	5	5	5	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.25	0.75	0.5	0.5	0.5	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	7	7	7	6	6	6

Significance (impact magnitude * probability)	1.75	5.25	3.5	3	3	0.6
SAHRIS site ID	93477	93479	93481	93485	93510	46488
Site no	HER-SKA042	HER-SKA034	HER-SKA043	HER-SKA051	HER-SKA071	KAT002
Full Site Name	Vaalhoek/Bloemfontein Farmstead	Francois Esterhuizen memorial stone	De Hoek quiver tree forest	Rooisand house	Rock engraving - eland with flat horns	KAT_Prins 002
Site Type	Building	Monuments and Memorials	Natural	Building	Rock Art	Artefacts
Grading	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb
Nature of Impact	None	None	None	Indirect	None	None
Distance	Adjacent to the road	On the road	270m from fibre optic cable route	12m from road	28m from fibre cable route	180m from fibre optic cable route
Mitigation	-	-	-	A conservation architect should draw up a management plan for its maintenance as part of the SKA properties	-	-
Status of the impact	Neutral	Neutral	Neutral	Negative	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Medium	Low	Low
Score	1	1	1	4	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Medium reversibility	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.5	1	0.25	0.5	0.5	0.25

Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	6	6	6	9	6	6
Significance (impact magnitude * probability)	3	6	1.5	4.5	3	1.5

SAHRIS site ID	46489	46490	46493	46494	93790	93791	93792
Site no	KAT003	KAT004	WILLIS002	WILLIS003	HER-SKA082	HER-SKA083	HER-SKA084
Full Site Name	KAT_Prins 003	KAT_Prins 004	WILLISTON002	WILLISTON003	Artefact Scatter	Rock engraving	Artefact Scatter
Site Type	Artefacts	Stone walling	Artefacts	Stone walling	Artefacts	Rock Art	Artefacts
Grading	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb	Grade IIIb
Nature of Impact	None	None	None	None	None	None	None
Distance	-	-	-	-	100m from existing road	90m from satellite station and 35m from MV underground	-
Mitigation	-	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term	Permanent
Duration	4	4	4	4	4	4	5
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability

Probability score	0.1	0.1	0.1	0.1	0.1	0.5	0.1
Degree of Confidence	Medium	Medium	Medium	Medium	High	Medium	Medium
Magnitude (potential intensity +duration +extent)	6	6	6	6	6	6	7
Significance (impact magnitude * probability)	0.6	0.6	0.6	0.6	0.6	3	0.7

Table A7. Impact assessment table for the Grade IIIc heritage resources in the SKA Phase 1 study area, during the construction phase

SAHRIS site ID	89921	93438	93458	93460	93453	93466
Site no	KAT_Morris_004.1	HER-SKA002	HER-SKA057	HER-SKA029	HER-SKA014	HER-SKA048
Full Site Name	KAT004.1	Random MSA hornfels scatters	Shale stone kraal along river	Farm boundary cairn	Kraal and threshing floor	Rock engraving
Site Type	Artefacts	Artefacts	Stone walling	Structures	Artefacts, Ruin > 100 years, Stone walling	Rock Art
Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Latitude	-30.7438	-30.66584	-31.04665	-31.04265	-30.800106	-30.72764
Longitude	21.43306	22.04248	21.0614	21.0763	21.381921	21.35971
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	None	Direct	Direct	None	Indirect	None
Nature of Impact	None	Direct	Direct	None	Indirect	None
Distance	-	1m from fibre optic cable route	12m from the existing road	-	20m	-
Comment	-	-	-	-	on koppie	-
Mitigation	-	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	-	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	-
Status of the impact	Negative	Negative	Negative	Neutral	Negative	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1

Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.1	1	0.1	0.1	1	0.1
Degree of Confidence	Medium	High	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	6	6	6	6	6	6
Significance (impact magnitude * probability)	0.6	6	0.6	0.6	6	0.6

SAHRIS site ID	93474	93483	93492	93462	93471	93502
Site no	HER-SKA028	HER-SKA050	HER-SKA052	HER-SKA054	HER-SKA026	HER-SKA063
Full Site Name	Farm boundary cairn	OES flask in the road	Zoutrivier farmstead	LSA scatter	Friesland Suid Boundary marker	Dolerite cobble cluster
Site Type	Structures	Artefacts	Building	Artefacts	Structures	Archaeological
Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Latitude	-31.04354	-30.70609	-30.62023	-30.65634	-31.00274	-30.668464
Longitude	21.07745	21.37661	21.30582	21.28707	21.07933	22.040806
Impact by SKA satellite	None	None	None	None	None	Indirect
Impact by SKA Infrastructure	None	None	None	Direct	Direct	Direct
Nature of Impact	None	None	None	Direct	Direct	Direct
Distance	400m from satellite station	2.7km from satellite station	1km from steel monopole	8m from station	The site is located 5m from the access road and 5m from the fibre cable route	34m from existing road
Comment	-	-	-	-	-	-

