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The South African Radio Astronomy Observatory Square Kilometre Array Heritage Impact Assessment and Conservation Management Plan Project

Heritage Impact Assessment

Project Number:

NRF4874

Prepared for:

The South African Radio Astronomy Observatory

July 2018

SAHRIS Case ID: 12292

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Report Type:	**Heritage Impact Assessment**
Project Name:	**The South African Radio Astronomy Observatory Square Kilometre Array Heritage Impact Assessment and Conservation Management Plan Project**
Project Code:	**NRF4874**

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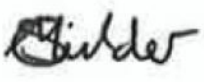
Stephanie Mulder	Visual Impact Assessment		June 2018
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EXECUTIVE SUMMARY

Digby Wells Environmental (hereinafter Digby Wells) are providing specialist heritage services to the South African Radio Astronomy Observatory (SARAO) as per their brief (*BID SKA PEP 6 001/2017*). This brief requires the full execution of services to complete a Heritage Impact Assessment (HIA) and Conservation Management Plan (CMP) in support of their Square Kilometre Array (SKA) Project ("the Project"). The international SKA Organisation (SKAO) proposes to establish an additional 133 antennas to the 64-dish MeerKAT telescope and associated infrastructure.

This Heritage Resources Management (HRM) process must satisfy the requirements of Section 38(3) of the National Heritage Resources Act, 1999 (Act 25 of 1999) (NHRA) as well as Statutory Comment issued by the South African Heritage Resources Agency (SAHRA) on Case ID: 10314[1].

This document serves as the HIA report and the first primary deliverable of the HRM process. The following activities were completed during this stage of the HRM process:

- Defining the cultural landscape within which the Project is situated, including the archaeological, built heritage, palaeontological and visual components;
- Identifying, as far as is feasible, heritage resources that may be impacted upon by the Project and define the Cultural Significance (CS) of such resources;
- Assessing the possible impacts to the identified heritage resources;
- Consideration of the socio-economic benefits of the Project; and
- Providing feasible mitigation and management measures to avoid, remove or reduce the perceived impacts and risks.

Through an understanding of the distribution of various heritage resources within the site-specific study area, the statement of CS as presented in the table below demonstrates an average high CS for the cultural landscape.

Summary of the Cultural Significance of the Cultural Landscape

Resource ID	Description	Integrity	CS Value	Cultural Significance
Abrahamskraal Formation	Sandstone, mudstone lithology with diverse terrestrial and freshwater tetrapods of Tapinocephalus to Lystrosaurus Biozones, Palaeoniscoid fish, freshwater bivalves, trace fossils and sparse vascular plants	4	20	Very High

[1] Available at: http://www.sahra.org.za/sahris/cases/csir-ska-phase-1

Resource ID	Description	Integrity	CS Value	Cultural Significance
Burial grounds and graves	Unidentified burials associated with the /Xam	4	20	Very High
Burial grounds and graves	Burial grounds and graves affiliated with historic farmsteads and associated labourer homesteads - i.e. Xhosa, Korana and Griqua	4	20	Very High
Burial grounds and graves	Burial grounds and graves affiliated with historic farmsteads and associated labourer homesteads	4	20	Very High
Burial grounds and graves	Burial grounds and graves affiliated with historic farmsteads and associated labourer homesteads	4	20	Very High
White Hill Formation	Mesosaurid reptiles, rare cephalochordates, variety of palaeoniscoid fish, small eocarid crustaceans, insects, low diversity of trace fossils	4	20	Very High
Rock Engravings	Images produced by incising, chipping, or pecking to depict imagery of realistic and proportionally correct animals, human figures and shamanistic concepts	4	18	Very High
Rock Paintings	Limited and distinctive set of geometric forms, such as circular outlines, crosses, lines, concentric circles, oblong forms and finger-applied dots	4	17	High
Historic Built Environment	Corbelled houses - vernacular architecture in the context of setting	4	15	High
LSA (Site)	Microlithic scrapers and segments. Assemblage characterised by many blades and backed blades on CCS. Preliminarily classified as Swartkop.	4	15	High
Visual	Visual, aesthetic and scenic character	3	12	Medium
LSA (Herder period)	Lithics dominated by coarse irregular flakes commonly on quarts, with small or absent retouched component. Characterised by large samples of thin walled ceramics	4	11	Medium

Resource ID	Description	Integrity	CS Value	Cultural Significance
LSA Occurrences	Assemblage characterised by un-patinated hornfels.	3	10	Low
ESA Occurrences	Long blades, cores and low incidences of formal tools moderate to heavily weathered	2	7	Low
Historic Built Environment	Farmstead ruins and complexes as tangible markers of a historically layered cultural landscape	2	6	Low
MSA Occurrences	High proportion of minimally modified blades and points produced from good quality raw material. Occur widely over the landscape through geological action rather than human.	2	4	Negligible

A summary of the impact assessment is presented in the table below. Considering the identified impacts the following recommendations are made:

Specific Recommendations

Aspect	Recommendation	Description
Archaeology	*In situ* conservation of identified archaeological resources	Identified archaeological resources must remain *in situ. Where new infrastructure occurs within proximity to the resource,* a minimum buffer of 50 m must be observed during construction and operational activities. The extent of the buffer area must be clearly demarcated, and signage placed to indicate the presence of the resource. Where infrastructure realignment is possible, this must be undertaken to exclude the buffer area from development footprints. This recommendation is applicable to the following known archaeological resources: HER-SKA014; HER-SKA056; MXD-001; MXD-002; MXD-003; SA-001; SA-002; SA-005; SA-006; SA-007; SA-009; SA-012; SA-013; SA-014; SA-015; SA-017; BGG-001; BGG-002; RA-003, RA-004, RA-006, RA-007, RA-008, RA-009 and RA-010; HER-SKA004; HER-SKA013; HER-SKA068; HER-SKA069; HER-SKA008; HER-SKA016; HER-SKA027, and burial grounds and graves associated with farmsteads within the core area.

Aspect	Recommendation	Description
	Detailed recording of identified archaeological resources	Where new infrastructures that are not capable of realignment (i.e. antennas) are situated within the defined 50 m buffer, the identified heritage resources must be recorded in detail prior to the construction phase. This may include inter alia, distribution and density mapping, surface collection and test excavations subject to the approval of a Section 35 Permit. This recommendation is applicable to the following identified heritage resources: SA-005, SA-006, SA-012, SA-014, SA-015 and SA-017.
	Phase 2 Archaeological Mitigation	The heritage resource SA-016 is situated within the development footprint of antenna SKA-027. The assessor acknowledges that realignment of this infrastructure is not feasible in the context of the SKA Project, and preservation of the site in situ as a management measure being a challenge. In this instance, the identified impact cannot be removed or avoided, but the intensity of the impact to SA-016 can be reduced through adoption of the following recommendations: ▪ SA-016 must be recorded in detail prior to the construction phase. This may include *inter alia*, distribution and density mapping, and test excavations subject to the approval of a Section 35 Permit; and ▪ A Watching Brief undertaken by a suitably qualified and accredited archaeologist must be completed during earth moving activities to record all material cultural remains that may be exposed. The results of the Watching Brief must be compiled into a Watching Brief Report and submitted to SAHRA for noting.
Built Environment	*In-situ* conservation of identified Built Heritage resources within the SKA Core area	This recommendation is applicable to the following heritage resources: BHS 1, BHS 5 and BHS 6. The identified Historical Built Environment resources must remain *in situ* and a minimum buffer of 1 km must be established around these resources. This buffer zone must be considered a 'no-go' area within which no Project-related activities are to take place. These resources must be recorded in detail through photographs and measured drawings prior to the commencement of the construction phase.

Aspect	Recommendation	Description
	Establish buffers around identified Built Heritage resources within the site-specific study area	This recommendation is applicable to the following heritage resources: BHS 7 and BHS 8 Buffers around the identified Historical Built Environment resources must be observed. The following buffers and requirements are applicable: ▪ BHS 7: a minimum buffer of 1 km must be established around these resources. This buffer zone must be considered a 'no-go' area within which no Project-related activities are to take place. ▪ BHS 8: a minimum buffer of 50 m must be established this resource. This buffer zone must be considered a 'no-go' area within which no Project-related activities are to take place.
	Conservation through records for buildings to be demolished	This recommendation is applicable to the following heritage resources: BHS 2, BHS 3 and BHS 4 Any proposed demolition of graded structures is subject to the requirements stipulated under Sections 27 & 34 of the NHRA and regulated by Chapter IV of GN R 548. The graded structures and associated adjacent structures must be recorded in detail in support of the application for demolition, and as a method of "preservation through record". Records should consist of photographs and measured drawings. It is recommended the structures only be demolished to their existing floor level, i.e. removal of the walls and superstructure but keeping the buildings foot print to prevent squatting and the need for maintenance. Historic building materials, where in existence and in a good condition (such as door and window frames or fireplaces), should be retained and made available for reuse for other historic structures in the area.
Visual	Limit light pollution of the construction camps	Lighting of the construction camps at night must not exceed the minimum requirements for safety and security. Down lighting and low-pressure lighting mediums such as sodium light sources must be implemented. Lights must be directed inwards to the camp area and not outwards

General Recommendations

Recommendation	Description
Develop a Conservation Management Plan and Chance Find Protocol for implementation	A project specific CMP including CFPs must be developed and implemented as part of this Project that considers the project related activities in relation to the specified infrastructures. The CMP and CFPs must consider the sensitivity of the landscape in terms of palaeontology (Refer to Figure 4-1) and archaeology (Refer to Plan 8). This is currently part of the scope of the HRM Process and will be submitted to SAHRA and NC-PHRA for adjudication and approval.
Declaration of Built Heritage resources	Built Heritage resources with a recommended field rating of Grade II be formally declared or Grade III included in the national inventory.
Establish buffers around Built Heritage resources within the site-specific study area as per Section 6.4 of the specialist Built Environment Assessment (Appendix F)	The significance of these resources will inform the size of the recommended buffer to be implemented around the structures intended for retention. Grade II resources will require a 1 km buffer, retained Grade III A resources will require a 150 m buffer zone and retained Grade III B and III C resources require a 50 m buffer. These buffer zones must be implemented during construction and operation phases.
Structures older than 60 years are subject to permitting requirements	Structures are older than 60 years are afforded general protection and subject to permitting requirements stipulated under Sections 27 & 34 of the NHRA and regulated by Chapter IV of GN R 548. . Individual permit applications must therefore be submitted for each protected building proposed for demolition. The affected structures must be recorded in detail prior to their alteration or destruction. This will include *inter alia* photographs and measured drawings.
Rehabilitate after construction	The development footprint must be rehabilitated as far as possible to reduce the intensity of the visual disturbance. This may include the following activities: ▪ Limiting heights of any topsoil spoils that may be created ▪ Trenched areas must be re-contoured ▪ Borrow pits and quarries must be profiled to a natural topography ▪ Disturbed areas must be revegetated with indigenous species in accordance with the requirements contained within the Ecological Assessment
Reduce visual disturbance during construction	Dust suppression techniques should be employed as far as possible to limit dust pollution during construction activities.
	Construction during the night must be avoided as far as possible. Where unavoidable, areas where these activities are taking place should be lit and the number of lights and brightness must not exceed the minimum requirements for safety and security. Down lighting and low-pressure lighting mediums such as sodium light

Recommendation	Description
	sources must be implemented to minimise light pollution. Lights should be directed inwards towards the Project area and not outwards from the Project area.

SKA Project

Local Setting

Legend

- SKA Phase 1 Core
- SKA Phase 1 Spiral Arms
- City
- National Road
- Regional Study Area
- Local Study Area
- Provincial Boundary
- International Boundary

BOTSWANA

NAMIBIA

North West

Northern Cape

Free State

Eastern Cape

Western Cape

SOUTH AFRICA

KIMBERLEY

CAPE TOWN

PORT ELIZABETH

Namakwa District Municipality

Pixley ka Seme District Municipality

Kareeberg Local Municipality

Hantam Local Municipality

Karoo Hoogland Local Municipality

N1 N2 N7 N8 N9 N10 N12 N14 N18

18°0'0"E 21°0'0"E 24°0'0"E

27°0'0"S 30°0'0"S 33°0'0"S

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• Sustainability • Service • Positive Change • Professionalism • Future Focused • Integrity

Projection: Geographic
Datum: WGS 1984

Ref #: kam.NRF4874.201805.040
Revision Number: 1
Date: 08/05/2018

N

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Kilometres

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Summary of the Impact Assessment

Impact	Pre-mitigation:						Post-mitigation:					
	Duration	Extent	Intensity	Conse-quence	Proba-bility	Signifi-cance	Duration	Extent	Intensity	Conse-quence	Proba-bility	Signifi-cance
Direct impacts to palaeontological resources through the development of new roads or existing road upgrades	Permanent	Province/ Region	Very low - negative	Moderately detrimental	Improbable	Negligible - negative	Permanent	Limited	Very low - positive	Moderately beneficial	Improbable	Negligible - positive
Direct impact to identified fossil heritage on the Farm Son Tuin (Die Tuin)	Permanent	Province/ Region	Moderate - negative	Highly detrimental	Unlikely	Minor - negative	Permanent	Limited	Low - positive	Moderately beneficial	Unlikely	Negligible - positive
Potential direct impacts to palaeontological resources - good integrity	Permanent	Province/ Region	Very high - negative	Extremely detrimental	Probable	Minor - negative	Permanent	Limited	Very high - positive	Highly beneficial	Probable	Minor - positive
Potential direct impacts to palaeontological resources - poor integrity	Permanent	Province/ Region	Very low - negative	Moderately detrimental	Probable	Minor - negative	Permanent	Limited	Very low - positive	Moderately beneficial	Probable	Minor - positive
Direct impacts to multi-layered archaeological sites with medium CS	Permanent	Province/ Region	Moderately high - negative	Highly detrimental	Improbable	Negligible - negative	Transient	Very limited	Low - positive	Negligible	Improbable	Negligible - positive
Direct impacts to Stone Age scatters and isolated findspots with low CS	Permanent	Province/ Region	Very low - negative	Moderately detrimental	Likely	Minor - negative	Transient	Very limited	Very low - positive	Negligible	Likely	Negligible - positive
Direct impacts to Stone Age sites with high CS (SA-016)	Permanent	National	Extremely high - negative	Extremely detrimental	Likely	Moderate - negative	Permanent	Local	Extremely high - positive	Highly beneficial	Improbable	Negligible - positive
Indirect impacts to burial grounds and graves with very-high CS	Permanent	International	Extremely high - negative	Extremely detrimental	Highly unlikely	Negligible - negative	Transient	Very limited	High - negative	Slightly detrimental	Highly unlikely	Negligible - negative
Indirect impacts to Rock Art with medium to medium-high CS	Permanent	National	Moderately high - negative	Highly detrimental	Probable	Minor - negative	Transient	Very limited	High - negative	Slightly detrimental	Highly unlikely	Negligible - negative
Potential direct impacts to unidentified archaeological resources with good integrity	Permanent	Province/ Region	Moderately high - negative	Highly detrimental	Probable	Minor - negative	Permanent	Limited	Low - positive	Moderately beneficial	Probable	Minor - positive
Potential direct impacts to unidentified archaeological resources with poor integrity	Permanent	Province/ Region	Very low - negative	Moderately detrimental	Probable	Minor - negative	Permanent	Limited	Very low - positive	Moderately beneficial	Probable	Minor - positive

Impact	Pre-mitigation:						Post-mitigation:					
	Duration	Extent	Intensity	Conse-quence	Proba-bility	Signifi-cance	Duration	Extent	Intensity	Conse-quence	Proba-bility	Signifi-cance
Demolition of historic built environment resources older than 60 years	Beyond project life	Local	Moderately high - negative	Moderately detrimental	Certain	Moderate - negative	Beyond project life	Local	Moderately high - positive	Moderately beneficial	Certain	Moderate - positive
Indirect impacts on Corbelled House structures within the site-specific area resulting in damage or destruction (BHS-1 & BHS-7)	Permanent	National	Extremely high - negative	Extremely detrimental	Improbable	Minor - negative	Transient	Limited	High - positive	Slightly beneficial	Highly probable	Minor - positive
Indirect impacts on the Groot Paardekloof Farmstead (BHS-5) and School (BHS-6)	Permanent	National	Very high - negative	Extremely detrimental	Improbable	Minor - negative	Transient	Limited	High - positive	Slightly beneficial	Highly probable	Minor - positive
Indirect Impacts on graded heritage resources (BHS-2, BHS-3; BHS-4 and BHS-8)	Permanent	Municipal Area	Moderately high - negative	Highly detrimental	Unlikely	Minor - negative	Transient	Limited	Moderate - positive	Slightly beneficial	Highly probable	Minor - positive
Visual impacts through change of land use	Permanent	Province/ Region	Moderately high - negative	Highly detrimental	Certain	Major - negative	Permanent	Municipal Area	Moderate - negative	Highly detrimental	Certain	Moderate - negative
	Permanent	Province/ Region	Moderately high – positive	Highly beneficial	Certain	Major - positive	N/A					
Visual impacts created during site clearing	Medium term	Province/ Region	Moderate - negative	Moderately detrimental	Certain	Moderate - negative	Medium term	Local	Low - negative	Slightly detrimental	Highly probable	Minor - negative
Visual impacts from construction of the antennas	Permanent	Province/ Region	Moderately high - negative	Highly detrimental	Certain	Major - negative	Permanent	Municipal Area	Moderate - negative	Highly detrimental	Highly probable	Moderate - negative
Visual impacts from the expansion of existing camps and construction of temporary camps	Permanent	Municipal Area	Moderate - negative	Highly detrimental	Certain	Moderate - negative	Beyond project life	Local	Low - negative	Moderately detrimental	Highly probable	Minor - negative
Visual impact from the development of new roads or upgrade of existing roads	Permanent	Municipal Area	Moderate - negative	Highly detrimental	Certain	Moderate - negative	Beyond project life	Local	Low - negative	Moderately detrimental	Highly probable	Minor - negative
Visual impact from the construction of Solar PV plants	Permanent	Municipal Area	Moderate - negative	Highly detrimental	Certain	Moderate - negative	Beyond project life	Local	Low - negative	Moderately detrimental	Highly probable	Minor - negative
Visual impacts of the power line and fibre optic networks	Permanent	Municipal	Moderate -	Highly	Certain	Moderate -	Beyond	Local	Low -	Moderately	Highly	Minor -

Impact	Pre-mitigation:						Post-mitigation:					
	Duration	Extent	Intensity	Conse-quence	Proba-bility	Signifi-cance	Duration	Extent	Intensity	Conse-quence	Proba-bility	Signifi-cance
		Area	negative	detrimental		negative	project life		negative	detrimental	probable	negative
Visual impacts of the proposed borrow pits and quarries	Permanent	Municipal Area	Moderately high - negative	Highly detrimental	Certain	Moderate - negative	Beyond project life	Local	Moderate - negative	Moderately detrimental	Highly probable	Minor - negative
Visual impacts during operation of the SKA Radio Telescope	Permanent	Province/ Region	Moderately high - negative	Highly detrimental	Certain	Major - negative	Permanent	Municipal Area	Moderate - negative	Highly detrimental	Highly probable	Moderate - negative
Visual impacts of the construction camps during the operational phase	Permanent	Municipal Area	Moderate - negative	Highly detrimental	Certain	Moderate - negative	Project Life	Local	Low - negative	Moderately detrimental	Highly probable	Minor - negative

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1 Introduction

The South African Radio Astronomy Observatory (SARAO) provided a brief (*BID SKA PEP 6 001/2017*) for the full execution / implementation of services to complete a Heritage Impact Assessment (HIA) and Conservation Management Plan (CMP) in support of the Square Kilometre Array (SKA) Project ("the Project"). The international SKA Organisation (SKAO) proposes to establish an additional 133 antennas to the 64-dish MeerKAT telescope and associated infrastructure.

The prerequisite for the HIA and CMP was to satisfy the requirements of Section 38(3) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) and Statutory Comment issued by the South African Heritage Resources Agency (SAHRA) on Case ID: 10314[2].

Digby Wells Environmental (hereinafter Digby Wells) was the successful bidder and was subsequently appointed by SARAO as the specialist service provider in support of the aforementioned Heritage Resources Management (HRM) process.

This report constitutes the HIA to comply with requirements of the NHRA, and serves as the first primary deliverable of the HRM Process.

1.1 Project Background

The Project comprises two primary components, namely the 'core' (36 land parcels[3]) and three 'spirals' (73 land parcels) covering an approximate areal extent of 211 000 hectare (ha). This land makes provision for the SKA Radio Telescope site, KAT-7 radio telescope, MeerKAT, HIRAX and HERA instruments.

In support of obtaining environmental exclusion in terms of Section 24(2)(e) for the Project, the Department of Environmental Affairs (DEA) commissioned the Council for Scientific and Industrial Research (CSIR) to complete a Strategic Environmental Assessment (SEA) (CSIR, 2016) in accordance with the principles of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). The SEA is interpreted as Phase 1, the first step in the development of management principles into environmental decision making processes.

The Phase 1 study area was investigated by various specialists through desktop geographic information system (GIS) analysis and site visits from November 2015 to May 2016. The SEA included a strategic level assessment of the heritage resources within the area under consideration to determine potential impacts (Almond, 2016; Bluff, et al., 2016). The results of this assessment included the identification of 105 heritage resources. These were categorised according to the recommended grading as outlined in Section 7 of the NHRA, as

[2] Available at: http://www.sahra.org.za/sahris/cases/csir-ska-phase-1

[3] Land parcels refer to any plot or piece of land which has been demarcated and which has fixed boundaries. It includes farms, farm portions and erven.

well as identifying the heritage resource type as defined by Sections 27, 28, 31, 34, 35, 36 and 37. This, however, was not exhaustive.

The identified heritage resources are summarised in the following table:

Table 1-1: Heritage Resources Reported in the SEA

NHRA Grading	NHRA Section		Description
7(1)(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 region	Section 27		Corbelled buildings declared Provincial Heritage Sites on the farms Grootfontein, Arbeidsfontein and Stuurmansfontein
	Section 31		Culturally significant areas, namely Hartogskloof, Groot Pardekloof and Abiquaputs.
7(1)(c) – Grade III: Other heritage resources worthy of conservation, and which prescribes heritage resources assessment criteria, consistent with the criteria set out in Section 3(3), which must be used by a heritage resources authority or local authority to assess the intrinsic, comparative and contextual significance of a heritage resource and the relative benefits and costs of its protection, so that the appropriate level of grading of the resource and consequent responsibility for its management may be allocated in terms of Section 8.	IIIa – High local significance	Section 27	Monuments
		Section 34	Historical buildings
		Section 35	Stone Age artefacts and Rock Art
		Section 36	Burial Grounds and Graves
	IIIb – Moderate local significance	Section 35	Archaeological sites and Rock Art
	IIIc – Low local significance	None Provided	No descriptions

The strategic level assessment of the heritage resources was submitted to SAHRA via the South African Heritage Resources Information System (SAHRIS) (Case ID: 10314) digital portal 27 October 2016[4]. The assessment was submitted to SAHRA and the provincial

[4] Submission of the various specialist reports were subsequent to a Special Advisory Committee meeting on 05 August 2016 and 13 September 2016 respectively. Additional comments were issued by SAHRA on 10 March 2017 during a Special Advisory Committee meeting.

heritage resources agency, the Northern Cape Provincial Heritage Resources Agency[5] (NC-PHRA), to comply in part with the requirements encapsulated in Section 38 of the NHRA and Section 24 of the NEMA.

SAHRA issued final comment on Case ID: 10314 in terms of Section 38(4) of the NHRA on 16 March 2017, endorsing the prescribed specialist recommendations and Project in principle. The endorsement from SAHRA was predicated on the following:

- An HIA, compiled in accordance with Section 38(3) of the NHRA, will be required for components of the Project that trigger a NEMA Listed Activity;
- An HIA, compiled in accordance with Section 38(3) of the NHRA, will be required for components of the Project that trigger an activity defined in Section 38(1) of the NHRA, but not defined in the NEMA Listed Activities;
- The compiled HIA must be submitted to SAHRA for adjudication as required by Section 38 of the NHRA;
- Comments provided on 10 March 2017 must be addressed in future HIAs. Those of particular relevance to this HRM process include:
  - The HIA must assess all heritage resources as defined in Section 2 of the NHRA;
  - A final footprint verification survey by a palaeontologist must be completed and submitted to SAHRA;
  - An assessment of consolidated alluvial deposits along major water courses must be submitted to SAHRA;
  - A report recording and recommending grading of historical farmsteads, cemeteries and corbelled buildings must be submitted to NC-PHRA and SAHRA;
  - Identified heritage resources as per Dreyer (2008)[6], including Provincial Heritage Site 9/2/019/0011 be investigated immediately by the present Environmental Control Officer (ECO) and considered in the HIA;
  - The National Inventory must be considered as a data source;
  - All newly identified sites must be inventorised and submitted to SAHRA for inclusion into the National Inventory;
  - A Heritage Management Plan[7] (HMP) must be compiled to comply with the NHRA and National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEM: PAA), and implemented as part of the Integrated Environmental Management Plan (IEMP);

[5] Formally *Ngwao Boswa jwa Kapa Bokone* (NKBK), however, referenced in this report as NC-PHRA

[6] Available at: http://sahra.org.za/sahris/sites/default/files/heritagereports/9-2-019-0001-20080520-PAHS_0.pdf

[7] The requirement for the compilation of an HMP will be addressed through the development of the CMP.

- An independent specialist must identify, record, assess and provide recommendations for the long term conservation of heritage resources within the Project area;
- All heritage monitoring must be recorded, reported and submitted to SAHRA and NC-PHRA;
- A Chance Finds Procedure must be developed and implemented as part of the HMP;
- All developed management plans (*i.e. traffic, land, storm and waste water, alien invasive and fauna & flora*), must consider heritage resources as applicable and possible permitting requirements in terms of Section 27, 33, 34, 35 and 36 of the NHRA;
- Any amendment to impact management actions pertaining to heritage resources must be forwarded to SAHRA and NC-PHRA for comment and / or permitting; and
- Any amendment to IEMP must be forwarded to SAHRA and NC-PHRA for comment and / or permitting.