Mitigation	-	-	-	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded
Status of the impact	Neutral	Neutral	Neutral	Negative	Negative	Negative
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.1	0.1	0.1	1	0.75	0.75
Degree of Confidence	Medium	Medium	Medium	High	Medium	Medium
Magnitude (potential intensity +duration +extent)	6	6	6	6	6	6
Significance (impact magnitude * probability)	0.6	0.6	0.6	6	4.5	4.5

SAHRIS site ID	93503	93504	93514	93516	93517	93518
Site no	HER-SKA064	HER-SKA065	HER-SKA075	HER-SKA077	HER-SKA078	HER-SKA079
Full Site Name	Large MSA Scatter	Stone Kraal	Rock engraving - scratched	Rock engraving - scraped	LSA scatter	LSA scatter
Site Type	Artefacts	Stone walling	Rock Art	Rock Art	Artefacts	Artefacts

Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Latitude	-30.665071	-30.684974	-30.756544	-30.72	-30.706135	-30.705973
Longitude	22.047313	22.020652	21.395509	21.359506	21.375672	21.375757
Impact by SKA satellite	Indirect	None	None	None	None	None
Impact by SKA Infrastructure	Indirect	Direct	Direct	None	None	None
Nature of Impact	Indirect	Direct	Indirect	None	None	None
Distance	130m from road - 250 from station	5m from existing road	1m from the road	-	2.7km from station	2.7km from station
Comment	-	-	-	-	-	-
Mitigation	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded. Avoidance might be difficult in this instance since the boulder is located in very close proximity of the road	-	-	-
Status of the impact	Negative	Negative	Negative	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Medium	Medium	Medium	Low	Low	Low
Score	4	4	4	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.25	0.75	0.75	0.1	0.1	0.1

Degree of Confidence	Medium	Medium	High	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	9	9	9	6	6	6
Significance (impact magnitude * probability)	2.25	6.75	6.75	0.6	0.6	0.6

SAHRIS site ID	93519	93507	89920	46487	93445	93469
Site no	HER-SKA080	HER-SKA068	KAT005.1	KAT001	HER-SKA010	HER-SKA049
Full Site Name	LSA scatter	Rock engraving - scratched	KAT005.1	KAT_Prins 001	Stone dam wall	Stone realignment
Site Type	Artefacts	Rock Art	Rock Art	Artefacts	Stone walling	Stone walling
Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Latitude	-30.706061	-30.799453	-30.74282	-30.752267	-30.77814	-30.72876
Longitude	21.376042	21.384056	21.43054	21.4298	21.40346	21.3928
Impact by SKA satellite	None	None	None	None	None	None
Impact by SKA Infrastructure	None	Direct	None	Direct	Indirect	Indirect
Nature of Impact	None	Direct	None	Direct	Indirect	Indirect
Distance	2.7km from station	70m from existing road		60m from fibre optic cable route	115m from existing road	100m from MV power line
Comment	-	-	-	-	-	-
Mitigation	-	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	-	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid during upgrade of the road, same as 93478, the quiver tree forests growing around it	Avoid if possible, but otherwise sufficiently recorded.
Status of the impact	Neutral	Negative	Neutral	Negative	Negative	Negative
Potential intensity (before mitigation)	Low	Low	Low	Low	Medium	Low
Score	1	1	1	1	4	1

Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.1	0.5	0.1	0.5	0.25	0.25
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	6	6	6	6	9	6
Significance (impact magnitude * probability)	0.6	3	0.6	3	2.25	1.5

SAHRIS site ID	93476	93489	93491	93468	93493	93499	93505
Site no	HER-SKA047	HER-SKA038	HER-SKA039	HER-SKA036	HER-SKA037	HER-SKA009	HER-SKA066
Full Site Name	Farm ruins	Dam wall	Rock fence line	Rondavels	Walkraal farmstead	Hornfels artefact scatter	Stone Age scatter
Site Type	Ruin > 100 years, Artefacts	Stone walling	Structures	Building	Building, Stone walling	Artefacts	Artefacts
Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Latitude	-30.74644	-31.34694	-31.35844	-31.325305	-31.328861	-30.794115	-30.369687
Longitude	21.36809	21.23085	21.23903	20.981741	21.073505	21.391754	21.412965
Impact by SKA satellite	None	None	None	None	None	None	Direct
Impact by SKA Infrastructure	Direct	Direct	Indirect	Direct	Indirect	Direct	Direct
Nature of Impact	Direct	Direct	Indirect	Direct	Indirect	Direct	Direct
Distance	26m from existing road	15m from the road	110m from the road	50m from the road	150m from the road	50m from the road	25m from satellite
Comment	-	-	-	-	-	-	-