1.2 Project Description

SKAO proposes to establish an additional 133 antennas. Of these, 112 antennas will be established in the core and the remaining 21 will be installed in three spiral arms (seven in each arm). These spiral arms are:

- The Brandvlei Spiral (Arm), comprising the western extent;
- The Van Wyksvlei or Carnarvon Spiral (Arm) comprising the eastern extent; and
- The Williston Spiral (Arm), comprising the southern extent of the site-specific study area.

Together with above-mentioned antennas, the SKAO proposes to install the following infrastructure:

- Access gravel roads to a width of 4 m;
- Upgrading up to 320 km of existing roads;
- Establishment of approximately 115 km new roads;
- Develop electrical infrastructure including:
  - Approximately 240 km above and below ground power cables within a 22-30 m wide servitude; and
  - Substations and electrical kiosks.
- Establishment of 20 borrow pits;

- Establishment of four stone quarries; and
- Establishment of three temporary construction camps and upgrades to the Klerefontein camp.

Current planning estimates that construction activities associated with SKA Phase 1 will commence in the latter part 2019, continuing to 2027. The lifespan of SKA Phase 1 is expected to be 50 years from the completion of construction. To this effect, SARAO must undertake the necessary studies to comply with the requirements presented in Section 1.1 above and the South African national legislative framework.

1.3 Project Location

The Project is located in the Karoo region in the Northern Cape Province of South Africa, some 900 km, 650 km and 90 km from Johannesburg, Cape Town and Carnarvon respectively. The vast semi-arid landscape is characterised by abrupt ridges and conical hills scattered across extensive sandy and silty plains.

Table 1-2 presents a summary of the Project location detail. Plan 1 presents the location of the Project in relation to the places mentioned in Table 1-2.

1.4 Terms of Reference

To undertake field verification at the SKA1_MID radio telescope and associated infrastructure footprint and the SARAO Klerefontein Support Base prior to construction of the Project, the results of which will form part of an HIA that satisfies the requirements of Section 38(3) of the NHRA.

As stipulated in the interim comments[8] issued by SAHRA on Case ID 12292, dated 28 March 2018, the HIA must comply with Section 38(3) of the NHRA and applicable Minimum Standards.

[8] Available at the following link: http://www.sahra.org.za/sahris/sites/default/files/casedecisions/Case%2012292%20-%20Response%20to%20NID.pdf

Table 1-2: Project Location Summary

Province	District Municipality	Local Municipality	Towns[9]
Northern Cape	Namakwa District Municipality (NDM)	Karoo-Hoogland Local Municipality (KHLM)	Williston
			Sutherland
			Fraserburg
		Hantam Local Municipality (HLM)	Calvinia
			Brandvlei
			Loeriesfontein
	Pixley ka Seme District Municipality (PSDM)	Kareeberg Local Municipality (KLM)	Carnarvon
			Vosburg
			Vanwyksvlei
		SIyathemba Local Municipality (SLM)	Prieska
			Marydale
			Copperton
		Ubuntu Local Municipality (ULM)	Victoria West
			Loxton
			Richmond
Location Coordinates	**Northern Extent**		
	30°11'48.417"S	21°26'54.437"E	
	Southern Extent		
	31°34'32.785"S	21°26'54.437"E	
	Eastern Extent		
	30°51'6.013"S	22°20'53.736"E	
	Western Extent		
	30°51'6.013"S	20°32'48.75"E	
Predominant Land Uses	Stock farming: mostly bare, none vegetated and low shrubland; and a small percentage of thicket/dense bush, woodlands / open bush and grasslands.		

[9] Highlighted towns affected by the SKA Project.

1.5 Scope of Work

This section summarises the Scope of Work (SoW) as presented in the SKA PEP 6 001/2017 brief. An abbreviated summary of the SoW as per the tender documentation is presented in the following table:

Table 1-3: Abbreviated Summary of Required SoW

Scope of Work	Description
Pedestrian Survey	Physical, pedestrian survey of the SKA1_MID radio telescope, Klerefontein Support Base and associated infrastructure development footprint. Survey is aimed at identifying and mapping heritage resources in affected areas. Particular attention must be given to area where dolerite outcrops occur and river courses. The palaeontological surveys must pay particular attention to the Lower Beaufort Geological Group (*Abrahamskraal Formation*). Survey team to be accompanied by SAN Council representatives.
Cultural Significance (CS) Assessment and Field Rating Recommendations	All identified heritage resources must be subject to a CS assessment in accordance with the criteria outlined in Section 3(3) of the NHRA. The assessor must also make recommendations to the appropriate field rating / grading in accordance with Section 7 of the NHRA.
Impact Assessment	The potential impacts that may manifest from the development of the Project on the identified heritage resources must be completed, and appropriate, feasible management measures should be recommended for implementation. The impact assessment must also consider the visual / lighting impacts that may results from the development of the Project.
Approved Conservation Management Plan (CMP)	The CMP must collate all the preceding steps into a single management document for approval by the competent authority that summarises the findings of the assessment, and clearly defines the required management measures. These must at a minimum include: ▪ Chance Find Protocols, inclusive of Fossil Finds; ▪ Production of Sensitivity Maps (*made available in GIS enabled format*); ▪ Required, regulated procedures for SAHRA Permit Applications in terms of Sections 34, 35 or 36 of the NHRA and NHRA Regulations (GN R 548); and ▪ A lighting plan.

1.6 Expertise of the Specialists

The expertise of the HRM specialist is presented in Table 1-4:

Table 1-4: Expertise of the Specialist

Team Member	Bio Sketch
Justin du Piesanie ASAPA Member 270 AMAFA Registered ICOMOS Member 14274 IAIAsa Member Years' Experience: 12	Justin is the Divisional Manager for Social and Heritage Services at Digby Wells. Justin joined the company in August 2011 as an archaeologist and was subsequently made HRM Manager in 2016 and Divisional Manager in 2018. He obtained his Master of Science (MSc) degree in Archaeology from the University of the Witwatersrand in 2008, specialising in the Southern African Iron Age. Justin also attended courses in architectural and urban conservation through the University of Cape Town's Faculty of Engineering and the Built Environment Continuing Professional Development Programme in 2013. Justin is a professional member of the Association of Southern African Professional Archaeologists (ASAPA), and accredited by the association's Cultural Resources Management (CRM) section. He is also a member of the International Council on Monuments and Sites (ICOMOS), an advisory body to the UNESCO World Heritage Convention. He has over 12 years combined experience in HRM in South Africa, including heritage assessments, archaeological mitigation, grave relocation, NHRA Section 34 application processes, and Conservation Management Plans (CMPs). Justin has gained further generalist experience since his appointment at Digby Wells in Botswana, Burkina Faso, Cameroon, the Democratic Republic of Congo, Liberia, Mali and Senegal on projects that have required compliance with IFC requirements such as Performance Standard 8: Cultural Heritage. Furthermore, Justin has acted as a technical expert reviewer of HRM projects undertaken in Cameroon and Senegal. Justin's current focus at Digby Wells is to develop the HRM process as an integrated discipline following international HRM principles and standards. This approach aims to provide clients with comprehensive, project-specific solutions that promote ethical heritage management and assist in achieving strategic objectives.
Jaco van der Walt ASAPA Member 159 AMAFA Registered APHP Member 114 Years' Experience: 20	Jaco van der Walt has been practicing as a CRM archaeologist for 20 years. He obtained an MA degree in Archaeology from the University of the Witwatersrand focusing on the Iron Age in 2012 and is a PhD candidate at the University of Johannesburg focusing on Stone Age Archaeology with specific interest in the Middle Stone Age (MSA) and Later Stone Age (LSA). Jaco is a professional member of the Association of Southern African Professional Archaeologists (ASAPA), and accredited by the association's Cultural Resources Management (CRM) section. He is also a member of the Association of Professional Heritage Practitioners (APHP). Jaco has a vast range of experience in impact assessments, archaeological mitigation, grave relocation, NHRA Section 34 application processes, and Conservation Management Plans (CMPs) in all provinces of South Africa. He has also worked on various international projects in Zimbabwe, Botswana, Mozambique, Lesotho, DRC, Zambia and Tanzania. Through this he has a sound understanding of the IFC Performance Standard

Team Member	Bio Sketch
	requirements, with specific reference to Performance Standard 8 – Cultural Heritage.
Shannon Hardwick ASAPA Member 451 AMAFA Registered Years' Experience: 01	Shannon joined the Digby Wells team in May 2017 as a Heritage Management Intern, and has subsequently been appointed as an Assistant Heritage Resources Management Consultant. Shannon is an archaeologist who obtained a Master of Science (MSc) degree from the University of the Witwatersrand in 2013, specialising in historical archaeobotany in the Limpopo Province. She is a published co-author of one paper in *Journal of Ethnobiology*. Since joining Digby Wells, Shannon has gained generalist experience through the compilation of Notification of Intent to Develop (NID) applications as well as Heritage Basic Assessment Reports (HBARs), Heritage Scoping Reports (HSRs) and Heritage Impact Assessment (HIA) reports. Her other experience includes compiling a Community Health, Safety and Security Management Plan (CHSSMP) and researching Artisanal and Small-Scale Mining for input into a Livelihood Restoration Framework (LRF). Shannon's experience in the field includes pre-disturbance surveys in South Africa and fieldwork in Malawi.
Stephanie Mulder GISSA Member Years' Experience: 11	Stephanie is the manager of GIS at Digby Wells. Stephanie joined the company in September 2009 as an Environmental GIS Specialist and was subsequently made GIS Manager in July 2012. She obtained her Bachelor of Science (BSc) Honours degree in Geography from the University of Johannesburg in 2006. Stephanie is responsible for managing the GIS team and overseeing all GIS and Visual work. Since starting at Digby Wells, Stephanie has developed and refined the methodology for assessing topographical and visual impacts, including the visual impact of night time lighting. She has conducted numerous VIAs to both local and international best practice guidelines including IFC Performance Standards and Equator Principles and the World Bank Group Environmental, Health and Safety Guidelines. Her skills include 3D topographical and visibility modelling, visualisation/mapping, and impact prediction and mitigation. She has experience managing GIS specific projects and has also managed several social survey projects. Stephanie has a strong technical GIS background and has experience using GIS as a digital cartographic and spatial analytical tool. She also has experience with interactive mapping, sensitivity analysis, site selection and remote sensing projects. Stephanie is a registered member of GISSA (Geo-Information Society of South Africa).
Marion Bamford FRSSAf Registered MASSAf Registered IOP Registered	Marion Bamford is the Director of the Evolutionary Studies Institute (ESI) at the University of the Witwatersrand. She obtained her PhD in Palaeobotany from Wits in 1990. After working at the Council for Geosciences in Pretoria she returned to Wits and completed a two year postdoctoral fellowship specialising in fossils woods before becoming a researcher in the Bernard Price Institute. Her duties were research and lecturing to undergraduates, honours students and supervision of post graduates. She became an Associate Professor in 2007, Full Professor in 2014 and the Director of the ESI in 2017. Her research

Team Member	Bio Sketch
PSSA Registered SASQUA Registered Years' Experience: 22	field is palaeobotany and her speciality is fossil wood and is a member of many international research teams in Africa. She has carried out field research in South Africa, Zimbabwe, Botswana, Namibia, Mozambique, Zambia, Tanzania, Kenya and Ethiopia, as well as France, Brazil, Argentina and Australia. Her expertise includes fossil plants from the Devonian to the Present and uses leaves, seeds, wood, charcoal, pollen and phytoliths. Marion has published over 120 scientific papers and has an NRF B2 rating. She reviews manuscripts for international journals and funding bodies. She is a fellow of the Royal Society of South Africa, a member of the South Academy of Science, past president of SASQUA and PSSA and is the African representative of the International Organisation of Palaeobotanists (IOP). She has been doing Palaeontological Impact Assessments for 22 years and written over 50 reports.
Brendan Hart APHP Accredited Professional Member 0104 SACAP Registered CANT 3222 SAIA Member Gifa Member Years' Experience: 13	Brendan is a founding partner of Mayat Hart Architects and Heritage Consultants. Brendan co-founded the company in 2012 and is a principal architect and an accredited professional heritage practitioner. He obtained a Bachelors of Architectural Studies (with distinction) in 2001 and a Bachelor of Architecture (with distinction) in 2004 from the University of the Witwatersrand. This was followed with the completion of a Masters in the Conservation or the Built Environment at the University of Cape Town in 2013. Brendan is a fully accredited professional member of the Association of Professional Heritage Practitioners (serving on their accreditation committee), registered with the South African Council for the Architectural Profession, a member of the South African Institute of Architects and the Gauteng Institute for Architecture (serving on their heritage committee). Brendan is also a lecturer and member of staff at the School of Architecture and Planning at the University of the Witwatersrand, lecturing in design and honours level architectural history. Brendan's HRM and architectural conservation experience includes numerous section 34 and 38 applications under the NHRA. These include section 38 applications made to SAHRA for the Delville Wood memorial in Longueval, France; Restoration of the Johannesburg City Hall (a provincial heritage site); restoration of the Old Fort, Johannesburg (ZAR era fort); restoration of various buildings in the Johannesburg CBD; restoration of Merton Keep, French Ambassador's residence, Pretoria. Brendan also guest lectures and is widely published with lectures for The Johannesburg Heritage Foundation, The Gauteng Institute for Architecture, AZA 2018 national architecture conference and at the Docomomo international conference in Solvenia in August 2018. His articles have been published in Architecture South Africa, the international Docomomo Journal, the Wits Review and various local and international books.
Yasmin Mayat APHP Accredited Professional Member 0039	Yasmin is a founding partner of Mayat Hart Architects and Heritage Consultants. Yasmin co-founded the company in 2012 and is a principal architect and an accredited professional heritage practitioner. She obtained a Bachelor of Science (majoring in botany and zoology) from the University of Cape Town in 1996, a Bachelors of Architectural Studies in 2001 and a Bachelor of Architecture in 2005 from the University of the Witwatersrand. This

Team Member	Bio Sketch
SACAP Registered PR Arch 20771 SAIA Member Gifa Member Years' Experience: 12	was followed with the completion of a Masters in the Conservation or the Built Environment at the University of Cape Town in 2013. Yasmin is a fully accredited professional member of the Association of Professional Heritage Practitioners, registered Professional Architect with the South African Council for the Architectural Profession, a member of the South African Institute of Architects and the Gauteng Institute for Architecture (serving on their heritage committee). Yasmin also lectures part time in the History of Architecture at the School of Architecture and Planning at the University of the Witwatersrand. Yasmin's HRM and architectural conservation experience includes numerous section 34 and 38 applications under the NHRA. These include section 38 applications made to PHRAG for the restoration of the Johannesburg City Hall (a provincial heritage site); urban planning, conservation, museum and memorial for the Sharpeville Massacre site in Vereeniging; restoration of various buildings in the Johannesburg CBD and numerous section 34 applications. Yasmin also guest lectures and is widely published with lectures for The Johannesburg Heritage Foundation, The Gauteng Institute for Architecture, the Gauteng Provincial Government and the AZA 2018 national architecture conference. Her articles have been published in Architecture South Africa, the international Docomomo Journal and various local and international books.

1.7 Structure of the Report

The remainder of the report, with references to the relevant information required in terms of Section 38(3) of the NHRA, is structured as per Table 1-5.

Table 1-5: Structure of the Report

Chapter	Description	NHRA information requirements
2	Outlines the legislative framework relevant to the specialist heritage study.	-
3	Identifies the specific constraints and limitations of the HIA.	-
4	Describes the methodology employed in the compilation of this HIA.	-
5	Provides the baseline cultural landscape.	38(3)(a)
6	Summarises the results of the field assessment.	38(3)(a)
7	Motivates for the defined CS of the identified heritage resources and landscape.	38(3)(b)
8	Considers the potential impacts to heritage resources by project related activities.	38(3)(c)
	Outlines possible risks to heritage resources and heritage related risks to the project.	

Chapter	Description	NHRA information requirements
9	Considers the development context to assess the socio-economic benefits of the project in relation to the presented impacts and risks.	38(3)(d)
10	Presented the results of consultation.	38(3)(e)
11	Details the specific recommendations based on the contents of the HIA.	38(3)(g)
12	Collates the most salient points of the HIA and concludes with the specific outcomes and recommendations of the study.	38(3)(f) 38(3)(g)
13	Lists the source material used in the development of the report.	-

2 Regulatory Framework

SARAO submitted the IEMP to the Minister of Environmental Affairs for consideration for adoption as an environmental management instruments in terms of Section 24(2)(e) of the NEMA. The intention of the adoption of this instrument (i.e. the IEMP) will allow for the development of the identified activities associated with the development of the SKA Project within the geographical scope indicated in the document, without environmental authorisation, but in line with the environmental management principals and measures of the plan. These principles and management measures have been proposed based on the assessment of possible environmental sensitivities and impacts and their mitigation and management measures undertaken through a strategic environmental assessment process.

In response to the submission of the IEMP, the Minister gazetted the application for public comment on 16 March 2018 (refer to Government Gazette No. 41498/213). To this effect, SARAO are in the process of updating the IEMP for final submission to the Minister for consideration. Therefore, no listed activities are considered in this application.

This notwithstanding, the HRM process is subject to, firstly, the national South African legislative framework, including various Acts and Regulations, and secondly, international best practice standards as encapsulated in various doctrinal texts. This chapter provides a summary of the various Acts, Regulations and guidelines as applicable to the current HRM process.

Table 2-1: Applicable legislation considered in the HRM process

Applicable legislation considered	Reference where applied
Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) Section 24 of the Constitution states that everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures, that – ▪ Prevent pollution and ecological degradation; ▪ Promote conservation; and ▪ Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.	The HRM process was undertaken to identify heritage resources and determine heritage impacts associated with the Project. As part of the HRM process, mitigation measures, management and monitoring plans were recommended to ensure that any potential impacts are managed to acceptable levels to support the rights as enshrined in the Constitution.
Mineral and Petroleum Resources Development Act. 2002 (Act No. 28 of 2002) The MPRDA sets out the requirements relating to the development of the nation's mineral and petroleum resources. It also aims to ensure the promotion of economic and social development through exploration and mining-related activities. The application for a mining permit is subject to the requirements set out in terms of Section 27 of the Act. Here, a permit may only be issued if (1): ▪ the mineral in question can be mined optimally within a period of two years; and ▪ the mining area in question does not exceed 5.0 hectares Furthermore, the Act requires that 27(2) any person who wishes to apply to the Minister for a mining permit must simultaneously apply for an environmental authorisation and must lodge the application. Section 27 of this Act applies in respect of proposed establishment of borrow pits and stone quarries. A Section 27 Application does not explicitly require a heritage study and therefore does not trigger a NHRA section 38(8) application. However, a Section 27 Application does require an Environmental Authorisation (EA) application to be completed which entails a BAR or EIA to be conducted. The EIA or BAR must therefore be conducted in accordance with Section 39 of the MPRDA that give effect to the general	The HRM process, which relates specifically to the SKA Phase 1 Project and the associated mining permit exemption application, was compiled in accordance with the MPRDA read with the EIA Regulations, 2017.

Applicable legislation considered	Reference where applied
objectives of integrated environmental management encapsulated in Chapter 5 of the NEMA. The EIA must furthermore speak to impacts that the mining will have on the environment in accordance with section 24(7) of the NEMA. The Project is exempt from obtaining EA for mineral permits (*refer to the updated IEMP*).	
National Environmental Management Act, 1998 (Act No. 107 of 1998) The NEMA, as amended, was set in place in accordance with Section 24 of the Constitution of the Republic of South Africa. Certain environmental principles under NEMA have to be adhered to, to inform decision making on issues affecting the environment. Section 24 (1)(a), (b) and (c) of NEMA state that: *The potential impact on the environment, socio-economic conditions and cultural heritage of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.* Section 24(2)(e) makes provision for the Minister, or an MEC, to identify activities contemplated in paragraphs (a) and (b) that, based on an environmental management instrument adopted in the prescribed manner by the Minister or an MEC, with the concurrence of the Minster, may be excluded from the requirement to obtain an environmental authorisation from the competent authority. The Environmental Impact Assessment (EIA) Regulations, Government Notice Regulation (GN) R.982 were published on 04 December 2014 and promulgated on 08 December 2014 (as amended by GN R 326 of 7 April 2017). Together with the EIA Regulations, the Minister also published GN R.983 (amended by GN R 327) (Listing Notice No. 1), GN R.984 (as amended by GN R 325) (Listing Notice No. 2) and GN R.985 (as amended by GN R 324) (Listing Notice No. 3) in terms of Sections 24(2) and 24D of the NEMA, as amended.	The HRM process was undertaken in accordance with the principles of Section 2 of NEMA as well as with the EIA Regulations, 2017, promulgated in terms of NEMA.
GN R. 982 (as amended by GN R 326 of 7 April 2017): Environmental Impact Assessment Regulations, 2017 These three listing notices set out a list of identified activities which may not commence without an Environmental Authorisation from the relevant Competent Authority through one of the following processes:	The IEMP provides the Project exemption from applying for environmental authorisation of the proposed specified activities that exceed thresholds contained within the Listing Notices.

Applicable legislation considered	Reference where applied
▪ Regulation GN R. 983 - Listing Notice 1: This listing notice provides a list of various activities that require environmental authorisation and that must follow a basic assessment process. ▪ Regulation GN R. 984 – Listing Notice 2: This listing notice provides a list of various activities that require environmental authorisation and that must follow an environmental impact assessment process. ▪ Regulation GN R. 985 – Listing Notice 3: This notice provides a list of various environmental activities that have been identified by provincial governmental bodies that if undertaken within the stipulated provincial boundaries will require environmental authorisation. The basic assessment process will need to be followed.	To this effect, the HRM process specifically, was completed to comply with the requirements of Section 38(1) of the NHRA.
National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) The NHRA is the overarching legislation that protects and regulates the management of heritage resources in South Africa, with specific reference to the following Sections: ▪ 5. General principles for HRM; ▪ 6. Principles for management of heritage resources; ▪ 7. Heritage assessment criteria and grading; and ▪ 38. Heritage resources management. The Act requires that Heritage Resources Authorities (HRAs), in this case the SAHRA and NC-PHRA, be notified as early as possible of any developments that may exceed certain minimum thresholds in terms of Section 38(1), or when assessments of impacts on heritage resources are required by other legislation in terms of Section 38(8) of the Act. Section 49 provides for a system whereby any person may appeal to the SAHRA Council against any decision taken by a committee or other delegated representative of SAHRA or a provincial heritage resources authority. In the case of the SKA Phase 1 Project, this may include appeals against the issuing of permits in respect of Section 34, 35 or 36 of the NHRA, or approval of the final CMP.	A Notice of Intent to Develop (NID) was submitted, as part of the HRM process to the SAHRA and NC-PHRA to comply with Section 38(1). The HIA was compiled to comply with Section 5, 38 (1), (3), and (4) of the NHRA.
GN R 548: NHRA Regulations, 2000 The document regulates the general provisions and permit application process in respect of heritage resources forming part of the national estate. Applications must be made, as relevant, in accordance with the requirements of the following: ▪ Chapter II: Permit Applications and General Provisions	The HRM process was undertaken with cognisance of the applicable regulations. Proposed mitigations and management measures formalised in the CMP adhere to

Applicable legislation considered	Reference where applied
for Permit; ▪ Chapter III: Application for Permit: National Heritage Site, Provincial Heritage Site, Provisionally Protected Place, or Structure older than 60 Years; ▪ Chapter IV: Application for Permit: Archaeological or Palaeontological or Meteorite; ▪ Chapter V: Application for Permit to Reproduce a National Heritage Site; ▪ Chapter VI: Application for Permit: Heritage Objects; ▪ Chapter VII: Application for Permit to Export a Heritage Object; ▪ Chapter VIII: Application for Permit: Wrecks ▪ Chapter IX: Application for Permit: Burial Grounds and Graves; and ▪ Chapter X: Procedure for Consultation Regarding Protected Area; ▪ Chapter XI: Procedure for Consultation Regarding Burial Grounds and Graves; and ▪ Chapter XII: Discovery of Previously Unknown Graves.	the requirements as encapsulated in GN R 548.
National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEM: PAA) The NEM: PPA provides for South Africa's system of protected areas. It establishes the mechanisms for the protection, conservation and management of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes. It makes further provisions for intergovernmental co-operation and public consultation in matters concerning protected areas to promote the continued existence, governance and functions of the National Parks.	The HRM process considered the requirements of declaration as stipulated under Section 20(2)(a)(i) and (c) and co-management by Section 42. The HIA and CMP reference to the Cultural Heritage Survey Guidelines and Assessment Tools for Protected Areas in South Africa promulgated on 8 December 2017 (GN R 1356)
World Heritage Convention Act, 1999 (Act No. 49 of 1999) (WHCA) The WHCA makes provision for the inclusion of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) Convention concerning the Protection of the World Cultural and Natural Heritage (*i.e. World Heritage Convention [WHC]*) of 1972, into South African law. The Act makes provision for the principles and requirements in the development of Integrated Management Plans (IMPs) under Chapter IV. These include: ▪ Section 21: Preparation and implementation of IMPs; ▪ Section 22: Harmonisation of IMPs; ▪ Section 23: Objects of IMPs;	The HRM process acknowledges that the Project area is situated within the /Xam Heartland, previously on the tentative UNESCO World Heritage Site list with the ≠Khomani Cultural Landscape, inscribed in 2017. The developed CMP will consider the requirements of Chapter IV to ensure compliance with international best practice standards.

Applicable legislation considered	Reference where applied
▪ Section 24: Contents of IMPs; ▪ Section 26: Duration of IMPs; and ▪ Section 28: Model IMP	
Astronomy Geographic Advantage Act, 2007 (Act No. 21 of 2007) (AGA) and Karoo Central Astronomy Advantage Areas Spectrum Regulations, 2015 (GN R 1166) The AGA Act provides for the preservation and protection of areas uniquely suited for optical and radio astronomy and to provide for matters connected with astronomy advantage areas (AAAs). The Karoo Core AAA and Karoo Central AAAs have been declared as per Sections 7 and 9 of the Act. The Regulations outline restrictions that must be observed within the relevant Karoo Central AAAs. These regulations refer to the prohibition and/or restriction of certain radio frequencies (RFI) and electromagnetic interference (EMI), administrative matters and financial compensation.	The RFI and EMI requirements influenced the HRM field assessments. These constraints are acknowledged in Chapter 3 below. The CMP considered the restrictions encapsulated in the AGA Act and GN R 1166.

Table 2-2: Applicable guidelines considered in the HRM process

Applicable guidelines considered	Reference where applied
South African Heritage Resources Agency (SAHRA) Archaeology, Palaeontology and Meteorites (APM) Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports (2007) The guidelines provide the minimum standards that must be adhered to for the compilation of a HIA Report. Chapter II Section 7 outlines the minimum requirements for inclusion in the heritage assessment as follows: ▪ Background information on the Project; ▪ Background information on the cultural baseline; ▪ Description of the properties or affected environs; ▪ Description of identified sites or resources; ▪ Recommended field rating of the identified sites to comply with Section 38 of the NHRA; ▪ A statement of Cultural Significance in terms of Section 3(3) of the NHRA; and ▪ Recommendations for mitigation or management of	The HRM process was completed to adhere to the minimum standards as defined by Chapter II of the SAHRA APM Guidelines (2007)

Applicable guidelines considered	Reference where applied
identified heritage resources.	
GN 1356: NEM: PAA Cultural Heritage Survey Guidelines and Assessment Tools for Protected Areas in South Africa promulgated on 8 December 2017: The guidelines enable managers of Protected Areas to work within the ambit of the national HRM system in a quest of continuous improvement and sustainable management of heritage resources. It establishes best practice standards to effectively: ▪ Support the implementation of the NHRA in the identification and protection of places of CS in Protected Areas; ▪ Provide the basic means of ensuring those who manage Protected areas: i. Are aware of the heritage resources within their Protected Area; ii. Have knowledge of the CS of these identified heritage resources within the Protected Area; iii. Have the knowledge to conduct basic recording of heritage resources in the Protected Area; and ▪ Fulfil the basic requirements of the NHRA and other applicable legislation.	The physical data collection adhered to the minimum required standards to record and inventorise identified heritage resources. Principles of consultation and dissemination of information was incorporated into the HRM approach in the HIA and CMP development.
United Nations Educational, Scientific and Cultural Organisation (UNESCO) Convention concerning the Protection of the World Cultural and Natural Heritage of 1972 (World Heritage Convention [WHC]) While fully respecting the sovereignty of the States, the Convention formalises requirements for the national and international protection of cultural and natural heritage in respect of the collective interest of the international community. Article 5 requires each State Party to this Convention to: a. Adopt a general policy which aims to give cultural and natural heritage a function in the life of the community and integrate the protection of that heritage into comprehensive planning programmes; b. Set up services for the protection, conservation and presentation of the cultural and natural heritage with appropriate staff;	The HRM process was completed to achieve the requirements of Article 5 of the WHC

Applicable guidelines considered	Reference where applied
c. Develop scientific and technical studies and research and to work out such operating methods as will make the State capable of counteracting the dangers that threaten its cultural and natural heritage; d. Take the appropriate measures necessary for the identification, protection, conservation, presentation and rehabilitation of this heritage; and e. Establish or development for training in the protection, conservation and presentation of the cultural and natural heritage and to encourage scientific research in the field.	
Operational Guidelines for the Implementation of the World Heritage Convention, 12 July 2017 The guidelines aim to facilitate the implementation of the WHC. It further provides for: ▪ Chapter II D: Criteria for the assessment of Outstanding Universal Value ▪ Chapter II E: Integrity and/or Authenticity; and ▪ Chapter II F: Protection and Management.	The HRM process did consider the principles encapsulated in Chapter II of the guidelines in the designation of CS, and recommendations for protection and management of identified heritage resources and greater cultural landscape.
United Nations Educational, Scientific and Cultural Organisation (UNESCO) Convention for the Safeguarding of the Intangible Cultural Heritage, 2003 The purpose of the Convention is to safeguard and respect the intangible cultural heritage of the communities, groups and individuals concerned that concurrently raises awareness at local, national and international level of its importance. Chapter III advises to the safeguarding of the intangible cultural heritage at a national level through, amongst other, the following: ▪ Article 12 – Inventories; ▪ Article 14 – Education, awareness-raising and capacity building; and ▪ Article 15 – Participation of communities, groups and individuals.	The physical data collection did adhere to the minimum required standards to record and inventorise identified heritage resources. The HRM process was furthermore, designed to consider the Articles 14 and 15.
International Council on Monuments and Sites (ICOMOS): International Charter for the Conservation and Restoration of Monuments and Sites, 1964 (*Venice Charter*) The Charter establishes the importance of architectural work, as well as the urban and rural setting in which it is found to which CS is attributed. It acknowledges the importance in maintaining	The HRM process did consider the principles of conservation and restoration detailed in the Charter to ensure the integrity, meaning and CS of identified heritage resources are, at a minimum,

Applicable guidelines considered	Reference where applied
the integrity and meaning of heritage resources through conservation and restoration interventions. Articles 4 through 8 provide a set of guidelines for the conservation of such heritage resources, which underlay many of the principles of subsequent ICOMOS doctrinal texts.	maintained.
International Council on Monuments and Sites (ICOMOS): Charter for the Protection and Management of the Archaeological Heritage, 1990 The Charter provides for the protection and proper management of archaeological heritage to enable archaeologists and other scholars an opportunity to study and interpret these resources on behalf of and for the benefit of present and future generations, through effective collaboration between professionals from several disciplines and local cultural groups. The Charter reflects the basic principles and guidelines for global validity as follows: ▪ Article 2: Integrated Protection Policies; ▪ Article 3: Legislation and Economy; ▪ Article 4: Survey; ▪ Article 5: Investigation; ▪ Article 6: Maintenance and Conservation; ▪ Article 7: Presentation, Information and Reconstruction; and ▪ Article 8: Professional Qualifications.	The HRM process was designed on the principles and guidelines within the Charter to adhere to international best practice standards.

Applicable guidelines considered	Reference where applied
International Council on Monuments and Sites (ICOMOS): The NARA Document on Authenticity, 1994 The NARA Document provides a framework to test authenticity in ways which accord full respect to the social and cultural values of all societies. All cultures and societies are rooted in the particular forms and means of tangible and intangible expression which constitute their heritage, and these must be respected. The document postulates that conservation of cultural heritage is rooted in the value ascribed and our ability to understand this value depends, in part, on the credibility of information sources. This is a requisite for assessing all aspects of authenticity. This may differ between and within cultures, therefore, it is crucial that recognition be accorded to the specific nature of its heritage values and the credibility of the related information sources.	The HRM process did consider a great variety of information sources and assess these for credibility to permit the elaboration of the artistic, historic, social and scientific dimensions.
International Council of Monuments and Sites (ICOMOS): Principles for the Recording of Monuments, Groups of Buildings and Sites, 1996 These Principles expand upon Article 16 of the Venice Charter to outline the standards to inform the recording and documentation of heritage resources. Recording of sites should be undertaken as a record against potential damage or destruction of the monument(s) or site(s) as well as to inform future decisions that may be made regarding the heritage resources. Prior to new records being made, older records must be examined and analysed in terms of their adequacy, Records must be suitable for archival storage and should be appropriate to the monument(s) or site(s) being recorded and should consider the reason for recording.	The HRM process does include records and documentation that considers the tangible as well as the intangible aspects of the heritage resources.
International Council on Monuments and Sites (ICOMOS): Charter on the Built Vernacular Heritage, 1999 The Charter recognises that built vernacular heritage, i.e. the traditional and natural way by which communities house themselves, is an important, fundamental expression of the culture of a community and its relationship with its environment. It aims, supplementary to the Venice Charter, to establish principles for the care and protection of built vernacular heritage. Principles for conservation include: ▪ Conservation must be carried out by multidisciplinary expertise while recognising the inevitability of change	The assessment of the vernacular built heritage within the Project area considered the principles detailed in the Charter, focussed not only on the tangible aspects of the structures, but the intangible associations through use and space.

Applicable guidelines considered	Reference where applied
and development, and the need to respect the community's established cultural identity; ▪ Contemporary work should respect the cultural values and traditional character of vernacular buildings, groups and settlements; ▪ The vernacular is best conserved by maintaining and preserving groups and settlements of a representative character, region by region; ▪ The built vernacular heritage is an integral part of the cultural landscape and this relationship must be taken into consideration in the development of conservation approaches; ▪ The vernacular embraces not only the physical form and fabric of buildings, structures and spaces, but the ways in which they are used and understood, and the traditions and the intangible associations which attach to them.	
International Council on Monuments and Sites (ICOMOS): International Cultural Tourism Charter, 1999 The Charter formalises the ethos that natural and cultural heritage belongs to all people with the right and responsibility to understand, appreciate and conserve its CS. The Charter details various principles that strive to facilitate and encourage: ▪ Accessibility of heritage resources and their CS to host communities and visitors; ▪ Promotion and management of tourism in ways that respect and enhance heritage resources CS and living cultures of host communities; ▪ Dialogue between conservation interests and tourism; and ▪ The formulation of plans and policies to develop detailed, measureable goals and strategies relating to the presentation and interpretation of heritage places and cultural activities, in the context of their preservation and conservation.	The CMP considered the principles of the Charter in as far as feasible, viable tourism opportunities are identified considering the special constraints of the Project.

Applicable guidelines considered	Reference where applied
International Council on Monuments and Sites (ICOMOS): Principles for the Analysis, Conservation and Structural Restoration of Architectural Heritage, 2003 The document presents the basic concepts of conservation required to promote rational methods of analysis and repair methods appropriate to cultural context. These comprise the following sections: ▪ Section 1: General criteria; ▪ Section 2: Research and diagnosis; and ▪ Section 3: Remedial measures and controls.	The approach of the specialist Built Environment assessment was designed based on the principles of Section 2. Any recommended mitigation and/or management measures were cognisant of the principles as outlined in Section 3.
International Council on Monuments and Sites (ICOMOS): Declaration of the Kimberley Workshop on the Intangible Heritage of Monuments and Sites, 2003 The Declaration commits ICOMOS to taking account of the intangible values and local communities that are the custodians of these values in the management and preservation of monuments and sites. Chief amongst which is the collaboration with communities to identify: ▪ Concepts of intangible heritage; ▪ Impacts of change and the diverse perceptions; ▪ Mechanisms of preservation; and ▪ Interpretations and dissemination methods.	The HRM process was designed to facilitate an inclusive and consultative approach to the development of mitigation and management measures in accordance with the principles of the Declaration.
International Council on Monuments and Sites (ICOMOS): Xi'an Declaration on the Conservation of the Setting of Heritage Structures, Sites and Areas, 2005 The Declaration acknowledges the contribution of setting to the designated CS. The CS is derived from the perceived social, aesthetic, scientific and historic value of heritage resources and its interactions with setting. It requires that, to understand and interpret the setting in diverse contexts, a multi-disciplinary approach and use of diverse information sources must be used within a regulatory framework. Relevant principles to be considered include: ▪ Principle 7 – Impacts of incremental or rapid change on setting should be effectively controlled; ▪ Principle 8 – HIA's should be required for all new developments; ▪ Principle 9 – Rate of change and impacts of change an transformation on setting is an on-going process which	The HRM process was undertaken to adhere to the principles of the Declaration.

Applicable guidelines considered	Reference where applied
must be monitored and managed; ▪ Principle 10 – Management must aim to retain CS and distinctive character; ▪ Principle 12 – Co-operation and engagement with associated and local communities is essential for the sustainable conservation and management of setting; and ▪ Principle 13 – Dissemination of information through various mechanisms must be encourages to support co-operation and sharing of knowledge.	
International Council on Monuments and Sites (ICOMOS): Québec Declaration on the Preservation of the Spirit of Place, 2008 Building on the Kimberley Declaration, the document identifies principles and recommendations to preserve the spirit of place through the safeguarding of tangible (*sites, buildings, landscapes, routes, objects*) and intangible heritage (*memories, narratives, written documents, traditional knowledge, values, etc.*). The Declaration acknowledges that the spirit of a place can vary in time and from one culture to another, that it continually reconstructed by various social actors, managers and users who all actively and concurrently contribute to giving it meaning. Relevant principles and recommendations are encapsulated in Articles 4 through 10.	The HRM process was undertaken in accordance with the recommendations encapsulated in the Declaration to, as far as possible, identify and preserve the spirit of place through active engagement with heritage resource producers and users.

3 Constraints and Limitations

The following constraints and limitations were experienced in the compilation of this report:

- The conclusions of the preliminary palaeontological assessment (Almond, 2016) are considered accurate. The palaeontological assessment completed in support of this HIA did not reassess the site-specific study area in its entirety. This assessment considered site-specific study areas underlain by lithostratigraphic units with moderate to very high palaeontological sensitivity, as determined by the SAHRIS Palaeontological Sensitivity Map, only;
- The in-field palaeontological assessment was significantly constrained by access to properties by the current landowners. At the time of the pedestrian survey, permission to access one property, the farm Palmietfontein, was granted;

- Information collated within the National Inventory database lacked detailed descriptions of the recorded heritage resources, compounding multiple heritage resources types at a single locale. These were considered accurate and not reassessed as part of this study;
- No intangible heritage resources were recorded through the engagement process. All intangible aspects were limited to verbal inputs from the San Council representatives during the pre-disturbance survey. This, however, is a constraint as the representatives are not from the local community or local study area;
- Medicinal plants are not explicitly considered in the HIA. These resources form part of the Ecological Assessment;
- Extent of the site-specific study area could not be surveyed in its entirety within the allocated time to complete this assessment and develop the consequent management plan. An archaeological predictive model was developed to refine the study area for in-field assessment to mitigate this limitation and inform recommendations;
- The access route to the development footprint of SKA014 was inaccessible at the time of the in-field survey due to recent rainfall and consequent development of erosion gullies. This site falls within a high heritage potential area and was not subject to in-field assessment;
- Middle Range Theory as devised by Binford (1972) is criticised[10] as being logically flawed and founded on tautology. While the authors acknowledge this criticism of Middle Range Theory, elements were utilised to provide the framework and reasoning in the development of the aforementioned predictive model;
- Academic convention assigns a higher CS rating to ephemeral Later Stone Age (LSA) occurrences (Orton, 2007). This convention was considered in this assessment and was incorporated in the scientific criteria of the CS assessment;
- Existing environmental conditions and accessibility to properties hampered access to select structures in respect of the Historic Built Environment Assessment;
- The valuation reports provided by SARAO in respect of structures within the SKA Core Area are assumed to be complete and accurate. The limitations of the valuation assessors in respect of identifying heritage resources were considered and mitigated against by cross referencing multiples sources;
- Lidar contours with a 0.5 m contour interval are available for the Project area but only 20 m contour relief data is available for the surrounding area. The topographical model was created using the available 20 m contour relief data. This data is generalised and some of the topography detail is lost. Ideally contour relief data with

[10] Refer to C. Pierce (1989) for a detailed critique of Middle Range Theory in archaeology.

a higher resolution is desired to increase the accuracy of the topographical and viewshed models but the Lidar data is too detailed for the model extent;

- The previous assessments completed in support of the various processes undertaken, including the EA of the 64-dish MeerKAT radio telescope, and the consequent records are considered accurate and applicable. These assessments were considered but not reassessed as part of this report; and
- The RFI Policy that controls radio frequency interference restricted the use of digital cameras within proximity to the established antenna that constitute the MeerKAT 64-dish array. Identified heritage resources located within the defined buffer zones were not recorded through photographs.

4 Methodology

4.1 Defining the Study Area

Heritage resources do not exist in isolation to the greater natural and social environment, including socio-cultural, social-economic and socio-political contexts. The NHRA requires the grading of heritage resources in terms of national, provincial and local concern, based on their importance and therefore on the official (i.e. State) management effort required. These categories require different types and levels of baseline information to adequately predict potential heritage impacts. Three 'concentric' study areas were defined for the purpose of this study and presented in Plan 1 below, which include:

- The *site-specific* study area: the farm portions associated with the proposed project including a 500 m buffer area or, in a linear development, the proposed development footprint(s) including a 200 m buffer on either side;
- The *local* study area: the area most likely to be influenced by any changes to heritage resources in the project area, or where project development could cause heritage impacts. The local study area is defined as the area bounded by the local municipalities (*i.e. KLM, HLM, SLM, and KHLM*) with particular reference to the immediate surrounding properties or farms. The local study area was specifically examined to offer a backdrop to the socio-economic conditions within which the proposed development will occur. The local study area furthermore provided the local development and planning context that may contribute to cumulative impacts; and
- The *regional* study area: the area bounded by the district municipality demarcation (i.e. NDM and PSDM). Where necessary, the regional study may be extended outside the boundaries of the district municipality to include much wider regional expressions of specific types of heritage resources and historical events. The regional study area also provided the regional development and planning context that may contribute to cumulative impacts.

Plan 1

SKA Project

Local Setting

Legend

- SKA Phase 1 Core
- SKA Phase 1 Spiral Arms
- City
- National Road
- Regional Study Area
- Local Study Area
- Provincial Boundary
- International Boundary

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4.2 Developing Cultural Significance and Field Ratings

Digby Wells has designed a significance rating process to provide a numerical rating of the CS[11] of identified heritage resources. This process considers heritage resources assessment criteria as set out in subsection 3(3) of the NHRA to determine the intrinsic, comparative and contextual significance of identified heritage resources. The importance rating of a resource is based on information obtained through a review of available credible sources as well as its representativity or uniqueness (i.e. known examples of similar resources to exist).

The matrix rated the importance (or the potential) of an identified resource relative to its contribution to certain values – aesthetic, historical, scientific and social. Resource significance was directly related to the impact on it that could result from project-related activities, as it provided minimum accepted levels of change to the resource.

The value of an identified heritage resource is determined prior to the completion of any assessments of impacts. A heritage resource's value is a direct indication of its sensitivity to change (i.e. impacts).

4.2.1 Determining Cultural Significance

CS was determined based on identified resources' importance or contribution to four broad value categories: aesthetic, historical, scientific and social values. These categories summarised the CS and other values described in Section 3(3) of the NHRA. The resources' importance or contributions to these values were considered in terms of associative (qualitative) and / or rarity (quantitative) attributes, based on collected secondary data. The integrity or condition of resources further influenced the CS. Integrity is largely determined based on resources' current, observed state of conservation, as well as notable changes made to it over the years.

4.2.2 Determining Field Ratings

Field ratings assist the responsible heritage resources authority to grade heritage resources into national (Grade I), provincial (Grade II) or local (Grade III) categories, and are required under Chapter II Section 7(J) of the SAHRA Minimum Standards.

Field ratings considered the assigned CS and the level of official management required or the local competency of heritage authorities[12].

[11] Cultural significance is defined in the NHRA as the intrinsic "aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance" of a heritage resource. These attributes are combined and reduced to four themes used in the Digby Wells significance matrix: aesthetic, historical, scientific and social.

[12] Currently the NC-PHRA is only competent to manage and issue permits on NHRA Section 34 heritage resources, and no local (i.e. local government) competency exists within the province. All decisions relating to archaeology, palaeontology and burial grounds and graves therefore fall under the ambit of SAHRA.

4.3 Primary Data Collection

4.3.1 Palaeo-Sensitivity Map

Almond (2016) completed a preliminary palaeontological assessment in support of the SEA. Almond (2016, p. 41) concluded the majority of the site-specific study area comprised a palaeontological sensitivity ranging from low to very low, interspersed with lithostratigraphic units of moderate to high sensitivity. The Williston Spiral comprising the southern extent of the site-specific study area, however, is underlain by lithostratigraphic units with moderate to very high palaeontological sensitivity.

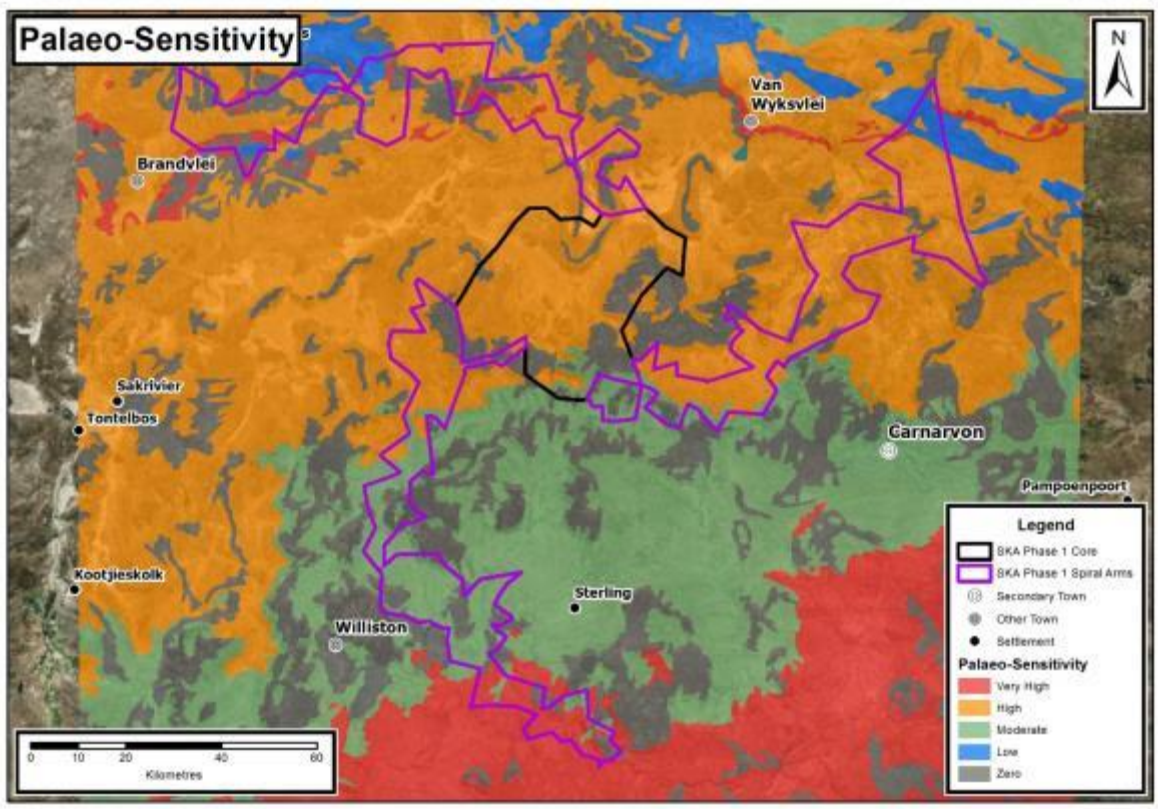


Figure 4-1: Palaeo-Sensitivity Map adapted from SAHRIS with the development footprint corridor overlaid

The site-specific study area properties underlain by very-high sensitivity lithostratigraphic units were targeted for primary data collection. The remaining properties with a moderate sensitivity were considered where possible within the time allocated and aforementioned constraints.

4.3.2 Predictive Model

The extent of the greater study area has been identified as a constraint in Section 0 above. To mitigate against this, Digby Wells undertook to develop a predictive model, considering elements of Middle Range Theory and a Landscape Use hypothesis, to identify areas with the greatest archaeological potential or sensitivity.

Binford (1972) as cited in Morris (2012, p. 121), constructs models through present-day ethno-archaeological observations to understand patterns in traces from the past, both in terms of formation processes and the relationships between material and non-material elements of culture. This Middle Range Theory comprises four components:

- Documentation of causal relations between relevant dynamics and observable statics;
- Recognition of signature patterns in static remains;
- Inferences of past dynamics from observation of signature patterns in archaeological record; and,
- Evaluation of these inferences.

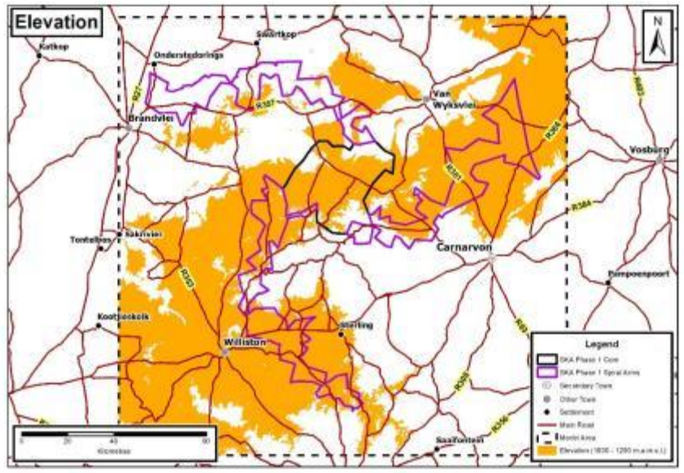
In this instance, the known cultural material remains, as well as its interactions with the landscape were considered to explain the distribution of archaeological resources. This was further reinforced through utilising Deacons ‘eurytopic’ landscape hypothesis, i.e. Later Stone Age (LSA) groups’ use of a much broader range of habitats rather than a narrow focus on permanent water sources (cited in Hallinan & Parkington, 2017).