Mitigation	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid - no impact is expected by the upgrade of the road	Avoid	Avoid	Avoid - if not possible the site has been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded
Status of the impact	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Potential intensity (before mitigation)	Medium	Low	Medium	Medium	Medium	Low	Low
Score	4	1	4	4	4	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term	Permanent
Duration	4	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.5	0.75	0.25	0.5	0.25	0.5	0.75
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	9	6	9	9	9	6	5
Significance (impact magnitude * probability)	4.5	4.5	2.25	4.5	2.25	3	3.75

SAHRIS site ID	93506	93508	93511	93512	93513	93515	93521
Site no	HER-SKA067	HER-SKA069	HER-SKA072	HER-SKA073	HER-SKA074	HER-SKA076	HER-SKA081
Full Site Name	Rock engraving - scratched	Rock engraving - scratched	Boulder enclosure	Rock engraving - scratched	Rock engraving – scratched	Rock engraving - scratched	Rock engraving - scratched
Site Type	Rock Art	Rock Art	Archaeological	Rock Art	Rock Art	Rock Art	Rock Art

Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Latitude	-30.797075	-30.799039	-30.755853	-30.755807	-30.756046	-30.756674	-30.696854
Longitude	21.389394	21.384166	21.394984	21.394522	21.39559	21.395938	21.17729
Impact by SKA satellite	None	None	None	None	None	None	None
Impact by SKA Infrastructure	Indirect	Direct	Direct	Direct	Direct	Direct	Direct
Nature of Impact	Indirect	Direct	Direct	Direct	Direct	Direct	Direct
Distance	200m from the road	30m from the road	30m from fibre cable route	70m from fibre cable route	20m from fibre cable route	7m from the fibre cable route	10m from the road
Comment	-	-	-	-	-	-	-
Mitigation	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid, but if avoidance is not possible, the site has already been sufficiently recorded	Avoid - if not possible the site has been sufficiently recorded - avoidance might be difficult in this instance since the boulder is located in very close proximity of the road	Site is sufficiently recorded
Status of the impact	Negative	Negative	Negative	Negative	Negative	Negative	Negative
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible

Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.25	0.5	0.5	0.5	0.5	0.75	0.75
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	6	5	6	6	6	6	6
Significance (impact magnitude * probability)	1.5	2.5	3	3	3	4.5	4.5

Table A8.Impact assessment table for the Grade IIIc heritage resources in the SKA Phase 1 study area, during the operational phase

SAHRIS site ID	89921	93438	93458	93460	93453	93466
Site no	KAT_Morris_004.1	HER-SKA002	HER-SKA057	HER-SKA029	HER-SKA014	HER-SKA048
Full Site Name	KAT004.1	Random MSA hornfels scatters	Shale stone kraal along river	Farm boundary cairn	Kraal and threshing floor	Rock engraving
Site Type	Artefacts	Artefacts	Stone walling	Structures	Artefacts, Ruin > 100 years, Stone walling	Rock Art
Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Nature of Impact	None	None	None	None	None	None
Distance	-	1m from fibre optic cable route	12m from the existing road	-	20m	-
Mitigation	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.1	1	0.1	0.1	1	0.1
Degree of Confidence	Medium	High	Medium	Medium	Medium	Medium
Magnitude (potential intensity +duration +extent)	6	6	6	6	6	6

Significance (impact magnitude * probability)	0.6	6	0.6	0.6	6	0.6
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SAHRIS site ID	93474	93483	93492	93462	93471	93502
Site no	HER-SKA028	HER-SKA050	HER-SKA052	HER-SKA054	HER-SKA026	HER-SKA063
Full Site Name	Farm boundary cairn	OES flask in the road	Zoutrivier farmstead	LSA scatter	Friesland Suid Boundary marker	Dolerite cobble cluster
Site Type	Structures	Artefacts	Building	Artefacts	Structures	Archaeological
Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Nature of Impact	None	None	None	None	None	None
Distance	400m from satellite station	2.7km from satellite station	1km from steel monopole	8m from station	The site is located 5m from the access road and 5m from the fibre cable route	34m from existing road
Mitigation	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.1	0.1	0.1	1	0.75	0.75
Degree of Confidence	Medium	Medium	Medium	High	Medium	Medium

Magnitude (potential intensity +duration +extent)	6	6	6	6	6	6
Significance (impact magnitude * probability)	0.6	0.6	0.6	6	4.5	4.5