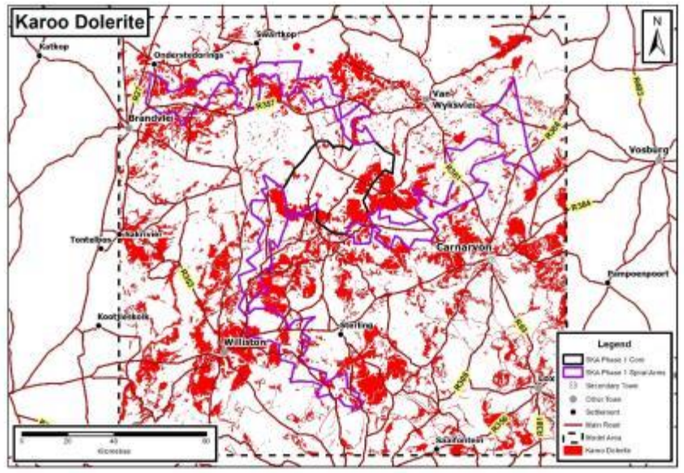
The Geographic Information System (GIS) Predictive Model considering the reasoning presented above and four natural feature criteria against the known distribution of recorded archaeological site sourced from the National Inventory. These comprised:

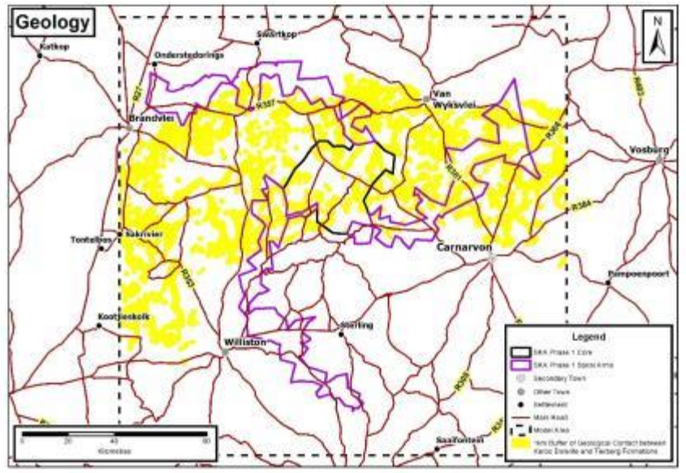
- Elevation;
- Slope;
- Geology; and
- Watercourses.

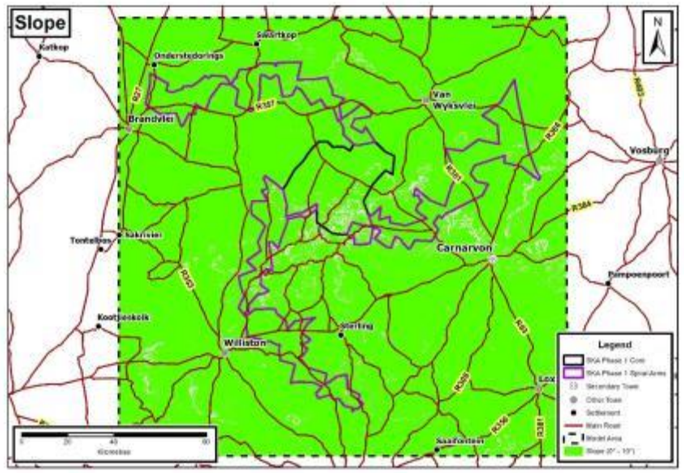
Table 4-1: Predictive model criteria and GIS methodology

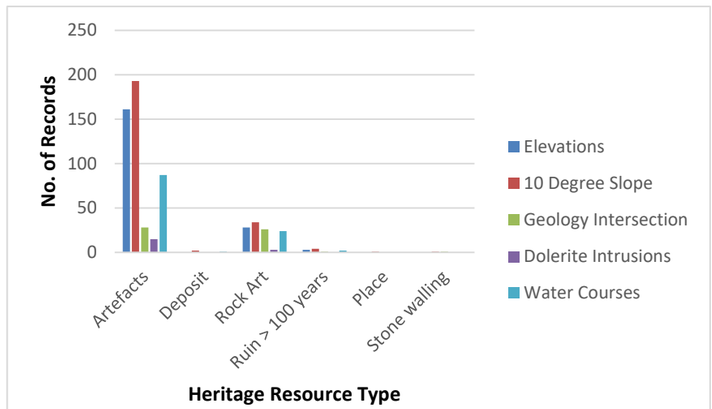
Criteria	Description and GIS Methodology
Elevation	The known distribution of Stone Age sites occur at higher elevations above the flat plains between 1000 – 1200 m. 81% of known heritage resources occur within this elevation range. GIS data sourced from the Chief Directorate: National Geo-Spatial Information (CD: NGI) provided 20 m contours as the primary input for the Digital Elevation Model (DEM). Topographical data from the 1:50 000 sheet maps were converted to Raster data via the ArcGIS 3D Analyst Extension.
Slope	Morris (2012, p. 139) states topography yields the opportunities and constraints for producing rock engravings and paintings. Rock Art sites, specifically engravings characteristic of the Karoo region, commonly occur on the dolerite boulders on the slopes of the outcrops between 10 – 16 degrees. 98% of known heritage resources occur within this range. The resultant DEM was utilised as input to develop a slope model using the "slope tool" of the ArcGIS 3D Analyst Extension.
Geology	The known distribution of Rock Art engravings are associated with the dolerite boulders. This is reiterated by Morris (2012, p. 139) where it is stated rock engravings primarily occur on dolerite and andesite. 8% of known heritage resources only occur within the Karoo Dolerite Suite Stone Age sites are commonly associated with dolerite outcrops intruding through the *Tierberg Formation*, as these provide a source of raw material for lithics and utilising natural enclosures. 23% of known heritage resources occur within 1 km of the intersection between the *Tierberg Formation* and Dolerites. GIS data sourced from the Council for Geosciences and that used by the CSIR during the SEA was utilised to identity the relevant geological strata.
Watercourses	Watercourses were used with a dual function, to eliminate wash areas where isolated or low density occurrences often occur, but are wholly removed from any discernible context, and to identify Stone Age site as these commonly occur within proximity to water sources. Deacon and Foster (2005) suggest that the landscape and the water sources specifically, were significant as this was a scarce resource that influenced the distribution of occupation sites throughout the landscape. GIS data sourced from the CD: NGI provided the location of watercourses and pans. The ArcGIS "Buffer Wizard" tool was utilised to delineate a 200 m buffer around these features.











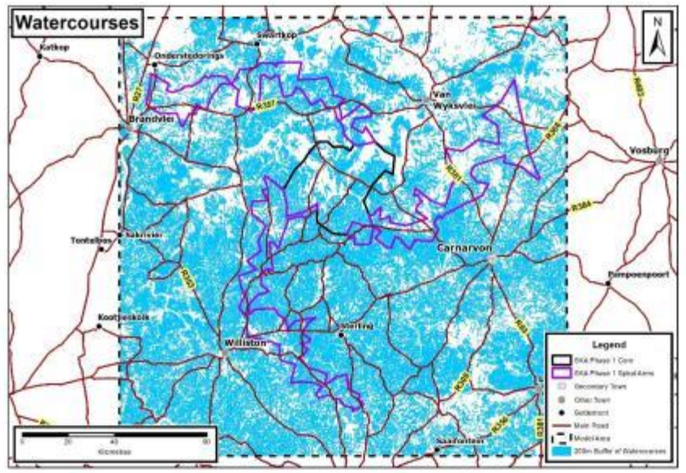


Figure 4-2: Graphical Representation of Predictive Model Criteria

4.3.3 In-field Methodology

4.3.3.1 Reconnaissance and Visual Survey

Justin du Piesanie, Jaco van der Walt and Stephanie Mulder undertook the reconnaissance and visual survey from 26 February through 02 March 2018. The assessors completed the survey as an adaptive, non-intrusive survey, i.e.: no sampling or Shovel Test Pits (STPs) were carried out, predominantly vehicular survey along the proposed linear infrastructure and pedestrian survey of select development footprints. Specific antennas were selected to test the predictive model (Section 4.3.2). These are listed in Table 4-4 below.

The objectives of the reconnaissance and visual survey were to:

- Orientate the Project team to the areal extent of the proposed development;
- Record the current state of the natural and cultural environment;
- Identify receptors and take the necessary photographs to complete the visual assessment;
- Categorise the visibility of the existing MeerKAT and KAT-7 radio telescope dish-antennas to inform the viewshed model;
- Ground truth assumptions of the predictive model to confirm its accuracy and applicability; and
- Physically identify any heritage resources that may be impacted upon through the implementation of the Project.

Identified heritage resources were recorded as waypoints using handheld GPS and documented through written and photographic records. The survey was recorded as GPS track logs.

The visibility of the existing MeerKAT and KAT-7 radio telescope dish-antennas in the core were utilised as the datum to determine the expected visibility of the proposed SKA antennas. These were photographed at varying distances with a focal length of 50 mm. From the results of the in-field assessment, the following categories were defined for the viewshed model:

Table 4-2: Viewshed model categories

Category	Daytime	Night time
Very-high exposure	0 – 2 km	
High exposure	2 – 5 km	0 – 2 km
Moderate exposure	5 – 9 km	2 – 4 km
Low exposure	9 – 14 km	4 – 8 km
Very-low exposure	14 – 20 km	

4.3.3.2 Palaeontological Survey

Marion Bamford, Alisoun House and Frederick Tolchard undertook the paleontological survey from 24 through 27 March 2018. The assessors completed the survey as an adaptive, non-intrusive survey, i.e.: no sampling was carried out.

As stated in Section 4.3.1, the survey focussed on the site-specific study area underlain by lithostratigraphic units ranging from moderate to very high sensitivity, considering the aforementioned access restrictions presented in Chapter 3 above. These properties comprised:

Table 4-3: Properties considered for the in-field assessment

Farm name	Owner	Palaeo-Sensitivity	Access
Weltevrede	Willie Olivier	Moderate & Very High	×
Korfsplaas	Jean van Schalkwyk	Moderate & Very High	×
Uitkomst	WT van Schalkwyk	Very High	×
Klipdrift	Michael Hoorn	Moderate & Very High	×
Die Tuin	R van Schalkwyk	Very High	×
Die Tuin	Louwsdrift Trust	Very High	×
Palmietfontein (Dampiesfontein)	JF van Wyk	Very High	✓
Langbaken	Langbaken Trust	Moderate	×
Vlokswerven	Vlokswerve Trust	Moderate & Very High	×
Rooikop	JN Louw	Very High	×
Zakfontein	JN Louw	Moderate	×

Random points along the proposed road upgrade were examined through pedestrian survey, where sediments and geology were examined, and the general landscape recorded. Identified paleontological resources were recorded as waypoints using handheld GPS and documented through written and photographic records.

The survey further considered general features on the farms Rooizand, Zout Rivier, De Hoek and Waterkloof within the SKA core area.

4.3.3.3 Archaeological Survey

Justin du Piesanie, Jaco van der Walt and Shannon Hardwick led a team from the Sol Plaatjies University and San Council in terms of the archaeological survey completed from 22 through 29 March 2018. The various team members comprised:

- Dr David Morris;
- Zola Daniels;

- Tiny Kars;
- Lovedelia Tshegofatso Mabilo;
- Jeanette Gomolemo Mmusi;
- Tlotlo Oliphant;
- Talisa Pieterse;
- Patience Kesebonye Setlholoeng; and
- Colin Louw.

The assessors completed the survey as an adaptive, non-intrusive survey, i.e.: no sampling or STPs were carried out, predominantly pedestrian survey of the development footprint of antennas within or in proximity to high heritage potential areas determined through the predictive model. These are presented in the following table:

Table 4-4: Development footprint considered during archaeological survey

Antennas within or in proximity to high heritage potential areas		
▪ SKA014	▪ SKA105	▪ SKA118
▪ SKA019	▪ SKA110	▪ SKA119
▪ SKA022	▪ SKA112	▪ SKA121
▪ SKA025	▪ SKA115	▪ SKA123
▪ SKA027	▪ SKA117	▪ SKA125

Identified heritage resources were recorded as waypoints using handheld GPS. The survey was recorded as GPS track logs. The sites were documented on recording forms based on the requirements of the NEM: PAA Guidelines (2017) and through photographs where possible considering the RFI Policy.

4.3.3.4 Built Environment Survey

The in-field assessment methodologies were informed through high-level remote research, primarily based on information contained within the SAHRIS database, previous assessments for the SKA Project, and the Vernacular Architecture Society of South Africa (VASSA) journal. The valuation reports provided by SARAO served as the primary basis for the in-field assessment.

Brendan Hart and Yasmin Mayat undertook the built environment survey from 26 through 29 March 2018. The assessors completed an inspection of all declared structures, previously identified buildings and structures with suggested gradings, and select structures and buildings at risk within the SKA Core.

4.3.4 Classification of Identified Heritage Resources

Previously recorded and newly identified heritage resources were classified according to the following categories to promote consistency in terminology across various sources:

Table 4-5: Heritage resource classification

Heritage Resource Classifications		
Archaeological	Historical Built Environment	Palaeontological
Battlefields	Intangible / Living	Recent heritage
Burial Grounds & Graves	Monuments & Memorials	Rock Art
Historical	Multi-layered	Ruins

In accordance with Orton (2016), archaeological resources are further considered as follows:

Table 4-6: Definitions for archaeological resources

Definition	Description
Background scatter	Widespread isolated artefacts whose distribution results from either primary or secondary causes
Occurrence	An area of exposed artefacts of generally moderate density with ill-defined spatial limits and in which the artefact distribution is most likely conditioned primarily by natural factors
Site	A spatially discrete area containing remains reflecting anthropogenic occupation or use at one or more times in the past and in which the artefact distribution is conditioned by largely by cultural factors

4.4 Secondary Data Collection

Data collection assists in the development of a cultural heritage baseline profile of the study area under consideration. Qualitative data was collected to inform this HIA and primarily obtained through secondary information sources, i.e. desktop literature review.

A survey of diverse information repositories was made to identify appropriate relevant information sources. These sources were analysed for credibility and relevance. Credible, relevant sources were then critically reviewed. The objectives of the literature review were to:

- Gain an understanding of the cultural landscape within which the Project is located; and
- Identify any potential fatal flaws, sensitive areas, current social complexities / issues and known or possible tangible heritage.

Repositories that were surveyed included the South African Heritage Resources Information System (SAHRIS), online / electronic journals and platforms, and certain internet sources. This HIA only includes a summary and discussion of the most relevant findings. Relevant sources were cited and included in the literature review's bibliography.

Table 4-7: Qualitative data sources

Reviewed Qualitative Data			
Databases			
National Inventory		SAHRIS	
University of the Witwatersrand Archaeological Site Database		Genealogical Society of South Africa	
SAHRIS Cases			
▪ Case ID: 85 ▪ Case ID:2378 ▪ Case ID:7415 ▪ Case ID:1923	▪ Case ID:4885 ▪ Case ID:4887 ▪ Case ID:5394 ▪ Case ID: 8680	▪ Case ID:6521 ▪ Case ID:7114 ▪ Case ID:7468 ▪ Case ID: 753	▪ Case ID: 8334 ▪ Case ID: 10314
Cited Text			
Almond, 2016	Anderson, 1985	Anderson & Anderson, 1985	Arthur, 2008
Atkinson, et al., 2017	Bailey, 2007	Bamford, 2018	Beaumont & Vogel, 1984
Beaumont, et al., 1995	Binford, 1972	Bluff, et al., 2016	Brenton, et al., 2014

Reviewed Qualitative Data			
CSIR, 2016	Cadman, 2007	Cape, 2016	Clark, 1982
Coplan, 2000	De Prada-Samper, 2012	Deacon, 1986, 1988, 1996	Deacon & Deacon, 1999
Deacon & Foster, 2005	Department of Environmental Affairs, 2018	Dreyer, C., 2008	Dreyer, J., 2001
Eastwood, et al., 2002	Ehret, 1982, 1985	Elphick, 1985	Esterhuysen & Smith, 2007
Fauvelle-Aymar & Sadr, 2008	Frescura, 1981	Frescura & Myeza, 2016	Hallinan & Parkington, 2017
Hollmann & Hykkerud, 2004	Humphreys & Thackeray, 1983	Jacobson, 1984, 2005	Johnson, et al., 2006
Kiberd, 2001, 2005, 2006	Kitching, 1977	Klatzow, 2010	Kramer, 2011
Kuman, et al., 2005	Landau, 2010	Le Roux & Keyser, 1988	Lombard & Parsons, 2008
Lombard, et al., 2012	Mitchell, 2002	Morris, 1988, 1994, 2012	Morris & Beaumont, 1991
Morris & Von Bezing, 1996	Mucina & Rutherford, 2010	Oberholzer, 2005	Oberholzer & Lawson, 2016
Orton, 2016	Ouzman, 1999, 2009	Parsons, 2000, 2003, 2004, 2006, 2008	Prinsloo, 1989
Sadr, 2008, 2015	Schrire & Deacon, 1989	Sealy & Yates, 1994	Smith, A.B., 1986, 1992, 1995, 2005
Smith & Ouzman, 2004	Smith & Zubieta, 2007	Smith, R.M., 1993	South African History Online, 2016
Viljoen, 1989		Walton, 1961, 1989	

4.5 Defining Heritage Impacts

Potential impacts to heritage resources may manifest differently across geographical areas or diverse communities when one considers the simultaneous affect to the tangible resource and social repercussions associated with the intangible aspects. Furthermore, potential impacts may concurrently influence the CS of heritage resources. This assessment therefore considers three broad categories adapted from Winter & Bauman (2005, p. 36).

Table 4-8: Impact definition

Category	Description
Direct Impact	Affect the fabric or physical integrity of the heritage resource, for example destruction of an archaeological site or historical building. Direct impacts may be the most immediate and noticeable. Such impacts are usually ranked as the most intense, but can often be erroneously assessed as high-ranking.
Indirect Impact	Occur later in time or at a different place from the causal activity, or as a result of a complex pathway. For example, restricted access to a heritage resource resulting in the gradual erosion of its CS that may be dependent on ritual patterns of access. Although the physical fabric of the resource is not affected through any direct impact, its significance is affected to the extent that it can ultimately result in the loss of the resource itself.
Cumulative Impact	Result from in-combination effects on heritage resources acting within a host of processes that are insignificant when seen in isolation, but which collectively have a significant effect. Cumulative effects can be: ▪ Additive: the simple sum of all the effects, e.g. the removal of a historical structures will minimise the sense of the historic landscape. ▪ Synergistic: effects interact to produce a total effect greater than the sum of the individual effects, e.g. the removal of all historical structures will sterilise the historic landscape. ▪ Time crowding: frequent, repetitive impacts on a particular resource at the same time, e.g. the effect of regular blasting activities on a nearby rock art site or protected historical building could be high. ▪ Neutralizing: where the effects may counteract each other to reduce the overall effect, e.g. the effect of changes from a historic to modern mining landscape could reduce the overall impact on the sense-of-place of the study area. ▪ Space crowding: high spatial density of impacts on a heritage resource, e.g. density of new buildings resulting in suburbanisation of a historical rural landscape.

4.6 Topography, Aesthetic Character and Viewshed Model

The receiving landscape topography defines the surface features that contribute to the aesthetic character. The assessor utilised available GIS vector data to identify the applicable surface features surrounding the Project by creating a topographical model using 20 m

contour relief data the Chief Directorate: National Geo-Spatial Information (CD: NGI) via ArcGIS 3D Analyst Extension.

Slope intensity and aspect models using the Slope and Aspect tools of ArcGIS 3D Analyst Extension were created from the topographical model. The slope model indicates the slope degree and was classified using the Natural Breaks (Jenks)[13] classification method.

The topography denotes whether or not a development will be visible from a defined receptor. A viewshed model to illustrate areas from which the Project infrastructure will be visible, using the Viewshed Tool of the ArcGIS 3D Analyst Extension was created from the topographical model. The following infrastructure heights were utilised to inform the viewshed model:

Table 4-9: Infrastructure heights used in the Viewshed Model

Infrastructure	Height	Source
Dish-antennas	21.5 m	Provided (CSIR, 2016)
Construction camp night time lighting	10 m	Assumed based on height of existing lighting masts at Losberg and Meysdam construction camps
Above ground powerlines	8 m	Assumed based on height of other powerlines in the area
Above ground fibre optic cables		Fibre optic cables will make use of the same poles as the powerlines to reduce impacts (CSIR, 2016)
Construction camp buildings	5 m	Average height of single storey building with pitched roof
Solar PV plants	3 m	Assumed based on height of other small-scale solar PV plants
Access roads	0 m	Ground level
Borrow pits		Below ground
Stone quarries		Below ground

[13] The Natural Breaks (Jenks) classification method splits data into classes based on natural groupings within the data. Natural breaks occur at low points on the histogram and are used to identify classes that group similar values together while maximising the differences between classes. This method accurately depicts trends in the data (Cartographica, 2010 and ESRI, 2016).

4.7 Site Naming Convention

Heritage resources identified by Digby Wells during the pre-disturbance survey were prefixed by the SAHRIS case identification generated for this Project. Information on the relevant period / feature code and site number followed (e.g. 12292/BGG-001). This number may be shortened on plans or figures to the period / feature code and site number (e.g. BGG-001).

Heritage resources identified through the secondary data collection were prefixed by the relevant SAHRIS case or map identification (where applicable), and the original site name used by the author (e.g. 1233/Site1).

4.8 Public Participation Process

Heritage resources do not occur in isolation from heritage producers or consumers. To this effect, a pivotal component of the HRM process is an effective, integrated Public Participation Process (PPP) to:

- Identify, acknowledge, and analyse the needs, wants and expectations of stakeholders;
- Facilitate two-way communication streams between all stakeholders that promotes inclusive, participatory decision-making processes; and
- Manage risks and conflicts that may manifest.

The PPP adhered to legislative requirements, as well as the principles embodied by the International Association of Public Participation (IAP2) to achieve the objectives, goals and priorities as outlined in the following table.

Table 4-10: Summary of PPP objectives

Stakeholder Engagement Process				
Notify	**Engage**	**Include**	**Co-operate**	**Empower**
Create awareness of the HRM process in relation to the SKA Project, how it will impact the public, and indicate proposed mutually beneficial solutions	Engage with key stakeholders and Interested and Affected Parties (I&APs) through implementation of a functional and effective communication plan	Create a platform for all stakeholders to provide suggestions, concerns, aspirations and solutions	Forge partnerships with the stakeholders to ensure alignment of interest for achieving common goals and objectives	Ensure meaningful participation and inclusive decision-making which empowers stakeholders

Information was disseminated to public through various mediums. This comprised *inter alia*:

- Advertisement in one local and national newspaper;
- Placement of Site Notices at strategic locations within the regional study area;
- Distribution of a Project Introduction letter to previously registered I&APs;
- Electronic placement of a Background Information Document (BID) via various digital platforms; and
- Submission of an NID via SAHRIS to comply with Section 38(1) of the NHRA.

5 Cultural Heritage Baseline

5.1 Geology and Palaeontological Sensitivities[14]

The geological context of the regional study area is associated with sediments of the Karoo Supergroup of Early to Middle Permian age (Le Roux & Keyser, 1988; Viljoen, 1989; Prinsloo, 1989; Johnson, et al., 2006; Almond, 2016; Bamford, 2018). The associated groups and formations considered in this report are presented in Table 5-2.

The Ecca Group formations were laid down within or on the margins of a very extensive inland sea or lake on southwestern Gondwana, whereas the *Abrahamskraal Formation* of the Lower Beaufort Group was deposited on land by rivers and in the shallow floodplain ponds or lakes (Almond, 2016). During the Early Jurassic Period, the Drakensberg Basalt outpouring, i.e. doleritic magmas of the Karoo Dolerite Suite, created extensive sills and dykes that intrude the Karoo sediments. These dolerites weather to fragmented, patinated boulders. Finally, Quaternary Sands and alluvium cover most of the study area. The Permian shales, mudstone and sandstone outcrops are, however, easily visible in the sparse vegetation (Bamford, 2018).

The Karoo Supergroup lithostratigraphic unit is inherently associated with fossil remains, both fauna and flora. This is evident in the numerous fossils previously recorded by several researchers (refer to Anderson & Anderson, 1985; Kitching, 1977; Smith, 1993). Table 5-2 details the associated palaeo-sensitivity and fossil heritage for the vairous formations as sourced from the SAHRIS database. The various palaeontological resources expected within the site-specific study area are presented in Table 5-1.

[14] This section provides contextual information as relevant to the lithostratigraphic units with moderate to very high palaeontological sensitivity in the southern extent of the site-specific study area. For a summary of the regional geological and palaeontological context please refer to Almond (2016). This is not repeated here for the sake of brevity.

Table 5-1: Possible fossil heritage within the site-specific study area

Geological Context	Fossil Heritage Type	Examples
Beaufort Group	Fauna	Dinocephalians, Dicynodonts, Gorgonopsians, Therocephalians, Cynodonts and primitive reptiles (e.g. Pareiasaurs)
Ecca Group	Aquatic Fauna	Temnospondyl amphibians, Palaeoniscoid fish, non-marine bivalves, and Phyllopod crustaceans.
	Flora	Petrified wood, rarer leaves of Glossopteris, Horsetail stems, plant rootlet horizons.
	Trace Fossils	Tetrapod trackways, burrows and coprolites. Arthropod trackways and burrows, “worm” burrows, fish fin trails.

Table 5-2: Geological context and associated palaeontological sensitivity

Ma	Eon	Era	Period	Lithostratigraphic units		Lithology	Sensitivity	Fossils
65-	PHANEROZOIC	CENOZOIC		Kalahari Group	Quartenary Sands	Fluvial gravels, sands, lacustrine and pan mudrocks, evaporites, aeolian sands, pedocretes (especially calcrete) (Q)	Low	Palynomorphs, root casts (rhizomorphs) and burrows (eg termitaria), rare vertebrate remains (mammals, fish, ostrich egg shell etc), diatom-rich limestones, freshwater stromatolites, freshwater and terrestrial shells (gastropods, bivalves), ostracods, charophytes
145-		MESOZOIC	Jurassic		Karoo Dolerite Suite	Intrusive dolerite dykes (Jd)	Zero	None
250-		PALAEOZOIC	Permian	Karoo Supergroup	Beaufort Group (Adelaide Subgroup)	Abrahamskraal Formation	Sandstone, mudstone (Pa)	Very-High	Diverse terrestrial and freshwater tetrapods of Tapinocephalus to Lystrosaurus Biozones (amphibians, true reptiles, synapsids – especially therapsids), palaeoniscoid fish, freshwater bivalves, trace fossils (including tetrapod trackways), sparse vascular plants (Glossopteris Flora, including petrified wood)
266-					Ecca Group	Waterford Formation	Shale, with sandstone-rich units (Pc)	Moderate	Range of non-marine trace fossils, vascular plants (including petrified wood) and palynomorphs of Glossopteris flora, mesosaurid reptiles, fish (including microvertebrate remains, coprolites), crustaceans, sparse marine shelly invertebrates (molluscs, brachiopods), microfossils (radiolarians etc), and insects.
						Tierberg Formation	Shale (Pt) - Offshore non-marine mudrocks with distal turbidite beds, prodeltaic sediments		Disarticulated microvertebrate remains (e.g. fish teeth, scales), sponge spicules, spare vascular plants (leaves, petrified wood), moderate diversity trace fossil assemblages (as below plus variety of additional taxa such as large ribbed pellet burrows, arthropod scratch burrows, Siphonichnus etc)
						White Hill Formation	Carbonaceous offshore non-marine mudrocks within minor volcanic ashes, dolomite nodules	Very-High	Mesosaurid reptiles, rare cephalochordates, variety of palaeoniscoid fish, small eocarid crustaceans, insects, low diversity of trace fossils (e.g. king crab trackways, possible shark coprolites), palynomorphs, petrified wood and other sparse vascular plant remains (Glossopteris leaves, lycopods etc)
290-						Prince Albert Formation	Marine to hyposaline basin plain mudrocks, minor volcanic ashes, phosphates and ironstones, post-glacial mudrocks at base	High	Low diversity marine invertebrates (bivalves, nautiloids, brachiopods), palaeoniscoid fish, sharks, fish coprolites, protozoans (foraminiferans, radiolarians), petrified wood, palynomorphs (spores, acritarchs), non-marine trace fossils (especially arthropods, fish, also various “worm” burrows), possible stromatolites, oolites

Plan 2

SKA Project

Geological Context

Legend

- SKA Phase 1 Core
- SKA Phase 1 Spiral Arms
- Secondary Town
- Other Town
- Settlement
- Main Road
- Perennial Stream
- Dam

Infrastructure

- Satellite Dish
- PV Site
- Powerline
- Existing Road to be Upgraded
- New Road
- Fibre Optic Cable

Geology

- Adelaide Subgroup, Beaufort Group
- Dwyka Group, Karoo Supergroup
- Jacomyns Pan Group
- Kalahari Group
- Karoo Dolerite Suite
- Mokolian Erathem
- Prince Albert Formationm, Ecca Group
- Tierberg Formation, Ecca Group
- Volksrust Formation, Ecca Group
- Waterford Formation, Ecca Group
- Whitehill Formation, Ecca Group

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5.2 Archaeology and Cultural Heritage

5.2.1 Stone Age

The South African Stone Age sequence is complex, spanning more than two million years (Mya). The sequence comprises three broad periods, each containing sub-phases and techno-complexes that manifest regional variations in characteristics and time ranges (Lombard, et al., 2012). These include the following:

- The Later Stone Age (LSA) (1840 - ~40 000 [kya]);
- The Middle Stone Age (MSA) (20 – 300 kya); and
- The Earlier Stone Age (ESA) (~200 kya – >2 Mya).

Table 5-3: South African Stone Age sequence (adapted from Lombard et al, 2012)

Period	Techno-complex	Dates	Also known as (including regional variants)
Later Stone Age <40 kya	Ceramic Final LSA	<2 kya	Ceramic post-classic Wilton, Late Holocene with pottery (Doornfontein, Swartkop)
	Final LSA	4 – 0.1 kya	Post-classic Wilton, Holocene microlithic (Smithfield, Kabeljous, Wilton)
	Wilton	8 – 4 kya	Holocene microlithic
	Oakhurst	7 – 1 kya	Terminal Pleistocene / early Holocene non-microlithic (Albany, Lockshoek, Kuruman)
	Robberg	18 – 12 kya	Late Pleistocene microlithic
	Early LSA	40 – 18 kya	

Period	Techno-complex	Dates	Also known as (including regional variants)
Middle Stone Age >20 - <300 kya	Final MSA	40 – 20 kya	MSA IV at Klasies River, MSA 4 generally
	Sibudu	58 – 45 kya	Late MSA / post-Howieson's Poort or MSA III at Klasies and MSA 3 generally
	Howieson's Poort	66 – 58 kya	-
	Still Bay	77 – 70 kya	
	Pre-Still Bay	96 – 72 kya	
	Mossel Bay	105 – 77 kya	MSA II at Klasies River, MSA 2b generally (Pietersburg, Orangian)
	Klasies River	130 – 105 kya	MSA I at Klasies River, MSA 2a generally (Pietersburg)
	Early MSA	300 – 130 kya	-
Earlier Stone Age >200 ka	ESA-MSA transition	600 - >200 kya	Fauresmith, Sangoan
	Acheulean	1.5 Mya – 300 kya	-
	Oldowan	>2 – 1.5 Mya	

Beaumont et al (1995) described the archaeology of the Northern Cape as rich and varied, manifesting as *"thousands of square kilometres of Bushmanland covered by a low density*

lithic scatter" attributed to all three broad periods. These are briefly discussed separately in the subsequent sections.

5.2.1.1 The Earlier Stone Age

The ESA marks the period during which our hominid ancestors learnt to select suitable raw material and manipulate stone to create tools. These included Oldowan Industry flakes struck from cobbles, and later Achuelean core tools characterised by straighter and sharper edges (Esterhuysen & Smith, 2007).

Within the Northern Cape, ESA lithics may include long blades, cores and low incidence of formal tools such as handaxes and cleavers. Considering the raw material and morphology of lithics from this period in the Northern Cape, they will be moderate to heavily weathered where identified. According to Beaumont et al (1995), clusters with distinct Acheulean characteristics have been recorded in the regional study area.

Within a regional context, Wonderwerk Cave is an example in which a deep stratigraphic record has yielded examples of the ESA, as well as more recent assemblages associated with the MSA (Humphreys & Thackeray, 1983).

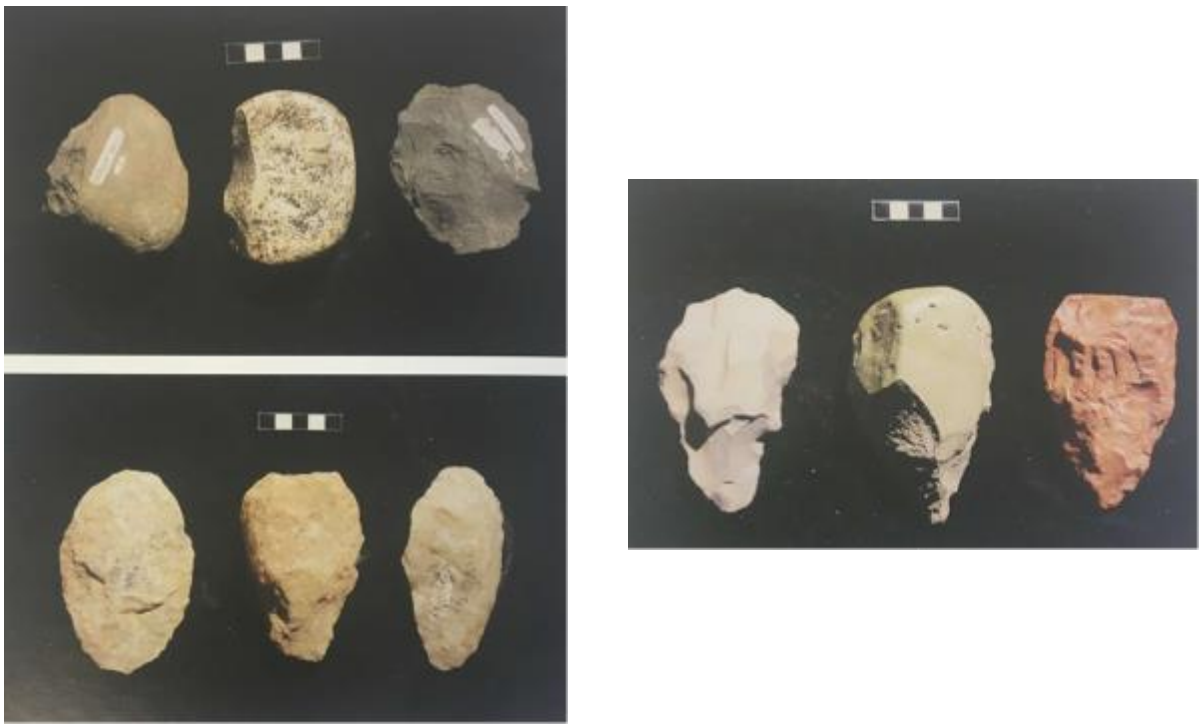

Figure 5-1: Example of ESA lithics

(Adapted from Esterhuysen & Smith, 2007)

5.2.1.2 The Middle Stone Age

The MSA consists of high proportions of minimally modified blades, represented by the Levallois technique characterise the early MSA (Clark, 1982). In general however, the MSA

is broadly defined by blades and points produced from good quality raw material, the use bone tools, ochre, beads and pendants (Deacon & Deacon, 1999).

In the Karoo, associated lithics occur widely over the landscape and can be considered as “background” scatter in that geological, rather than human action condition the fine-scale distribution (Orton, 2016). Thus, well researched MSA sites in this region of South Africa are uncommon. A noteworthy aspect of the Northern Cape archaeological record, however, is the frequent association of lithics associated with pans dispersed throughout the landscape (Beaumont, et al., 1995). Of interest is the work of Kiberd (2001; 2005; 2006) in respect of Bundu Pan, some 25 to 30 km northwest of Copperton. This site yielded ESA, MSA and LSA horizons and the artefacts were accompanied by warthog and equid teeth to name a few (Beaumont, et al., 1995).

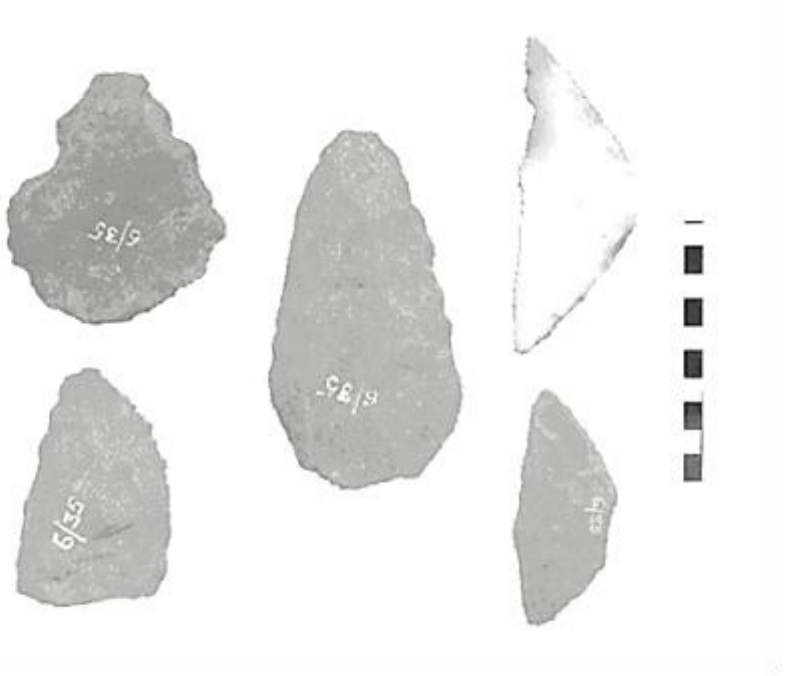

Figure 5-2: Example of MSA lithics

(Kuman, et al., 2005)

5.2.1.3 The Late Stone Age

The LSA dates from approximately 40 kya to the historical period. Ethnographically, this period correlates to habitation of the landscape by:

- *Bona fide* hunter-gatherer groups, i.e. the San;
- Southerly migration of pastoralists, i.e. Khoekhoe into the region from ~2 kya (Brenton, et al., 2014; Sadr, 2015).

Lithics associated with the LSA are specialised: specific tools being created for specific purposes, and the inclusion of bone tools into the assemblages (Mitchell, 2002). LSA sites commonly contain diagnostic artefacts, such as microlithic scrapers and segments. In this

region of the Northern Cape, the LSA is commonly represented by expression of the Final LSA dating to ~4 – 0.1 kya and the latest LSA techno-complex, Ceramic Final LSA dating from ~<2 kya (See Table 5-3). These techno-complexes represent tangible material culture markers of different socio-economic identities associated with the San and Khoekhoe respectively. Archaeologically, these commonly correlate with the Swartkop (i.e. hunter-gatherer) and Doornfontein (i.e. pastoralist) variants (Beaumont & Vogel, 1984; Beaumont, et al., 1995; Parsons, 2003; 2006; 2008).

Swartkop assemblages are characterised by many blades / bladelets and backed blades (Lombard & Parsons, 2008) on Crypto-Crystalline Silicates (CCS[15]) (Beaumont, et al., 1995; Parsons, 2003). Ceramic samples consist of coarse undecorated potsherds, often with grass temper, and few iron objects. Sites dating to this period usually occur close to water sources like pans or stream-bed margins, bedrock depressions containing seasonal water (referred to as *!gorras*), hollows on dunes, and on the flanks or crests of koppies (Beaumont, et al., 1995; Parsons, 2008). Interestingly stone built structures, such as ovals or circles, are known to occur at Swartkop sites. These features may represent the bases of huts, windbreaks or hunter's hides (Parsons, 2004; Jacobson, 2005; Lombard & Parsons, 2008). These sites are linked to the historic /Xam communities of the area who usually followed a hunter-gatherer economy (Deacon, 1986; 1988; Beaumont, et al., 1995).

Doornfontein sites are mostly confined to permanent water sources and are characterised by large samples of thin-walled ceramics with a large portion of necks and rims decorated. Lithics are often produced on quartz, and dominated by coarse irregular flakes with a small or absent retouched component (Beaumont, et al., 1995; Parsons, 2003; 2008; Lombard & Parsons, 2008). Later manifestations contain coarser potsherds with some grass temper, a higher number of iron or copper objects, and large ostrich eggshell beads (Jacobson, 1984; 2005). These assemblages are mostly associated with the Khoekhoe who usually followed a pastoralist economy (Beaumont, et al., 1995).

The oldest known LSA techno-complex recorded in the regional study area is represented as Wilton (*regional variant Springbokoog*), dating to 8 – 4 kya. This techno-complex is distinguished by a significant frequency of many formal tools such as small scrapers, backed blades and bladelets (Parsons, 2006).

Notable sites in the region include:

Table 5-4: Notable LSA sites in the regional study area

Site	Techno-complex	Reference
Melkboom	Ceramic Final LSA	Beaumont et al, 1995; Parsons, 2008
Bokvasmaak		

[15] CCS broadly refers to sedimentary rock that has been altered through metamorphic processes resulting extremely fine-grained or microscopic crystals built with a silicon and oxygen structure.

Site	Techno-complex	Reference
Biesjespoort		
Renosterkop 1		Morris & Beaumont, 1991
Augrabies		Smith, 1986
Bloubos		Parsons, 2000; 2004
Jagtpan 7	Final LSA	Beaumont et al, 1995; Parsons, 2008
Sprinbokoog	Wilton	Beaumont et al, 1995

These LSA sites have very few, if any, associated organic items. The only organic finds are fragments of ostrich eggshell from eggs eaten or from shells used as flasks. Such flasks have been widely recorded across the Northern Cape (Morris, 1994; Morris & Von Bezing, 1996).

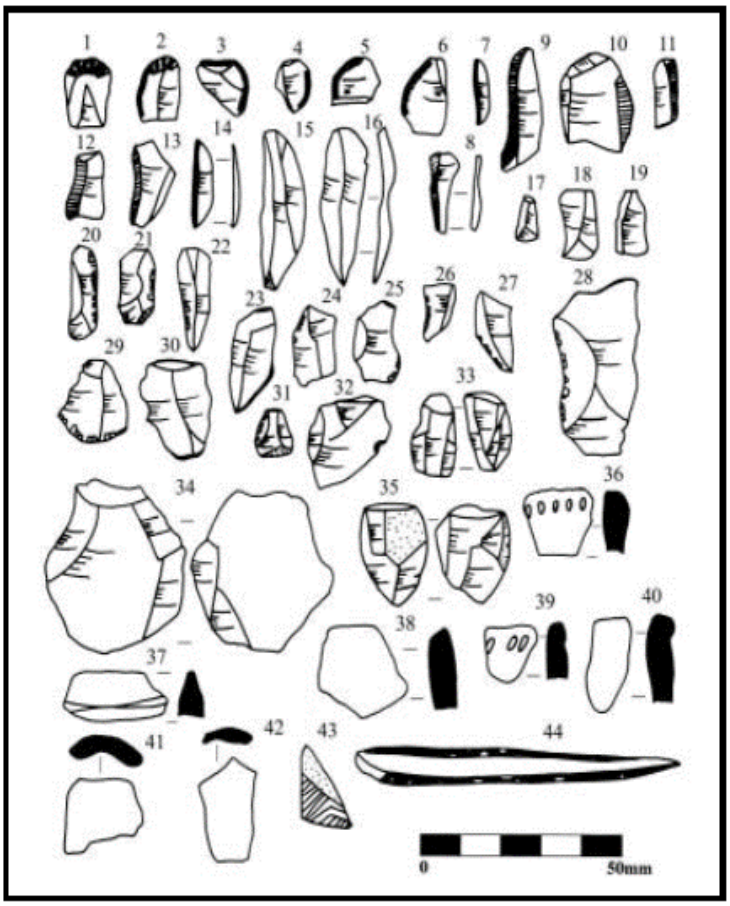

Figure 5-3: Example of LSA lithic assemblage and associated material culture

(Adapted from Parsons, 2006)

5.2.2 Rock art

The LSA period is further characterised by rock art as evidence of ritual practices and complex societies enfolded in the landscape, relative to other tangible heritage markers such as LSA lithics (Deacon & Deacon, 1999; Morris, 2012). At a macroscale, rock art within the Northern Cape includes both engraving and painting production techniques, i.e. technical approaches to making images on rock surfaces. These are briefly distinguished below:

- Rock engravings are produced by incising, chipping or pecking of the rock surface to remove the outer surface of the rock. These are commonly situated in the open, on boulders or exposed glaciated pavements within the central plateau of the interior of South Africa (Morris, 1988; Smith & Ouzman, 2004; Morris, 2012);
- Paintings are produced using fine brushes, quills, sticks or fingers predominantly done in red, white and black, and more rarely bichrome and polychrome (Eastwood, et al., 2002; Smith & Zubieta, 2007). Commonly identified in escarpment and mountainous areas and valleys where shelters occur and provide panels for paintings (Hollmann & Hykkerud, 2004; Morris, 2012).

The variations in production technique and distribution within the landscape notwithstanding, there are notable similarities between the rock engraving and painting "types" of rock art that suggest the distinction is not as significant as originally purported (Morris, 2012). By and large, it is accepted that these rock art are affiliated with the San and Khoekhoe communities (*Refer to subsequent sections for abbreviated discussion on San and Khoekhoe communities*).

The art of the San depict imagery of realistic and proportionally correct animals such as various antelope species, human figures, shamanistic concepts comprising symbolic beings or entoptic shapes, while correlating to themes of gender, landscape and politics (Eastwood, et al., 2002; Smith & Ouzman, 2004). This iconography and the site preference contrasts with the geometric imagery recorded throughout southern Africa. This suggests to some researchers that geometric art is either a subtradition of San art, or is a seperately produced tradition (Smith & Ouzman, 2004).

Geometric art is commonly accepted to be affiliated with the Khoekhoe, derived from a different context to that of the San. Within the tradition, the iconography repeats a limited and distinctive set of geometric forms, such as circular outlines, crosses, lines, concentric circles, oblong forms and finger-applied paint dots in rows, columns and clusters (Smith & Ouzman, 2004).

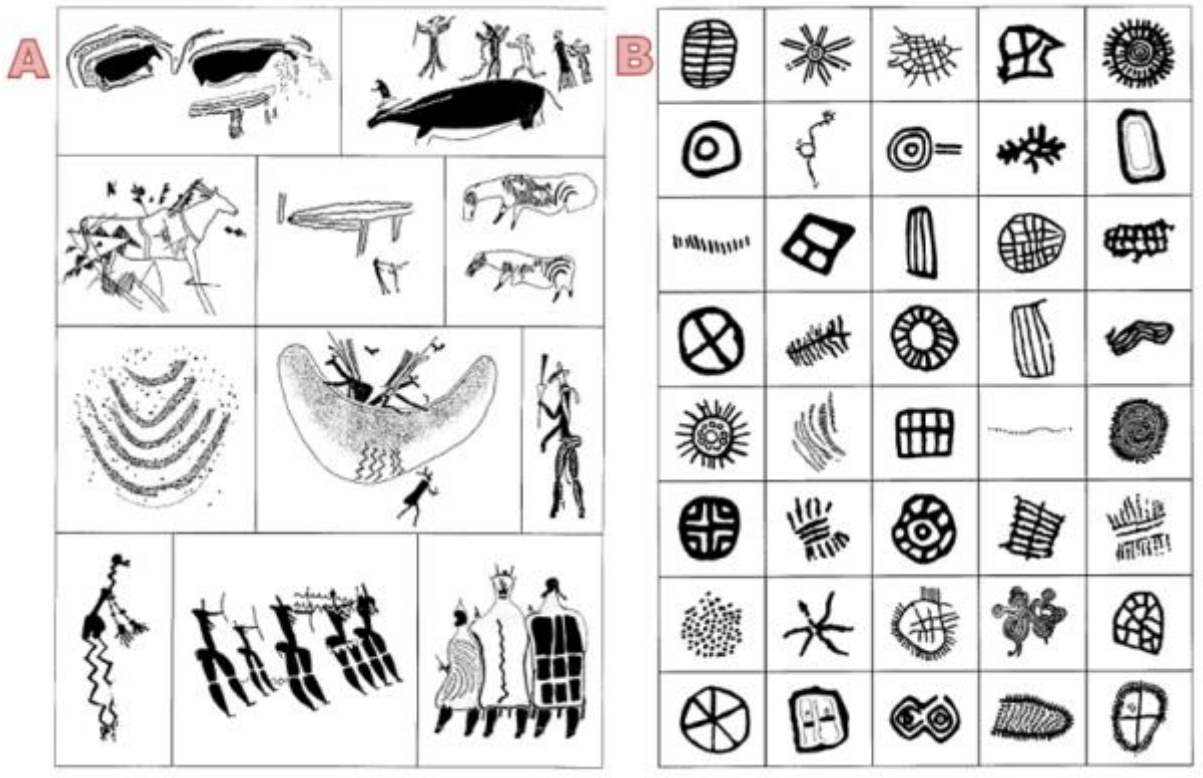

Figure 5-4: A – Range of San Rock Art Tradition. B – Range of Geometric Images Typical of Khoekhoe Rock Art Tradition

(Adapted from Smith & Ouzman, 2004)

Recorded within the area under consideration, are imagery associated with early travellers, soldiers and settlers from the nineteenth century. These may manifest as writing of names and dates, inscriptions made during the South African War of 1899 – 1902, or human figures in the corresponding attire (Ouzman, 1999; Smith & Ouzman, 2004; Morris, 2012). This tradition is distinct from the San and Khokhoe Rock Art, providing a chronicle for regional and farm histories, and sometimes the social context of the time as demonstrated through the blatant desecration of the precolonial traditions (Morris, 1988; Morris, 2012).

5.2.3 The /Xam, Khoekhoe and the Landscape

Researchers attribute the aforementioned LSA archaeological signatures as tangible markers of /Xam and Khoekhoe ethno-historical groups' occupation and use of the landscape (Beaumont & Vogel, 1984; Beaumont, et al., 1995; Smith & Ouzman, 2004; Parsons, 2006; Sadr, 2015).

The /Xam hunter-gatherer group occupied the landscape concentrated between present day Kenhardt and Carnarvon as the most western and eastern boundaries respectively. This "heartland" was known as /Xam-ka-!au. Significantly, Wilhelm Bleek and Lucy Lloyd recorded the folklore and beliefs of this group in their language during the 1870s' (Deacon & Foster, 2005). This is the only instance in which this occurred in South Africa, providing

insights into the /Xam worldview, rock art of the region and relationship with the landscape (Deacon, 1988; Deacon, 1996; Deacon & Foster, 2005).

Culturally significant areas associated with the Bleek and Lloyd manuscripts include Abiquaputs in the Brandvlei Spiral, and Groot Paardekloof within the SKA Core area.

Table 5-5: Culturally Significant Places Protected Under Section 31 of the NHRA as Sourced From the National Inventory

Site Name	SAHRIS ID	Type	Description
Abiquaputs	341484	Place of Significance	Grade II – Place named in the Bleek and Lloyd manuscripts
Groot Paardekloof	89876		

Through their beliefs, rituals and folklore, the /Xam personified and humanised aspects of the landscape, incorporating select physical features and environmental stimuli in a “mythical” reality. Bleek and Lloyd /Xam informants make reference to several examples of these associations. Deacon (1986; 1988) considered, amongst others, the Bitterpits pans and Strandberg Mountains (See Figure 5-6) respectively in her works to demonstrate how the natural world provided the inspiration for the metaphors and symbols used understanding and describing the spirit world.

Figure 5-5: Location of Kenhardt and Vanwyksvlei in relation to Ethno-Historical Occupation of the Regional Study Area

(Adapted from Deacon & Foster, 2005)

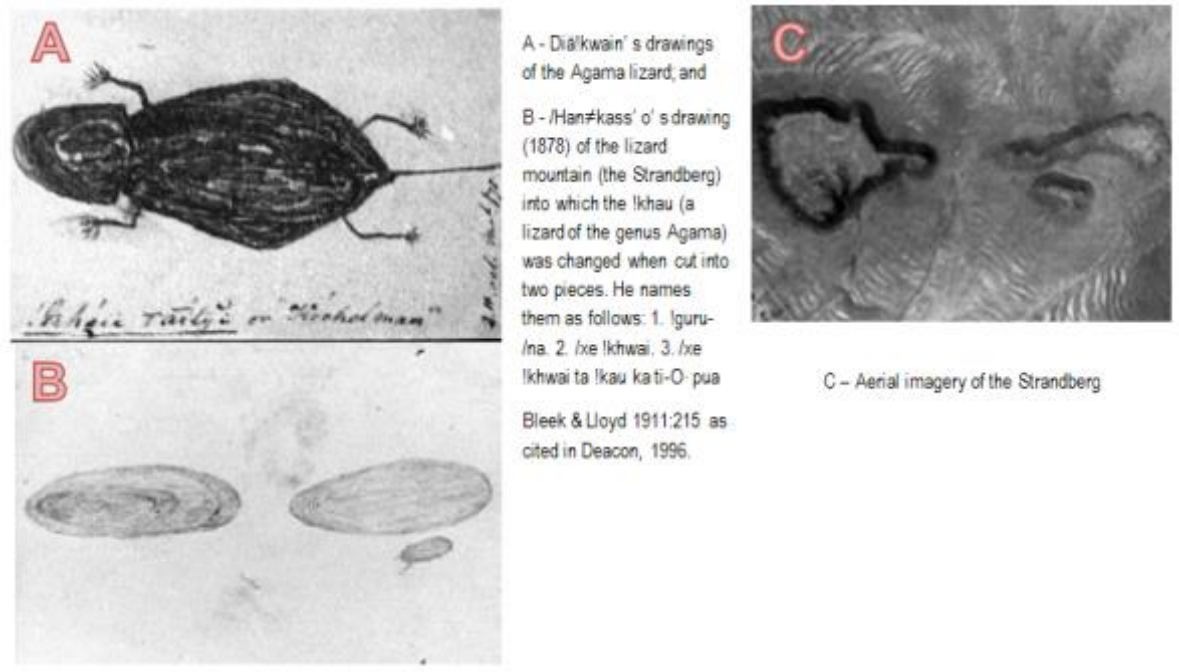

Figure 5-6: Example of Natural Landscape Features used as Metaphors for Aspects of the Spirit World

(Adapted from Deacon, 1996)

The /Xam later shared the landscape with Khoekhoe pastoralist groups (*See Figure 5-5 with specific reference to the Griqua and Korana*). Their arrival in the regional study area is subject to debate, centred on models of either migration or diffusion of the "pastoralist package" into the Cape (Ehret, 1982; Elphick, 1985; Schrire & Deacon, 1989; Smith, 1992; Sealy & Yates, 1994; Ehret, 1998; Smith & Ouzman, 2004; Fauvelle-Aymar & Sadr, 2008). The outcome of this debate notwithstanding, it is commonly accepted that a different socio-economic group from the /Xam occupied the region from as early as 2 kya.

The Khoekhoe had a distinctive lifestyle and material culture. This consisted of a seasonally transhumant way of life, temporary camps defined by mat huts and stone structures amongst which sheep and goats were kept safe at night, and a pastoralist "package" comprising LSA lithics and ceramics (Sadr, 2008). Pastoralists are thought to have moved quickly across the landscape in search for new pastures commonly along well watered and fertile inland river valleys (Arthur, 2008). These customs are said to have been retained well into the twentieth century (Smith & Ouzman, 2004).

Within the regional context, the Khoekhoe were represented by the Korana. The Korana have also been referred to as the Koranner, Corana, Koranna and the Kora (Coplan, 2000; Landau, 2010). Initially there were two main groups, however, quarrels over water and grazing rights, or the ownership of women or livestock usually caused divisions, resulting in many splinter groups whose names were not recorded or forgotten over time. Most Korana

settled in the region of the Orange River (See Figure 5-5), with smaller groups moving into the Overberg and Karoo (South African History Online, 2016).

5.2.4 Xhosa of the Northern Cape

The first records of the Xhosa in the regional study area suggest they settled in the vicinity of the Orange River around 1795. They migrated in search of independence from the Cape Colony, and to exploit the cattle and ivory trade to the north made possible through the introduction of arms and ammunition. The Xhosa settled amongst groups of San, Korana and Griquas[16], collectively described as “traders, colonial deserters and criminals” by the Cape colony settlers. By 1830, smaller, more fluid groups of Xhosa settled throughout the landscape, including along the Zak River (i.e. Sak River), and Schietfontein (i.e. Carnarvon) (Anderson, 1985).

The barren landscape of the Karoo was not suitable to sustain agricultural practices and the consequent sedentary lifeways. To this effect, the Xhosa settled along the Sak River and Schietfontein were largely seasonal nomadic, comparable to the Khoekhoe. After the initial settlement in the local study area, the Xhosa welcomed large numbers of colonial deserters, as well as intermarried with indigenous San women, Korana and Griqua pastoralist, increasing the population significantly over the following years. This increase in population, within an already harsh environment, led to competition for resources (Anderson, 1985). In this instance, the significant numbers of sheep and cattle associated with the Xhosa, Korana and Griquas’ resulted in overgrazing of grass seeds, which was a common food staple for the /Xam. This, in and of itself, exacerbated the raiding of livestock by the /Xam (Deacon & Foster, 2005), and consequent skirmishes between the Xhosa and /Xam (Anderson, 1985).

These circumstances worsened with the influx of Europeans from the colony. Missionaries first moved through the regional study area during the late 18th century (Cadman, 2007). As these missionaries moved northward, they established mission stations at various locales, two relevant examples being Amandelboom from which Williston was founded, and Schietfontein (i.e. Carnarvon). In this instance, the Rhenish Missionary society initially established the Amandelboom mission station amongst the Zak River Griqua, after which the “Schietfontein” Xhosa petitioned for a mission station of their own. The Reverend C. W. Alheit was dispatched, however, existing fractures amongst the diverse group were amplified, and many who did not agree with the mission stations authority or religion migrated elsewhere. Despite this, the Rev. Alheit played a dominant role in Carnarvon. His presence influenced the perceptions of Colonial officials and the increasing number of white stock farmers. At Schietfontein specifically, the group was seen as being under the confines of the missionary reserve, and internally as having freedom of movement (Anderson, 1985).

[16] Griqua / Grikwa an ethnic distinction of heterogeneous and multiracial, predominantly Khoekhoe and European descent; “coloured” people previously grouped together with San; Khoe and slaves under various names including Newlanders (Dreyer, 2001; Klatzow, 2010)

5.3 Historical Built Environment

At the time of the movement of missionaries into the Karoo, the wine and grain market within the colony was becoming saturated. Many white farmers considered stock farming as a viable alternative to counter the oversaturation of the wine and grain market, but overgrazing in the region of the Western Cape forced stock farmers to investigate further afield. Migrants moved into the Karoo area with wagons, tents and *matjiehuise* initially, adopting a transhumance farming economy (Walton, 1989; Kramer, 2011).

The 1813 Cradock Proclamation allowed for legal permanency and settlement of the land, although official survey of farm boundary demarcations only commenced in the 1820s. This gave the frontier farmers a greater sense of ownership, and facilitated a greater influx from the colony. It is surmised that during this period, the first permanent structures were constructed using the material available to them. The result was a vernacular architecture[17] known as corbelled buildings (Kramer, 2011) (Refer to Section 5.3.1 below for detailed descriptions and Figure 5-9).

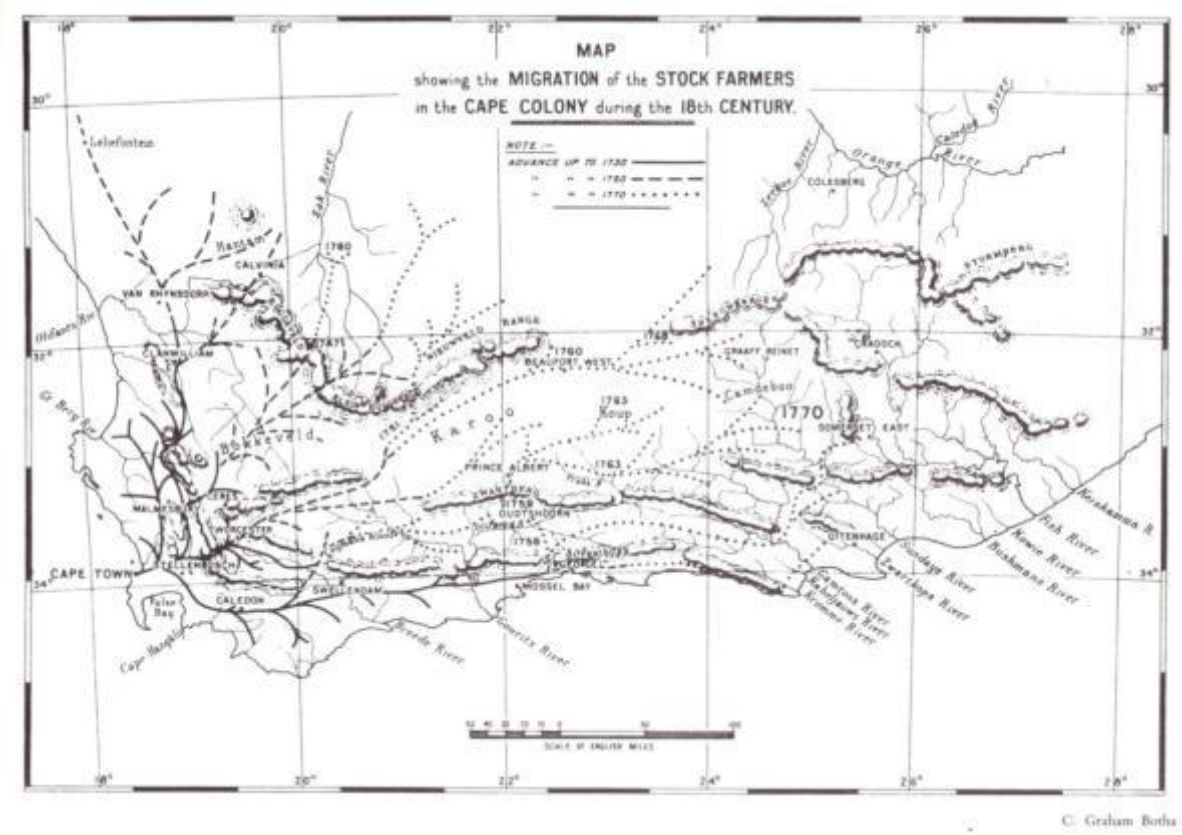

Figure 5-7: Map Depicting the Migration Routes of Stock Farmers from the Cape Colony during the 18th Century

(Walton, 1989)

[17] Vernacular architecture is an architectural style that is designed based on local needs, availability of construction materials and reflecting local traditions.

The encroachment on Schietfontein applied additional pressures on land capacity on the remotest areas of the colony and beyond. Frontier farmers, Xhosa, Korana and Griqua competed for large amounts of land to sustain their flocks, a high commodity during the "wool-boom" of the 1840s (Anderson, 1985). Furthermore, the indigenous /Xam groups were competing with all groups over access to land and its natural resources. As mentioned in Section 5.2.4 above, this resulted in increased livestock raiding and consequently tensions between the various groups. During this period, it is commonly accepted that the /Xam, and San groups in general, were considered vermin by the frontier farmers, and often clashed with other groups residing in the region. De Prada-Samper (2012, p. 173) states "thousands of San perished at the hands of commandos organised by frontier farmers, not always white, and that an untold number of women and children were forced to become serfs of the murderers or their families." Even in the instances where the /Xam were "assimilated" into the farm-economy, testimonies from the time are abound in references to people killed or maimed while working for the farmers.

From approximately 1860, Schietfontein divided into 200 erven, with the surveyed erven not being sufficient to support livestock of the Xhosa, or the pastoralist way of life of the Griqua. This encouraged the Xhosa and Griqua to abandon the area, with many of the former opting to become migrant labour within the diamond mines surrounding Kimberley. During this period, Schietfontein became a predominantly white community, and the preceding tensions between the various groups had exterminated the /Xam in the region (Anderson, 1985).

5.3.1 Corbelled Buildings

Corbelled[18] buildings vary in style, size and function where no two are alike. This makes them true forms of vernacular architecture. In general the buildings are constructed from stone and are circular, with few square or rectangular exceptions. The floors comprised a mixture of clay and cow dung, and in some instances rubbed smooth and often polished with a mixture of ox blood and fat. "*Keeping – holes*" were found in the walls and beams often stretched across the arcs for drying meat or hanging clothes. Animal horns were also used as pegs. The walls curve inwards to an apex, reaching heights between 2 – 5 m, giving it a beehive shape. The interior was often plastered and painted over with lime wash. The windows were restricted in size, believed to be constructed in this manner to guard against /Xam bowmen attack. The gradually domed roof is then closed off by a flat stone. The roofs often have projecting stones which most likely served as steps and anchors for scaffolding during construction, as well as repair work. The absence of wood from the landscape did not allow for the construction of a house with a pitched roof or "*brakdak*"[19] (Walton, 1961; Walton, 1989; Kramer, 2011)

[18] A method of construction using brick or stone where each course steps or projects slightly from the course below

[19] A flat, clay topped roof

These buildings are commonly associated with the permanent settlement of white stock farmers and later Trekboers in the Carnarvon (*Schietfontein*), Loxton and Fraserburg area, serving as a collection of invaluable information source of mid-19th century life in the Karoo which is largely undocumented (Kramer, 2011, p. 5). It has been suggested that these structures may have been influenced by the Xhosa residing in the region and the Sotho-Tswana from further north, groups that came from a "stone building" culture (Frescura, 1981; Kramer, 2011).

Walton (1989, p. 129) postulates that stock farmers opted to construct structures in conventional rectangular forms with flat *brakdak*, and later in time, corrugated iron roofs. This form of construction provided for larger living areas and required less maintenance. Within the site-specific study area, the evolution from corbelled buildings, to rectangular flat-roofed dwellings, and finally corrugated pitch roof structures can be observed.

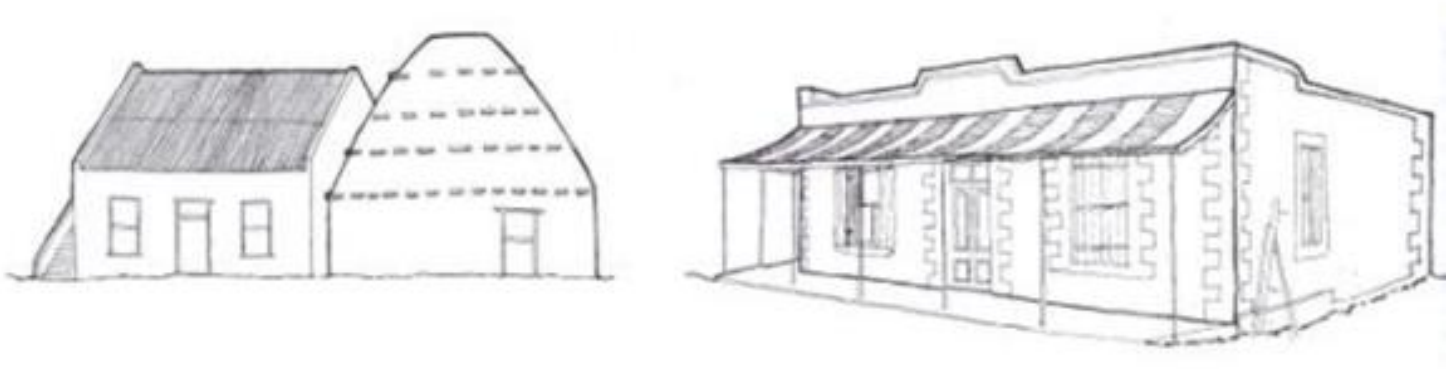

Figure 5-8: Corbelled house with pitched roof editions, and 1880s Karoo dwelling with concave corrugated sheeting roof

(Frescura & Myeza, 2016)

Figure 5-9: Examples of corbelled buildings that occur within the local study area

5.4 Visual Landscape

The site-specific study area is characterised by extensive flat open plains to the north, and mountainous areas to the south, with Karoo Dolerite outcrops throughout. The flats ("*vlaktes*") comprise extensive sandy to gravel plains with watercourses that only flow in response to the summer rainfalls, while the mountainous areas to the south consists flat-topped sandstone and dolerite koppies. These landforms are more pronounced as they protrude above the low, sparse vegetation (CSIR, 2016). The results of the topographical model demonstrate the following elevation and slopes within the site-specific study area:

Table 5-6: Results of the topographic model

Elevation	
Area	**Elevation in metres above mean sea level (mamsl)**
Brandvlei to Carnarvon Spiral Arms	896 – 1 551
Northern Plain (Core) to Dolerite Outcrops	954 – 1 420
Carnarvon Spiral Arm to Dolerite Outcrops	1 014 – 1 551
Williston Spiral Arm to Dolerite Outcrops	1 038 – 1 408
Slope	
Area	**Degrees**
General site-specific study area	0 – 3.5
Dolerite outcrops	3.5 – 11.5
Upper slopes of mountainous area	11.5 – 37

Table 5-7: Defined landscape types

(Oberholzer & Lawson, 2016)

Landscape Type	Characteristics	Significant Visual Features
Southern plain: Beaufort Group, Adelaide Formation mudstones, sandstones and shales.	Broad plain intruded in places by dolerites, and incised in the south-west corner of the study area by the Sak River and the Brak River. The elevation varies from 1 100 to 1 400 m.	Generally dry river courses and minor dolerite koppies. Koppies are visually sensitive, and the plains are visually exposed. Travelers on the R63 Route and a number of farmsteads are the main visual receptors.
Mountainous terrain: Ecca Group, 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 1 300 to 1 500 m. This is the most scenic part of the study area.	Scenic dolerite ridges and koppies, with a few small ports. 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.

Landscape Type	Characteristics	Significant Visual Features
Northern plain: Ecca Group, shales.	Broad and largely featureless plain at an elevation of 1 000 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.

This area falls within two biomes, namely the Azonal Vegetation Biome and the Nama-Karoo Biome (Cape, 2016). The vegetation comprises dwarf shrubland dominated by low sturdy and spiny, sometimes succulent, shrubs and 'white' grasses in the plains, and a mixture of small-leaved shrubs and shrubby succulents mixed with drought-resistant 'white' grasses in the mountainous areas (Mucina & Rutherford, 2010). These are expected to provide minimal visual screening. Existing trees planted as windbreaks or vegetation screens, however, are anticipated to have a screening effect.

The natural landscape is interspersed with isolated farmsteads.

Table 5-8: Vegetation and landscape features

(Mucina & Rutherford, 2010)

Vegetation Type	Vegetation and Landscape Features
Bushmanland Arid Grassland	Extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semi-desert 'steppe'. In places low shrubs of *Salsola* change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected.
Bushmanland Basin Shrubland	Slightly irregular plains with dwarf shrubland dominated by a mixture of low sturdy and spiny (and sometimes also succulent) shrubs (*Rhigozum*, *Salsola*, *Pentzia*, *Eriocephalus*), 'white' grasses (*Stipagrostis*) and in years of high rainfall also by abundant annuals such as species of *Gazania* and *Leysera*.
Bushmanland Sandy Grassland	Dense, sandy grassland plains with dominating white grasses (*Stipagrostis, schmidtia*) and abundant drought-resistant shrubs. After rainy winters rich displays of ephemeral spring flora (*Grielum humifusum, Gazania lichtensteinii*) can occur.

Vegetation Type	Vegetation and Landscape Features
Bushmanland Vloere	Flat and very even surfaces of pans and broad bottoms of intermittent rivers. The centre of a pan (or the river drainage channel itself) is usually devoid of vegetation; loosely patterned scrub dominated by *Rhigozum trichotomum* and various species of *Salsola* and *Lycium*, with a mixture of non-succulent dwarf shrubs of Nama-Karoo relationship. In places loose thickets of *Parkinsonia africana*, *Lebeckia linearifolia* and *Vachellia karroo* (previously *Acacia karoo*) can be found.
Northern Upper Karoo	Shrubland dominated by dwarf Karoo shrubs, grasses and *Senegalia mellifera* subsp*. detinens* (previously *Acacia mellifera* subsp*. detinens*) and some other low trees (especially on sandy soils in the northern parts and vicinity of the Orange River). Flat to gently sloping, with isolated hills of Upper Karoo Hardeveld in the south and Vaalbos Rocky Shrubland in the northeast and with many interspersed pans.
Upper Karoo Hardeveld	Steep slopes of koppies, butts, mesas and parts of the Great Escarpment covered with large boulders and stones supporting sparse dwarf Karoo scrub with drought-tolerant grasses of genera such as *Aristida, Eragrostis* and *Stipagrostis*.
Western Upper Karoo	Much dissected landscape in the southwest associated with the tributaries of the upper catchment of the Sak River (e.g. Renoster River, Riet River, Klein Sak River), often rocky. Mixture of small-leaved shrubs and shrubby succulents (*Brownanthus*, *Drosanthemum*, *Ruschia* etc.) with drought-resistant (mostly ‘white’) grasses is the determinant feature of the vegetation structure.

Figure 5-10: Current state of the physical landscape

6 Results from the Field Survey

The following chapter describes the tangible heritage resources that were identified and described during the pre-disturbance survey by palaeontology, archaeology, historical built environment and visual specialists. Following SAHRA's preferences regarding the information shared in public reports, the full site descriptions, including GPS co-ordinates, will be submitted to SAHRA as a separate document. Detailed site descriptions and photographs of the archaeological sites have been included in Appendix D. Photographs and descriptions of the heritage resources are included in the PIA (Appendix E), the built environment (Appendix F) and the VIA (Appendix G) reports attached to this document.

6.1 Palaeontological Survey

Two palaeontological records were identified and recorded during the field assessment. Table 6-1, Figure 6-1 and Figure 6-2 presented the details of these finds as relevant to this assessment.

Table 6-1: Identified palaeontological resources

Site Reference	Description	CS	FR
PAL-001	Depression, scattered pieces of shale with impressions of *Calamites* and *Paracalamites* (Sphenophyta – horsetails). The source stratum was not identified	Medium High	General Protection IV A
PAL-002	Small fragments of siltstone with impressions of Glossopteris leaves and sphenophyte stems, not *in situ.*		

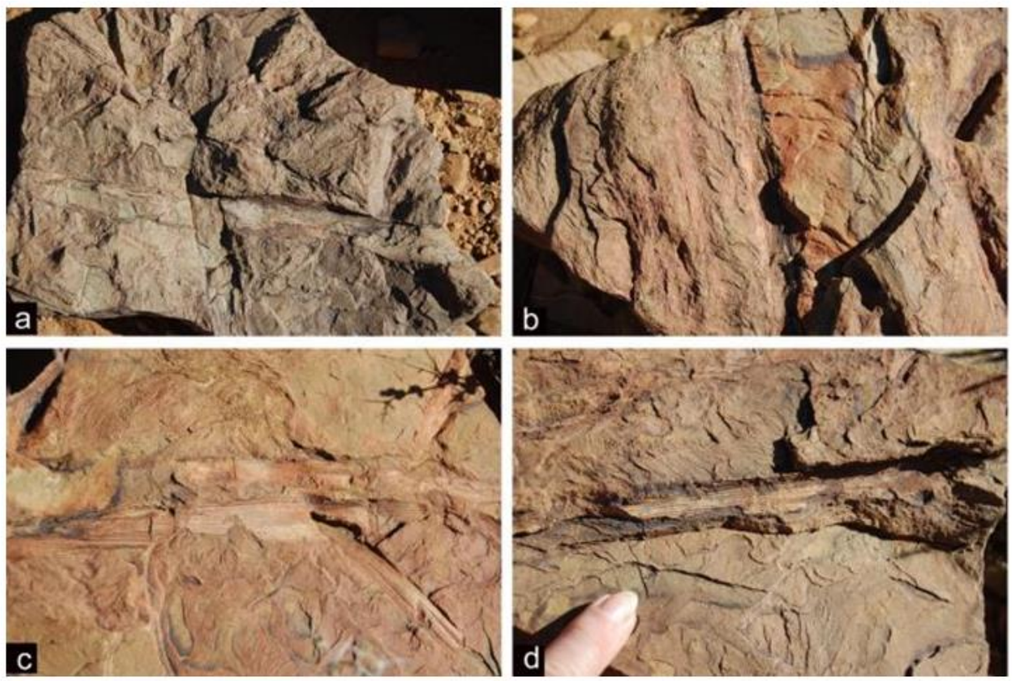

Figure 6-1: a – Impressions of plant culms of *Calamites* sp.; b – several parallel culms *of Paracalamites*; c – *Calamites* stem (horizontal) with clear longitudinal striations and a node to the left and side branch to the right; stem diameter 15mm; d – another *Calamites* culm

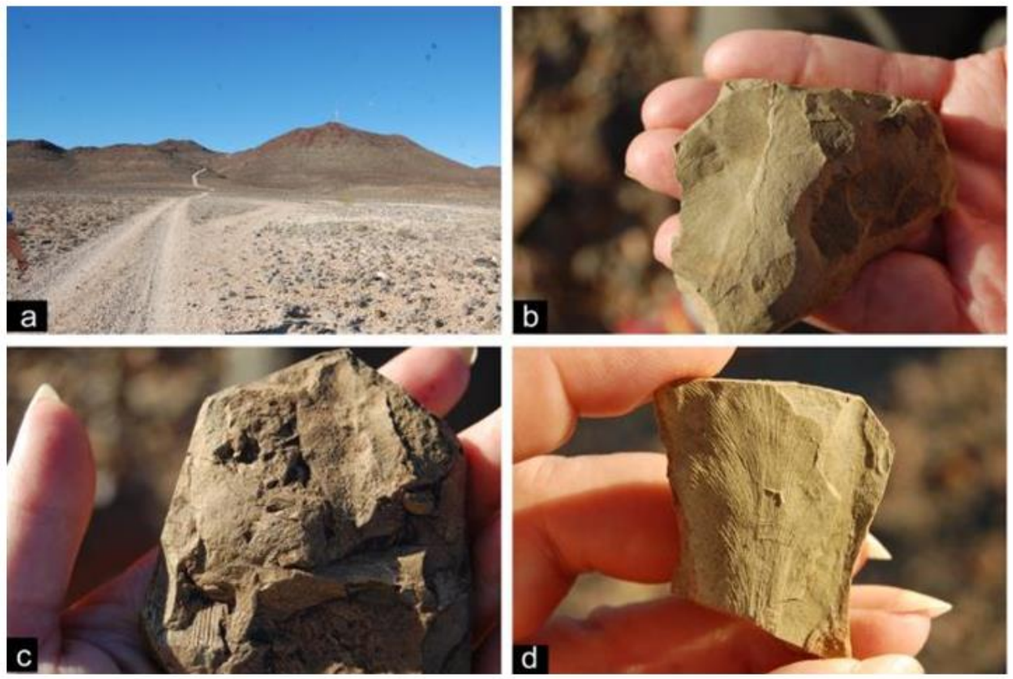

Figure 6-2: a – view of the road to the radio mast. Fossil site is on the right of the right kink in the road; foreground shows the typical small shale slabs throughout this area but only those at the site (about 200m^2) have fossil imprints; b – impression of a *Glossopteris* leaf with prominent midvein; c – *Equisetum* stem on the bottom left and *Glossopteris* leaf partial top right; d – *Glossopteris* leaf impression with broad, poorly defined midvein

6.2 Archaeological Survey

A total of 30 archaeological features were identified during the field assessment. Table 6-2 and Figure 6-3 to Figure 6-5 below include only the features within 500 m of the development footprint areas, as these are the features that are at the greatest risk of impacts from Project-related activities. Similarly, only the features listed in Table 6-2 will be dealt with in the impact assessment (Chapter 8 below).

Table 6-2: Identified archaeological resources and burial grounds and graves

Site Reference	Description[20]	CS	FR
BGG-001	Possible burial ground: ≤10 graves	Very High	Grade I
BGG-002	Possible burial ground: Single grave		
MXD-001	Site: low complexity, multiple components <25 sq. m / 5 x 5 m	Low	General Protection IV A
MXD-002	Site: high complexity, multiple components >2500 sq. m / 50 x 50 m	Medium	Grade III B
MXD-003	Site: high complexity, multiple components >2500 sq. m / 50 x 50 m		
RA-003	Rock art: engraving		
RA-004	Rock art: engraving		
RA-006	Rock art: engraving		
RA-007	Rock art: engraving		
RA-008	Rock art: engraving		
RA-009	Rock art: painting	Medium High	
RA-010	Rock art: painting		
SA-001	MSA open-air site consisting of a low-density surface scatter (<10:1 sq. m).	Low	General Protection IV A
SA-002	Low density surface scatter (<10:1 sq. m) associated with the Stone Age.		
SA-004	Isolated surface find including two lithics. One lithic has a patina and the other appears younger (possibly LSA).	Negligible	General Protection IV A

[20] Refer to Appendix D for more detailed site descriptions and site photographs.

Site Reference	Description[20]	CS	FR
SA-005	Low density surface scatter (<10:1 sq. m) of what appear to be LSA lithics, including two bladelets.	Low	General Protection IV A
SA-006	Low density surface scatter (<10:1 sq. m) of what appear to be LSA lithics, including two bladelets.		
SA-007	High density surface scatter (>20:1 sq. m) representing the MSA and LSA.		
SA-009	Stone Age low density surface scatter (<10:1 sq. m)		
SA-010	Isolated surface find of two LSA lithics, including one broken bladelet and one flake core.	Negligible	
SA-012	MSA low density surface scatter (<10:1 sq. m)	Low	
SA-013	Low density surface scatter (<10:1 sq. m) of Stone Age artefacts.		
SA-014	Site: low complexity, multiple components <25 sq. m / 5 x 5 m		
SA-015	Low density surface scatter (10:1 sq. m) representing the ESA, MSA and LSA.		
SA-016	High density surface scatter (>20:1 sq. m) of Stone Age artefacts, some of which may be LSA.	High	Grade III B
SA-017	Low density LSA surface scatter (<10:1 sq. m).	Low	General Protection IV A
SA-018	Isolated surface find of one lithic which may represent the MSA.	Negligible	

Figure 6-3: Possible Grave Recorded in the Site-Specific Study Area (BGG-002)

Figure 6-4: Examples of Identified Rock Art Engravings (top; RA-008) and Geometric Rock Art paintings (bottom; RA-009)

Figure 6-5: Examples of Lithic Occurrences Identified during the Field Assessment

6.3 Historic Built Environment Survey

The following built environment resources were recorded during the field assessment.

Table 6-3: Historic Built Environment Resources

Site Reference	Description	CS	FR
BHS 1 (SAHRIS ID: 93470)	Corbelled House associated with a historic farmstead located on De Hoek 70 RE	Medium High	Grade II
BHS 2 (SAHRIS ID: 93473)	Farmstead Ruins located on Zout Rivier 71 Portion 2	Medium	Grade III A
BHS 3 (SAHRIS ID: 46497)	Farmstead Building located on Rooi Zand 72 RE	Low	Grade III A

Site Reference	Description	CS	FR
BHS 4 (SAHRIS ID: 93485)	Farmstead Building located on Rooi Zand 72 Portion 1	Negligible	Grade III B
BHS 5	Groot Paardekloof Farmstead	Medium High	Grade II
BHS 6	Groot Paardekloof School House	Low	Grade III A
BHS 7	Corbelled House and Farmstead located on Waterval 497 Portion 1	High	Grade II
BHS 8	Retaining Walls located on Klein Paardekoof	Medium High	Grade III B

Figure 6-6: Examples of Corbelled Houses (Top) and Late 19th, Early 20th Century Farmstead Houses (Bottom) Assessed during the In-Field Survey

6.4 Visual Survey

The survey verified desktop data and confirmed the current visual character of the landscape. The antennas are the most visible category of infrastructure associated with the SKA Project. The assessor confirmed the daytime visibility of existing antenna to an extent

of 20 km, after which exposure is negligible. At night, the antennas are not visible as they do not emit light. Night-time light emissions are envisaged to be limited to the construction camps, at a maximum areal extent of 8 km considering the established camp. The photographs taken informed the day- and night-time Viewshed Models and development of photomontages (see Figure 6-7).

Table 6-4 illustrates the 'worst-case' scenario in terms of visual exposure of the SKA Project, using the antenna as the most visible component. This viewshed, refined in the practical day- and night-time Viewshed Models (Plan 5 and Plan 6), assist the assessor to identify and define sensitive receptors[21]. In this instance, these may primarily include farmstead residents and labourers, as well as road users. Considering the results and the criteria defined by Oberholzer (2005), the site-specific study area was rated as per

Table 6-5.

Table 6-4: Potential Day- and Night Time Viewshed Areas per Category

Impact	Daytime Viewshed Model		Night time Viewshed Model	
	Category	Viewshed Area	Category	Viewshed Area
Very High Visual Exposure	0 – 2 km	568.40 km²		
High Visual Exposure	2 – 5 km	1,802.96 km²	0 – 2 km	27.57 km²
Moderate Visual Exposure	5 – 9 km	3,194.36 km²	2 – 4 km	47.10 km²
Low Visual Exposure	9 – 14 km	4,038.44 km²	4 – 8 km	145.72 km²
Very Low Visual Exposure	14 – 20 km	4,035.17 km²		

Table 6-5: Rating of Landscape against VIA Criteria

Criteria	Description	Rating
Visibility of the project	Visible from a large area (e.g. several square kilometres)	High visibility
Visual exposure	Dominant or clearly noticeable	High exposure
Visual sensitivity of the area	Highly visible and potentially sensitive areas in the landscape	High visual sensitivity
Visual sensitivity of receptors	Residential areas, nature reserves and scenic routes or trails	High sensitivity

[21] Refer to Section 8.3.1 and 8.3.2 in the Visual Impact Assessment report for a more thorough description of the day- and night-time visual receptors.

Criteria	Description	Rating
Visual absorption capacity (VAC)	Partial screening by topography and vegetation	Moderate VAC
Visual intrusion	Results in a noticeable change or is discordant with the surroundings	High visual intrusion

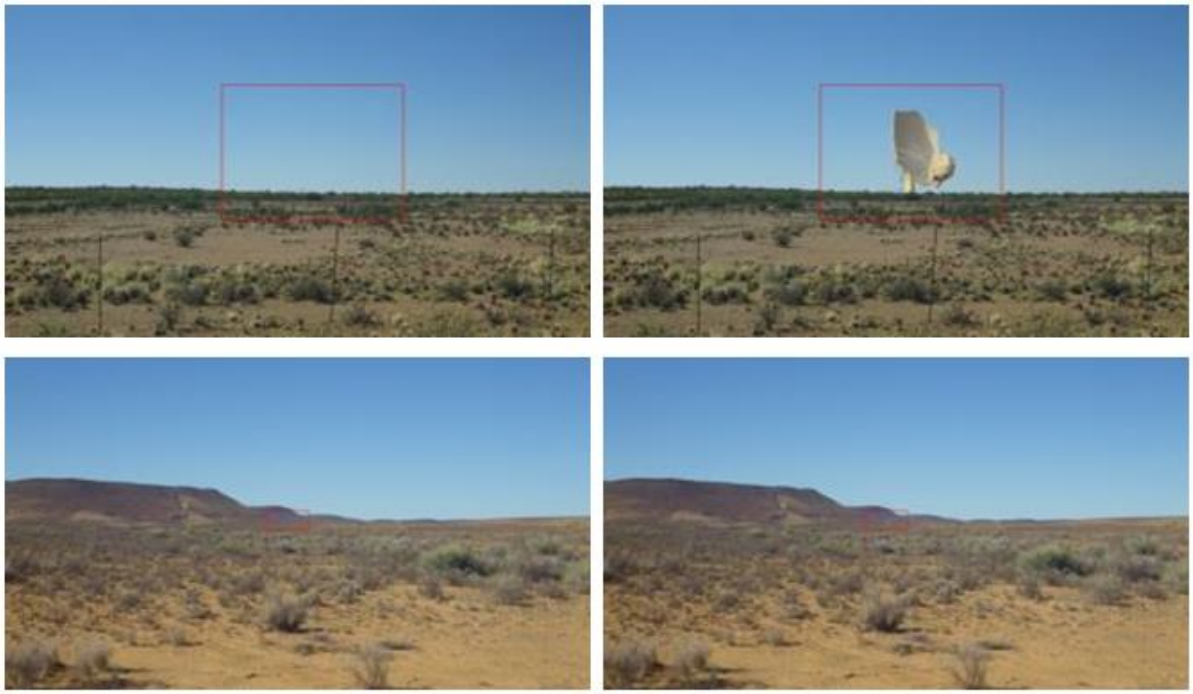

Figure 6-7: Photomontages Showing the Current and Potential Future Views for SKA008 (top) and SKA130 (bottom)

Plan 3

SKA Project

Distribution of Archaeological Sites

Legend

- SKA Phase 1 Core
- SKA Phase 1 Spiral Arms
- Secondary Town
- Other Town
- Settlement
- Archaeological Sites
- Main Road
- Perennial Stream
- Dam

DIGBY WELLS ENVIRONMENTAL

• Sustainability • Service • Positive Change • Professionalism • Future Focused • Integrity

Projection: Geographic
Datum: WGS 1984

Ref #: kam.NRF4874.201805.042
Revision Number: 1
Date: 08/05/2018

N

0 10 20 40

Kilometres

1:900 000

www.digbywells.com

Plan 4

SKA Project

Distribution of Historical Built Environment, Burial Grounds & Graves

Legend

- SKA Phase 1 Core
- SKA Phase 1 Spiral Arms
- Assessed Historical Built Environment
- Distribution of Historical Built Environment, Burial Grounds & Graves
- Secondary Town
- Other Town
- Settlement
- Main Road
- Perennial Stream
- Dam

DIGBY WELLS ENVIRONMENTAL

• Sustainability • Service • Positive Change • Professionalism • Future Focused • Integrity

Projection: Geographic
Datum: WGS 1984

Ref #: kam.NRF4874.201805.043
Revision Number: 1
Date: 08/05/2018

N

0 10 20 40

Kilometres

1:820 000

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Plan 5

SKA Project

Daytime Practical Viewshed Model

Legend

Project Area

- SKA Phase 1 Core
- SKA Phase 1 Spiral Arms
- 20km Buffer of Dish-Antenna
- Secondary Town
- Other Town
- Settlement
- Main Road
- Railway Line
- River
- Dam

Daytime Practical Viewshed Model

- 0 - 2 km: Potentially Very High Visual Exposure
- 2 - 5 km: Potentially High Visual Exposure
- 5 - 9 km: Potentially Moderate Visual Exposure
- 9 - 14 km: Potentially Low Visual Exposure
- 14 - 20 km: Potentially Very Low Visual Exposure

Receptors

Road Users

- Very High
- High
- Moderate
- Low
- Very Low

Receptors

Farmsteads

- Very High - Within Core (8)
- High - Within Core (5)
- Moderate - Within Core (8)
- Low - Within Core (1)
- Very High - Outside Core (4)
- High - Outside Core (23)
- Moderate - Outside Core (44)
- Low - Outside Core (65)
- Very Low - Outside Core (58)

Heritage Sites

- Very High - Within Core (53)
- High - Within Core (17)
- Moderate - Within Core (7)
- Very High - Outside Core (18)
- High - Outside Core (17)
- Moderate - Outside Core (11)
- Low - Outside Core (15)
- Very Low - Outside Core (21)

DIGBY WELLS ENVIRONMENTAL

• Sustainability • Service • Positive Change • Professionalism • Future Focused • Integrity

Projection: Transverse Mercator	Ref #: scm.NRF4874.201805.072
Datum: WGS 1984	Revision Number: 1
Central Meridian: 21°E	Date: 15/05/2018

N

0 10 20 40

Kilometres

1:750 000

www.digbywells.com

Plan 6

SKA Project

Night Time Practical Viewshed Model

21°20'0"E
21°25'0"E
21°30'0"E
21°35'0"E
30°35'0"S
30°40'0"S
30°45'0"S
30°50'0"S
Botterslaagte

Legend

Project Area

- SKA Phase 1 Core
- SKA Phase 1 Spiral Arms
- 8km Buffer of Construction Camp
- Main Road
- River

Night Time Practical Viewshed Model

- 0 - 2 km: Potentially High Visual Exposure
- 2 - 4 km: Potentially Moderate Visual Exposure
- 4 - 8 km: Potentially Low Visual Exposure

Receptors

Farmsteads

- High - Within Core (2)
- Moderate - Within Core (1)

Heritage Sites

- High - Within Core (11)
- Moderate - Within Core (10)
- Low - Within Core (7)
- Low - Outside Core (5)

Road Users

- High
- Moderate
- Low

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Revision Number: 1
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7 Cultural Significance of the Identified Landscape

Heritage resources are intrinsic to the history and beliefs of communities. They characterise community identity and cultures, are finite, non-renewable and irreplaceable. Considering the innate value of heritage resources, HRM acknowledges that these have lasting worth as evidence of the origins of life, humanity and society. Notwithstanding the inherent value ascribed to heritage, it is incumbent of the assessor to determine resources significance to allow implementation of appropriate management. This is achieved through assessing heritage resources value relative to certain prescribed criteria encapsulated in policies and legal frameworks.

This section presents a statement of CS as relevant to the newly identified heritage resources and greater cultural landscape of the site-specific study area. The statement of significance considers the identified heritage resources and landscape importance or contribution to four broad value categories: aesthetic, historical, scientific and social values, to summarise the CS and other values described in Section 3(3) of the NHRA.

The site-specific study area is known to comprise tangible and intangible heritage resources ranging from palaeontological through to the historical period, as evidence by the available data (refer to Sections 4.4 and 6 above). These resources do not occur in isolation from one another, but are rather as temporal palimpsests[22]. These resources must be considered within the context of the cultural heritage baseline to provide a meaningful interpretation of the CS of the individual resources, their interactions through time, and the multi-layered landscape.

The following table provides a summary of the determined CS of the various heritage resource types known to occur within the site-specific and local study areas. The results of these determinations are utilised to motivate for the CS of the cultural landscape within which the SKA Project is situated.

[22] An assemblage of material and objects that form part of the same deposit but are of different ages and ‘life” span (Bailey, 2007)

Table 7-1: Cs of the Known Heritage Resource Types within the Site-Specific and Local Study Areas

Resource ID	Resource Period	Type	Description	Aesthetic	Historic	Scientific	Social	INTEGRITY	VALUE	Designation
Abrahamskraal Formation	Precambrian (1,2 billion years ago [bya]) to late Pleistocene (20 kya)	Natural feature	Sandstone, mudstone lithology with diverse terrestrial and freshwater tetrapods of Tapinocephalus to Lystrosaurus Biozones, palaeoniscoid fish, freshwater bivalves, trace fossils and sparse vascular plants	-	-	5	-	4	20	Very High
White Hill Formation	Precambrian (1,2 bya) to late Pleistocene (20 kya)	Natural feature	Mesosaurid reptiles, rare cephalochordates, variety of palaeoniscoid fish, small eocarid crustaceans, insects, low diversity of trace fossils	-	-	5	-	4	20	Very High
ESA Occurrences	Earlier Stone Age (3 mya to 300 kya) (ESA)	Occurrence	Long blades, cores and low incidences of formal tools moderate to heavily weathered	3	-	4	-	2	7	Low

Resource ID	Resource Period	Type	Description	Aesthetic	Historic	Scientific	Social	INTEGRITY	VALUE	Designation
MSA	Middle Stone Age (c. 300 kya to 30 kya) (MSA)	Occurrence	High proportion of minimally modified blades and points produced from good quality raw material, including hornfels (which is highly patinated) and quartz. Occur widely over the landscape mostly through geological action rather than human.	3	-	1	-	2	4	Negligible
LSA Occurrences	Later Stone Age (c. 30 kya to 2 000 years ago [ya]) (LSA)	Occurrence	Assemblage characterised by un-patinated hornfels.	1	3	4	5	3	10	Low
LSA		Site	Microlithic scrapers and segments. Assemblages characterised by many blades and backed blades on CCS characteristic of Swartkop assemblages).	3	4	3	5	4	15	High

Resource ID	Resource Period	Type	Description	Aesthetic	Historic	Scientific	Social	INTEGRITY	VALUE	Designation
Rock Engravings	Later Stone Age (c. 30 kya to 2 000 ya) (LSA)	Rock art	Images produced by incising, chipping, or pecking to depict imagery of realistic and proportionally correct animals, human figures and shamanistic concepts	5	4	4	5	4	18	Very High
LSA	LSA Herder period (after 2 000 ya to c. 1000 CE)	Site	Lithics dominated by coarse irregular flakes commonly on quarts, with small or absent retouched component. Associated with thin walled ceramics	1	3	3	4	4	11	Medium
Rock Paintings	LSA Herder period (after 2 000 ya to c. 1000 CE)	Rock art	Limited and distinctive set of geometric forms, such as circular outlines, crosses, lines, concentric circles, oblong forms and finger-applied dots	5	3	4	5	4	17	High
Burial grounds and graves	Later Stone Age (c. 30 kya to 2 000 ya) (LSA)	Burial / grave	Unidentified burials associated with the /Xam				5	4	20	Very High

Resource ID	Resource Period	Type	Description	Aesthetic	Historic	Scientific	Social	INTEGRITY	VALUE	Designation
Burial grounds and graves	British Colony and First Boer Republics (1814 CE to 1880 CE)	Burial / grave	Burial grounds and graves affiliated with historic farmsteads and associated labourer homesteads - i.e. Xhosa, Korana and Griqua				5	4	20	Very High
Burial grounds and graves	Union of South Africa (1910 CE to 1961 CE)	Burial / grave	Burial grounds and graves affiliated with historic farmsteads and associated labourer homesteads				5	4	20	Very High
Burial grounds and graves	Apartheid Republic of South Africa (1961 to 1994)	Burial / grave	Burial grounds and graves affiliated with historic farmsteads and associated labourer homesteads				5	4	20	Very High
Historic Built Environment	British Colony and First Boer Republics (1814 CE to 1880 CE)	Site	Corbelled houses - vernacular architecture in the context of setting	5	3	3	4	4	15	High
Historic Built Environment	Union of South Africa (1910 CE to 1961 CE)	Site	Farmstead ruins and complexes as tangible markers of a historically layered cultural landscape	3	4	2	3	2	6	Low

Resource ID	Resource Period	Type	Description	Aesthetic	Historic	Scientific	Social	INTEGRITY	VALUE	Designation
Visual	N/A	Natural feature	Visual, aesthetic and scenic character	4	-	-	-	3	12	Medium

The CS of the various heritage resource types known to occur within the site-specific and local study area demonstrates the cultural heritage landscape to have a high CS rating.

Further to the aforementioned CS considering the criteria encapsulated in Section 3(3) of the NHRA, the site-specific study area is situated within the /Xam Cultural Landscape (refer to Section 5.2.3 above). This, along with the ≠Khomani Cultural Landscape[23] was considered in the UNESCO Tentative World Heritage Site List. The UNESCO Outstanding Universal Value (OUV) criteria under which the inscription was proposed are summarised in Table 7-2.

Table 7-2: Criteria and Justification under which Inscription was Proposed

OUV Criteria	Description
(iii) Bear a unique or at least exceptional testimony to a cultural tradition or to a civilisation which is living or which has disappeared	The recorded history preserves tangible evidence of the presence of the San and their ancestors in the form of archaeological deposits that stretch back to primordial human populations. More recently the economic and spiritual bonds of the 19th century /Xam (a San group) with their land, was copiously recorded in the 1870s, something not done elsewhere. Their rock engravings served to permanently enhance the spiritual potency of certain places used for rainmaking, initiation and other rituals. After hundreds of years of progressive subordination, assimilation and finally colonial era genocide, the /Xam are culturally extinct.
(iv) Be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates a significant stage in human history	The cultural landscape exemplifies a hunter-gatherer lifestyle of deep antiquity, designed to survive an extreme environment and live respectfully with nature, within the boundaries of nature rather than apart from it. There is ample evidence for artistic and ritual associations between particular places and beliefs about a potent spirit world that could be accessed to heal sickness and create harmony. Archaeological remains demonstrate the linkages between material culture and the environment.
(v) Be an outstanding example of traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change	The cultural landscape is expressive of the way of life that has dominated the long span of human history, i.e. the manner in which scarce resources such as water and plant foods were dealt with in conjunction with natural phenomena such as drought and predators. The hunting and tracking knowledge, skills in sourcing water and plant foods and the many other resources on which they depended, the cultural ways, belief systems that have

[23] UNESCO inscribed the ≠Khomani Cultural Landscape as a World Heritage Site in July 2017 based on its OUV against criteria (v) and (vi)

OUV Criteria	Description
	facilitated life in these environments, are unique. San are widely regarded as the direct descendants of the ancestors of all humankind as confirmed by genetic studies. The San demonstrate the close linkages between genetics, the ecology of waterless landscapes, and the exceptional cultural technologies developed to survive in it.
(vi) be directly or tangibly associated with event or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance	Records of the San and their history and culture reveal a rich and deep ethnobotanical knowledge and the potent spiritual world that underscores their beliefs. These reveal the deep respect for nature and the dynamic relationship between humans and other living creatures, some of them mythical or having mythical powers, that ensures the optimal use of resources with minimal damage to sustainability. San art is understood as being a deeply spiritual art, one that harnesses and shares with others the power of successive generations of San spiritual experience and enlightenment. The /Xam records as captured in the 1870s, and registered with the “Memory of the Word” project, are recognised as literally works through translation of /Xam poetry and folklore that assist scholars to understand deeper meanings of Rock Art.

8 Heritage Impact Assessment

The assessment of potential impacts to heritage resources considers the aforementioned project description in Section 1.2 above and associated construction and operational activities. These are discussed in the context of the various heritage resource types, and assimilated into a consolidated assessment of the cultural landscape as a zone of entanglement and palimpsest of these heritage resources.

8.1 Palaeontological Impact Assessment

This section considers the assessment of potential palaeontological impacts from the SKA Project. These are summarised in Table 8-1 through Table 8-4.

Table 8-1: Potential Direct Impacts to Palaeontological Resources from the Road Upgrades and New Roads

<table>
<tr><th colspan="5">IMPACT DESCRIPTION: Road upgrades and new roads</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">PRE-MITIGATION</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Earth moving activities through fossiliferous lithostratigraphic units will result in permanent destruction of the resource.</td><td rowspan="4">Consequence: Moderately detrimental
(-13)</td><td rowspan="5">Significance: Negligible - negative
(-26)</td></tr>
<tr><td>Extent</td><td>Province/ Region (5)</td><td>Permanent destruction of fossils will affect the fossil record for the region as these resources are sparse, i.e. restricted in their distribution</td></tr>
<tr><td>Intensity x type of impact</td><td>Very low - negative (-1)</td><td>The impact and extent will result in a minor change to the palaeontological record</td></tr>
<tr><td>Probability</td><td>Improbable (2)</td><td colspan="2">It is improbable that the impact will occur as the road servitudes are already established, and no fossils were identified during the field assessment in the development footprint of the roads.</td></tr>
<tr><td colspan="5">MITIGATION:</td></tr>
<tr><td colspan="5">SARAO must develop a Fossil Finds Procedure for inclusion into the IEMP, and implement it during construction and operational activities. (This is currently within the scope of the HRM Process, to be completed and included in the CMP).
Development footprint areas underlain by high palaeontologically sensitive lithology’s must be monitored during earth moving activities by:
1. A palaeontologist; or
2. The Environmental Control Officer (after appropriate training).</td></tr>
<tr><td colspan="5">POST-MITIGATION</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Any destruction of the fossil record through earth moving activities will be permanent</td><td>Consequence: Moderately beneficial</td><td>Significance: Negligible - positive</td></tr>
</table>

IMPACT DESCRIPTION: Road upgrades and new roads				
Dimension	**Rating**	**Motivation**		
Extent	Limited (2)	Limited to the road upgrade and new roads development footprint	(10)	(10)
Intensity x type of impact	Very low - positive (1)	Implementation and collection of the exposed fossils will contribute to the fossil record and scientific community		
Probability	Highly unlikely (1)	Previous activities associated with the establishment of the existing roads would have destroyed any existing fossils within the impact footprint. Considering the results of the field assessment, it is unlikely that any new fossils will be identified during the establishment of the new access roads.		

Table 8-2: Potential Direct Impacts to Identified Palaeontological Resources on the Farm Son Tuin (Die Tuin)

IMPACT DESCRIPTION: Direct impact to fossils on the Farm Son Tuin (Die Tuin)				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	Earth moving activities through fossiliferous lithostratigraphic units will result in permanent destruction of the resource.	Consequence: Highly detrimental (-15)	Significance: Minor - negative (-45)
Extent	Province/ Region (5)	Permanent destruction of fossils will affect the fossil record for the region as these resources are sparse, i.e. restricted in their distribution		

IMPACT DESCRIPTION: Direct impact to fossils on the Farm Son Tuin (Die Tuin)				
Dimension	**Rating**	**Motivation**		
Intensity x type of impact	Moderate - negative (-3)	Unmitigated change will result in moderate intensity impact to the fossils with medium - high CS		
Probability	Unlikely (3)	Considering the restricted distribution of fossils in this region, it is unlikely that the identified impacts will manifest		
MITIGATION:				
Impressions of *Calamites* and *Paracalamites* (Sphenophyta – horsetails) were identified within the site-specific study area, but not the development footprint. To this effect, SARAO must develop a Fossil Finds Procedure for inclusion into the IEMP, and implement it during construction and operational activities (*This is currently within the scope of the HRM Process, to be completed and included in the CMP*). Development footprint areas underlain by high palaeontologically sensitive lithology's must be monitored during earth moving activities by: 1. A palaeontologist; or 2. The Environmental Control Officer (after appropriate training)				
POST-MITIGATION				
Duration	Permanent (7)	Any destruction of the fossil record through earth moving activities will be permanent	Consequence: Moderately beneficial (11)	Significance: Negligible – positive (33)
Extent	Limited (2)	Limited to the development footprint area		
Intensity x type of impact	Low - positive (2)	Implementation and collection of the exposed fossils will contribute to the fossil record and scientific community		
Probability	Unlikely (3)	Considering the restricted distribution of fossils in this region, it is unlikely that the identified impacts will manifest		

Table 8-3: Potential Direct Impact to Unidentified Palaeontological Resources with Good Integrity

<table>
<tr><th colspan="5">IMPACT DESCRIPTION: Potential direct impacts to palaeontological resources - good integrity</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">PRE-MITIGATION</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Earth moving activities through fossiliferous lithostratigraphic units will result in permanent destruction of the resource.</td><td rowspan="4">Consequence: Extremely detrimental
(-18)</td><td rowspan="5">Significance: Minor - negative
(-72)</td></tr>
<tr><td>Extent</td><td>Province/ Region (5)</td><td>Permanent destruction of fossils will affect the fossil record for the region as these resources are sparse, i.e. restricted in their distribution</td></tr>
<tr><td>Intensity x type of impact</td><td>Very high - negative (-6)</td><td>Unmitigated change will result in a moderate change to fossils heritage with high CS</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">The restricted distribution of fossils noted, it still remains probable that fossil heritage may be impacted upon considering the nature and extent of the Project</td></tr>
<tr><td colspan="5">MITIGATION:</td></tr>
<tr><td colspan="5">SARAO must develop a Fossil Finds Procedure for inclusion into the IEMP, and implement it during construction and operational activities (This is currently within the scope of the HRM Process, to be completed and included in the CMP).
Development footprint areas underlain by high palaeontologically sensitive lithology’s must be monitored during earth moving activities by:
1. A palaeontologist; or
2. The Environmental Control Officer (after appropriate training).</td></tr>
</table>

IMPACT DESCRIPTION: Potential direct impacts to palaeontological resources - good integrity				
Dimension	**Rating**	**Motivation**		
POST-MITIGATION				
Duration	Permanent (7)	Earth moving activities through fossiliferous lithostratigraphic units will result in permanent destruction of the resource.	Consequence: Highly beneficial (15)	Significance: Minor – positive (60)
Extent	Limited (2)	Limited to the development footprint area.		
Intensity x type of impact	Very high - positive (6)	Implementation of the proposed mitigation measures will result in a moderate positive change to the regional fossil record.		
Probability	Probable (4)	The restricted distribution of fossils notwithstanding, it still remains probable that fossil heritage may be impacted upon considering the nature and extent of the Project.		

Table 8-4: Potential Direct Impact to Unidentified Palaeontological Resources with Poor Integrity

IMPACT DESCRIPTION: Potential direct impacts to palaeontological resources - poor integrity				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	Earth moving activities through fossiliferous lithostratigraphic units will result in permanent destruction of the resource.	Consequence: Moderately detrimental (-13)	Significance: Minor – negative (-52)

IMPACT DESCRIPTION: Potential direct impacts to palaeontological resources - poor integrity				
Dimension	**Rating**	**Motivation**		
Extent	Province/ Region (5)	Permanent destruction of fossils will affect the fossil record for the region as these resources are sparse, i.e. restricted in their distribution		
Intensity x type of impact	Very low - negative (-1)	Unmitigated change will result in a change to the fossil record assigned with a negligible CS		
Probability	Probable (4)	The restricted distribution of fossils noted, it still remains probable that fossil heritage may be impacted upon considering the nature and extent of the Project		
MITIGATION:				
SARAO must develop a Fossil Finds Procedure for inclusion into the IEMP, and implement it during construction and operational activities (*This is currently within the scope of the HRM Process, to be completed and included in the CMP*). Development footprint areas underlain by high palaeontologically sensitive lithology's must be monitored during earth moving activities by 1. A palaeontologist; or 2. The Environmental Control Officer (after appropriate training)				
POST-MITIGATION				
Duration	Permanent (7)	Earth moving activities through fossiliferous lithostratigraphic units will result in permanent destruction of the resource.	Consequence: Moderately beneficial (10)	Significance: Minor – positive (40)
Extent	Limited (2)	Limited to the development footprint area		
Intensity x type of impact	Very low - positive (1)	Implementation of the proposed mitigation measures will result in a low positive change to the regional fossil record		

IMPACT DESCRIPTION: Potential direct impacts to palaeontological resources - poor integrity			
Dimension	**Rating**	**Motivation**	
Probability	Probable (4)	The restricted distribution of fossils noted, it still remains probable that fossil heritage may be impacted upon considering the nature and extent of the Project	

8.2 Archaeological Impact Assessment

This section considers the assessment of potential archaeological impacts from the SKA Project. Archaeological resources with a negligible CS, in accordance with the SAHRA Minimum Standards (2007), are sufficiently recorded by inclusion in Section 6.2 above. These resources are not considered further in this assessment. This includes SA-004, SA-010 and SA-018.

The impact assessments are summarised in Table 8-5 through Table 8-12. Table 8-5 is relevant to sites that have multiple components and are of medium CS. These sites include HER-SKA014; HER-SKA056; MXD-001; MXD-002 and MXD-003.

Table 8-5: Direct Impacts to Multi-Layered Sites with Medium CS

IMPACT DESCRIPTION: Direct impacts to multi-layered sites with medium CS				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	Any unmitigated impacts to the multi-layered sites will result in a permanent loss of the heritage resource, or at the very least the tangible markers for decipher the interaction between various components of the site	Consequence: Highly detrimental (-16)	Significance: Negligible – negative (-32)
Extent	Province/ Region (5)	Damage or destruction of these sites will reduce the capacity to understand the heritage and cultural landscape of the region in the context of the baseline presented.		

IMPACT DESCRIPTION: Direct impacts to multi-layered sites with medium CS				
Dimension	**Rating**	**Motivation**		
Intensity x type of impact	Moderately high - negative (-4)	Damage or destruction of these sites are classified as a major change to resources with a medium CS		
Probability	Improbable (2)	Considering the nature of the Project, the areal extent of the development footprint, and the known distribution of these sites, it is improbable that the negative impact will manifest.		
MITIGATION:				
The identified sites must remain *in situ* and potential negative impacts removed through the following: ▪ A minimum buffer of 50 m must be established around known multi-layered sites during the construction phase; ▪ Infrastructures within the 50 m buffer must be considered for realignment (No antennas fall within proximity of known multi-layered sites). A Conservation Management Plan (CMP) for the SKA Project must be developed (*This is currently within the scope of the HRM Process*)				
POST-MITIGATION				
Duration	Transient (1)	Where recommendations are adopted, any impact that may manifest will be transient, not affecting the heritage value.	Consequence: Negligible (4)	Significance: Negligible – positive (8)
Extent	Very limited (1)	Isolated aspects of individual resources will be affected		
Intensity x type of impact	Low - positive (2)	Proposed management measures will reduce the intensity of potential negative impacts, and enhance the preservation of recorded heritage resources		
Probability	Improbable (2)	Through implementation of the management measures, it is improbable that identified negative impacts will manifest.		

The following table, Table 8-6, summarises the direct impacts to Stone Age archaeological features with low CS. These include occurrences. The following sites fall within this category: SA-001; SA-002; SA-005; SA-006; SA-007; SA-009; SA-012; SA-013; SA-014; SA-015; and SA-017.

Table 8-6: Direct Impacts to Stone Age Occurrences with Low CS

<table>
<tr><th colspan="5">IMPACT DESCRIPTION: Direct impacts to Stone Age occurrences with low CS</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">PRE-MITIGATION</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Unmitigated impacts to these sites will result in permanent damage or destruction, or in the permanent loss of context if the artefacts in the scatter are removed without being recorded.</td><td rowspan="4">Consequence: Moderately detrimental
(-13)</td><td rowspan="5">Significance: Minor – negative
(-65)</td></tr>
<tr><td>Extent</td><td>Province/ Region (5)</td><td>Damage or destruction of these sites will reduce the capacity to understand the heritage and cultural landscape of the region in the context of the baseline presented.</td></tr>
<tr><td>Intensity x type of impact</td><td>Very low - negative (-1)</td><td>Any impacts to these resources will be considered a negative change to resources of low CS.</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Considering the nature of the Project and the areal extent of the development footprint in relation to the known distribution of these sites, it is likely that the negative impact will manifest.</td></tr>
</table>

<table>
<tr><th colspan="5">IMPACT DESCRIPTION: Direct impacts to Stone Age occurrences with low CS</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">MITIGATION:</td></tr>
<tr><td colspan="5">The identified heritage resources should be maintained in situ as far as is feasible. It is recommended that a buffer of 50 m be established around known Stone Age occurrences with a low CS. This recommendation is applicable to the following heritage resources: SA-001; SA-002; SA-005; SA-006; SA-007; SA-009; SA-012; SA-013; SA-014; SA-015; SA-017.
Where infrastructures that are not capable of realignment (i.e. antenna) are situated within the 50 m buffer, the identified heritage resources must be recorded in detail prior to the construction phase. This may include inter alia, distribution and density mapping, surface collections and test excavations subject to the approval of a Section 35 Permit. This recommendation is applicable to the following identified heritage resources: SA-005, SA-006, SA-012, SA-014, SA-015 and SA-017.</td></tr>
<tr><td colspan="5">POST-MITIGATION</td></tr>
<tr><td>Duration</td><td>Transient (1)</td><td>Where recommendations are adopted, any impact that may manifest will be transient, not affecting the heritage value.</td><td rowspan="3">Consequence: Negligible
(3)</td><td rowspan="4">Significance: Negligible - positive
(15)</td></tr>
<tr><td>Extent</td><td>Very limited (1)</td><td>Isolated aspects of individual resources will be affected</td></tr>
<tr><td>Intensity x type of impact</td><td>Very low - positive (1)</td><td>Adoption of the proposed mitigation measures will result in a positive change to a resource with low CS</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Through implementation of the recommended management and mitigation measures, identified negative impacts will be avoided, or where not possible, the positive impacts enhanced.</td></tr>
</table>

Table 8-7: Direct Impacts to Stone Age Sites with High CS (SA-016)

<table>
<tr><th colspan="5">IMPACT DESCRIPTION: Direct impacts to Stone Age sites with high CS (SA-016)</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">PRE-MITIGATION</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Any unmitigated impacts to the Stone Age sites with high CS will result in the permanent loss of the heritage resource.</td><td rowspan="4">Consequence: Extremely detrimental
(-20)</td><td rowspan="5">Significance: Moderate – negative
(-100)</td></tr>
<tr><td>Extent</td><td>National (6)</td><td>Damage or destruction to this site, considering its affiliation with the /Xam and San in general, is considered an impact to a resource important in the pattern of the country's history.</td></tr>
<tr><td>Intensity x type of impact</td><td>Extremely high - negative (-7)</td><td>Damage or destruction is considered a major change to a heritage resource of high CS.</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td colspan="2">Considering the nature of the Project and the aerial extent of the development footprint in relation to the location of the site, in this instance antenna SKA-027, it is likely that the impact will manifest.</td></tr>
<tr><td colspan="5">MITIGATION:</td></tr>
<tr><td colspan="5">The heritage resource SA-016 is situated within the development footprint of antenna SKA-027. The assessor acknowledges that realignment of this infrastructure is not feasible in the context of the SKA Project, and preservation of the site in situ as a management measure being a challenge. In this instance, the identified impact cannot be removed or avoided, but the intensity of the impact to SA-016 can be reduced through adoption of the following recommendations:
▪ SA-016 must be recorded in detail prior to the construction phase. This may include inter alia, distribution and density mapping, surface collections and test excavations subject to the approval of a Section 35 Permit; and
▪ A Watching Brief undertaken by a suitably qualified and accredited archaeologist must be completed during earth moving activities to record all material cultural remains that may be exposed. The results of the Watching Brief must be compiled into a Watching Brief Report and submitted to SAHRA for noting.</td></tr>
</table>

IMPACT DESCRIPTION: Direct impacts to Stone Age sites with high CS (SA-016)				
Dimension	**Rating**	**Motivation**		
POST-MITIGATION				
Duration	Permanent (7)	The identified impact will result in the permanent loss of the heritage resource *in situ*.	Consequence: Highly beneficial (17)	Significance: Negligible – positive (34)
Extent	Local (3)	The impact will affect the CS of SA-016, and the sites within the context of the landscape remaining *in situ*		
Intensity x type of impact	Extremely high - positive (7)	The proposed recommendations will result in the scientific partial destruction of the site and its context which is a major change to a heritage resource with high CS, but the detailed recording of SA-016 will preserve the context and material remains in record, which will positively contribute to an understanding of the greater cultural landscape		
Probability	Improbable (2)	Through implementation of the recommendations, the intensity of the negative impact will be reduced. Therefore, it is improbable that the pre-mitigation impact identified will manifest with the same consequence.		

Table 8-9 presents the assessment of potential indirect impacts to burial grounds and graves within the site-specific study area in proximity to proposed infrastructures. These comprise the following known resources identified through the data collection process:

Table 8-8: Known Burial Grounds and Graves within the Core and Proximity to the Development Footprint

Farmstead Cemeteries	SAHRIS Database	Pre-disturbance Survey
Swartfontein 67 Ptn 1, 2, & RE; Botter Leegte 65 Ptn 1; Brak Puts 66 RE; De Hoek 70; Fraserberg 76 RE; Groot Paarde Kloof 74; Pofadderfontein 494 Ptn 1 & 2; Pofadderfontein 495; Schiet Poort 64 Ptn 2, & RE; Snymans Hoop 71 Ptn 1; Swartfontein 496 Ptn 1 RE & RE; Visser's Kloof 63 Ptn 3; Waterkloof 69; and Zoutrivier 71 Ptn 1 (*Vars Rivier*), 2 & RE	HER-SKA008; HER-SKA016; HER-SKA027; and HER-SKA056	BGG-001; and BGG-002.

Table 8-9: Indirect Impacts to Burial Grounds and Graves with Very-High CS

IMPACT DESCRIPTION: Indirect impacts to burial grounds and graves with very-high CS				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	Unmitigated impacts to burial grounds and graves will result in permanent damage to the surface features of the graves, and possibly the mortal remains	Consequence: Extremely detrimental (-21)	Significance: Negligible - negative (-21)

IMPACT DESCRIPTION: Indirect impacts to burial grounds and graves with very-high CS				
Dimension	**Rating**	**Motivation**		
Extent	International (7)	Damage to these resources could potentially have an international effect in terms of SARAO's reputation. Affected Next of Kin (NoK) may potentially reside in neighbouring countries.		
Intensity x type of impact	Extremely high - negative (-7)	The destruction of these heritage resource types are considered a major change to a heritage resource with very-high CS.		
Probability	Highly unlikely (1)	Considering the nature of the Project and the aerial extent of the development footprint in relation to the location of these heritage resources, it is highly-unlikely that the impact will manifest.		
MITIGATION:				
The identified sites must remain *in situ* and potential negative impacts removed through the following: ▪ A minimum buffer of 50 m must be established around known possible burial grounds and graves sites during the construction phase; and ▪ The buffers must be clearly demarcated, and signage placed during the construction period. Previously recorded burial grounds and graves within 100 m of the development footprint include: HER-SKA008; HER-SKA016; HER-SKA027 and HER-SKA056. Newly recorded burial grounds and graves during the pre-disturbance survey include BGG-001 and BGG-002. The presence of several farmstead burial grounds and graves are noted on properties within the site-specific study area listed in Table 8-8. A Conservation Management Plan (CMP) for the SKA Project must be developed (*currently within the scope of the HRM Process*).				
POST-MITIGATION				
Duration	Transient (1)	The proposed recommendation will remove the identified potential impact	Consequence: Slightly detrimental	Significance: Negligible – negative

IMPACT DESCRIPTION: Indirect impacts to burial grounds and graves with very-high CS				
Dimension	**Rating**	**Motivation**		
Extent	Very limited (1)	If an impact does manifest through unplanned events, it will be limited to the surface dressing / features of the resource	(-7)	(-7)
Intensity x type of impact	High - negative (-5)	Any unplanned events manifesting on these resources, where the recommended management measures are adopted, will result in a minor change to a heritage resource with very-high CS		
Probability	Highly unlikely (1)	Considering the nature of the Project and the aerial extent of the development footprint in relation to the location of these heritage resources, it is highly-unlikely that an impact will manifest.		

Table 8-10 below summarises the potential indirect impacts to Rock Art of medium to medium-high CS. This includes: RA-003m RA-004, RA-005, RA-006, RA-007, RA-008, RA-009 and RA-010. Previously recorded Rock Art sites within 100 m of the proposed development footprint include: HER-SKA004; HER-SKA013; HER-SKA068; HER-SKA069.

Table 8-10: Indirect Impacts to Rock Art with Medium to Medium-High CS

IMPACT DESCRIPTION: Indirect impacts to Rock Art with medium to medium-high CS				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	Unmitigated impacts may result in the permanent damage, or in extreme cases destruction, of Rock Art sites inherently associated with the /Xam, Khoekhoe and physical landscape.	Consequence: Highly detrimental (-17)	Significance: Minor - negative (-68)

IMPACT DESCRIPTION: Indirect impacts to Rock Art with medium to medium-high CS				
Dimension	**Rating**	**Motivation**		
Extent	National (6)	Damage or destruction to this site, considering its affiliation with the /Xam, San in general and Khoekhoe, is considered an impact to a resource important in the pattern of the country's history.		
Intensity x type of impact	Moderately high - negative (-4)	Any indirect impacts resulting in the damage or destruction of Rock Art sites is considered a major change to heritage resources with a medium-high CS		
Probability	Probable (4)	Considering the nature of the Project and the aerial extent of the development footprint in relation to the location of these heritage resources, it is unlikely that the impact will manifest, but they could happen.		
MITIGATION:				
The identified heritage resources must be maintained *in situ*. It is recommended that a minimum buffer of 50 m be established around all known Rock Art sites. Known rock art sites recorded during the in-field assessment include: RA-003, RA-004, RA-006, RA-007, RA-008, RA-009 and RA-010. Previously recorded Rock Art sites within 100 m of the proposed development footprint include: HER-SKA004; HER-SKA013; HER-SKA068; HER-SKA069. Established buffers must be clearly demarcated during the construction phase.				
POST-MITIGATION				
Duration	Transient (1)	The proposed recommendation will remove the identified potential impact	Consequence: Slightly detrimental (-7)	Significance: Negligible – negative (-7)
Extent	Very limited (1)	If an impact does manifest through unplanned events, it will be limited to select resources		

IMPACT DESCRIPTION: Indirect impacts to Rock Art with medium to medium-high CS				
Dimension	**Rating**	**Motivation**		
Intensity x type of impact	High - negative (-5)	Any unplanned events manifesting on these resources, where the recommended management measures are adopted, will result in a minor change to a heritage resource with medium-high CS		
Probability	Highly unlikely (1)	Considering the nature of the Project and the aerial extent of the development footprint in relation to the location of these heritage resources, it is highly-unlikely that an impact will manifest.		

Table 8-11: Potential Direct Impacts to Unidentified Archaeological Resources with Good Integrity

IMPACT DESCRIPTION: Potential direct impacts to unidentified archaeological resources with good integrity				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	Unmitigated impacts may result in permanent damage to or destruction of the unidentified heritage resources.	Consequence: Highly detrimental (-16)	Significance: Minor – negative (-64)
Extent	Province/ Region (5)	Permanent damage to or destruction of unidentified heritage resources will affect the archaeological record of the region in the context of the defined cultural landscape		
Intensity x type of impact	Moderately high - negative (-4)	Unmitigated impacts will result in a moderate change to archaeological record with high CS		

IMPACT DESCRIPTION: Potential direct impacts to unidentified archaeological resources with good integrity				
Dimension	**Rating**	**Motivation**		
Probability	Probable (4)	Considering the nature of archaeological resources, and the rich cultural heritage of the site-specific study area, it is probable that previously unidentified archaeological resources will be impacted upon.		
MITIGATION:				
SARAO must develop a CFP for inclusion into the IEMP, and implement it during construction and operational activities. (*This is currently within the scope of the HRM Process, to be completed and included in the CMP*) Development footprint areas in defined high archaeological sensitivities locations must be monitored during earth moving activities by: ▪ An archaeologist; or ▪ The Environmental Control Officer (after appropriate training).				
POST-MITIGATION				
Duration	Permanent (7)	Accidental exposure resulting in damage or destruction of the unidentified heritage resource will be permanent	Consequence: Moderately beneficial (11)	Significance: Minor – positive (44)
Extent	Limited (2)	Limited to the development footprint area		
Intensity x type of impact	Low - positive (2)	Implementation of the proposed mitigation measures will reduce the intensity of the impact, resulting in a low positive change.		
Probability	Probable (4)	Considering the nature of archaeological resources, and the rich cultural heritage of the site-specific study area, it is probable that previously unidentified archaeological resources will be impacted upon.		

Table 8-12: Potential Direct Impacts to Unidentified Archaeological Resources with Poor Integrity

<table>
<tr><th colspan="5">IMPACT DESCRIPTION: Potential direct impacts to unidentified archaeological resources with poor integrity</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">PRE-MITIGATION</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Unmitigated impacts may result in permanent damage to or destruction of the unidentified heritage resources.</td><td rowspan="3">Consequence: Moderately detrimental (-13)</td><td rowspan="4">Significance: Minor - negative (-52)</td></tr>
<tr><td>Extent</td><td>Province/ Region (5)</td><td>Permanent damage to or destruction of unidentified heritage resources will affect the archaeological record of the region in the context of the defined cultural landscape</td></tr>
<tr><td>Intensity x type of impact</td><td>Very low - negative (-1)</td><td>Unmitigated impacts will result in a negligible change to archaeological record with a low CS</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td colspan="2">Considering the nature of archaeological resources, and the rich cultural heritage of the site-specific study area, it is probable that previously unidentified archaeological resources will be impacted upon.</td></tr>
<tr><td colspan="5">MITIGATION:</td></tr>
<tr><td colspan="5">SARAO must develop a CFP for inclusion into the IEMP, and implement it during construction and operational activities.
Development footprint areas in defined high archaeological sensitivities locations must be monitored during earth moving activities by:
▪ An archaeologist; or
▪ The Environmental Control Officer (after appropriate training).</td></tr>
<tr><td colspan="5">POST-MITIGATION</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Unmitigated impacts may result in permanent damage to or destruction of the unidentified heritage resources.</td><td>Consequence: Moderately beneficial (10)</td><td>Significance: Minor - positive (40)</td></tr>
</table>

IMPACT DESCRIPTION: Potential direct impacts to unidentified archaeological resources with poor integrity				
Dimension	**Rating**	**Motivation**		
Extent	Limited (2)	Limited to the development footprint area		
Intensity x type of impact	Very low - positive (1)	Implementation of the proposed mitigation measures will reduce the intensity of the impact, resulting in a very-low positive change.		
Probability	Probable (4)	Considering the nature of archaeological resources, and the rich cultural heritage of the site-specific study area, it is probable that previously unidentified archaeological resources will be impacted upon.		

8.3 Historical Built Environment Assessment

This section considers the assessment of potential historical built environment impacts from the SKA Project. Table 8-13 presents the assessment of demolition of all structures within the site-specific study area that are generally protected by Section 34 of the NHRA. Table 8-14 through Table 8-16 consider the specific impacts to historical built environment resources considered in the specialist assessment, namely BHS 1 to 8. These are discussed separately below.

Table 8-13: Demolition of Historic Built Environment Resources Older than 60 Years

IMPACT DESCRIPTION: Demolition of historic built environment resources older than 60 years				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Beyond project life (6)	Demolition of structures will continue throughout and possibly beyond the project life.	Consequence: Moderately detrimental (-13)	Significance: Moderate - negative (-91)
Extent	Local (3)	The CS of individual structures and werfs derive additional significance from their surrounding historical, physical and contemporary built environment. Their removal will affect the local environment and other built structures therein.		
Intensity x type of impact	Moderately high - negative (-4)	The demolition of these structures will result in a major change to historic built structures with a low to high CS rating.		
Probability	Certain (7)	It is certain that select structures within the SKA Core management area will be demolished.		
MITIGATION:				
Any proposed demolition of structures older than 60 years are subject to the requirements stipulated under Section 34 of the NHRA and regulated by Chapter IV of GN R 548. It is recommended the structures be demolished down to their floor level, i.e. removal of all superstructures to retain the buildings footprint while preventing squatting or the need for maintenance. The identified heritage and associated adjacent structures must be recorded in detail in support of the application for demolition, and as a method of "preservation through record". Records should consist of photographs and measured drawings.				
POST-MITIGATION				
Duration	