SAHRIS site ID	93503	93504	93514	93516	93517	93518
Site no	HER-SKA064	HER-SKA065	HER-SKA075	HER-SKA077	HER-SKA078	HER-SKA079
Full Site Name	Large MSA Scatter	Stone Kraal	Rock engraving - scratched	Rock engraving - scraped	LSA scatter	LSA scatter
Site Type	Artefacts	Stone walling	Rock Art	Rock Art	Artefacts	Artefacts
Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Nature of Impact	None	None	None	None	None	None
Distance	130m from road - 250 from station	5m from existing road	1m form the road	-	2.7km from station	2.7km from station
Mitigation	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.25	0.75	0.75	0.1	0.1	0.1
Degree of Confidence	Medium	Medium	High	Medium	Medium	Medium

Magnitude (potential intensity +duration +extent)	6	6	6	6	6	6
Significance (impact magnitude * probability)	1.5	4.5	4.5	0.6	0.6	0.6

SAHRIS site ID	93519	93507	89920	46487	93445	93469
Site no	HER-SKA080	HER-SKA068	KAT005.1	KAT001	HER-SKA010	HER-SKA049
Full Site Name	LSA scatter	Rock engraving - scratched	KAT005.1	KAT_Prins 001	Stone dam wall	Stone realignment
Site Type	Artefacts	Rock Art	Rock Art	Artefacts	Stone walling	Stone walling
Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Nature of Impact	None	None	None	None	None	None
Distance	2.7km from station	70m from existing road	-	60m from fibre optic cable route	115m from existing road	100m from MV power line
Mitigation	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.1	0.5	0.1	0.5	0.25	0.25
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium

Magnitude (potential intensity +duration +extent)	6	6	6	6	6	6
Significance (impact magnitude * probability)	0.6	3	0.6	3	1.5	1.5

SAHRIS site ID	93476	93489	93491	93468	93493	93499	93505
Site no	HER-SKA047	HER-SKA038	HER-SKA039	HER-SKA036	HER-SKA037	HER-SKA009	HER-SKA066
Full Site Name	Farm ruins	Dam wall	Rock fence line	Rondavels	Walkraal farmstead	Hornfels artefact scatter	Stone Age scatter
Site Type	Ruin > 100 years, Artefacts	Stone walling	Structures	Building	Building, Stone walling	Artefacts	Artefacts
Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Nature of Impact	None	None	None	None	None	None	None
Distance	26m from existing road	15m from the road	110m from the road	50m from the road	150m from the road	50m from the road	25m from satellite
Mitigation	-	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term	Permanent
Duration	4	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.5	0.75	0.25	0.5	0.25	0.5	0.75
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium	Medium

Magnitude (potential intensity +duration +extent)	6	6	6	6	6	6	6
Significance (impact magnitude * probability)	3	4.5	1.5	3	1.5	3	4.5

SAHRIS site ID	93506	93508	93511	93512	93513	93515	93521
Site no	HER-SKA067	HER-SKA069	HER-SKA072	HER-SKA073	HER-SKA074	HER-SKA076	HER-SKA081
Full Site Name	Rock engraving - scratched	Rock engraving - scratched	Boulder enclosure	Rock engraving - scratched	Rock engraving – scratched	Rock engraving - scratched	Rock engraving - scratched
Site Type	Rock Art	Rock Art	Archaeological	Rock Art	Rock Art	Rock Art	Rock Art
Grading	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc	Grade IIIc
Nature of Impact	None	None	None	None	None	None	None
Distance	200m from the road	30m from the road	30m from fibre cable route	70m from fibre cable route	20m from fibre cable route	7m form the fibre cable route	10m from the road
Mitigation	-	-	-	-	-	-	-
Status of the impact	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Potential intensity (before mitigation)	Low	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1	1
Impact after mitigation	Low	Low	Low	Low	Low	Low	Low
Score	1	1	1	1	1	1	1
Spatial Extent	1	1	1	1	1	1	1
Duration	Long term	Long term	Long term	Long term	Long term	Long term	Long term
Duration	4	4	4	4	4	4	4
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability	Low irreplaceability
Probability score	0.25	0.5	0.5	0.5	0.5	0.75	0.75
Degree of Confidence	Medium	Medium	Medium	Medium	Medium	Medium	Medium

Magnitude (potential intensity +duration +extent)	6	6	6	6	6	6	6
Significance (impact magnitude * probability)	1.5	3	3	3	3	4.5	4.5

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Appendix C. Heritage Screener

Appendix D. Palaeontological Impact Assessment

Appendix E. Visual Impact Assessment
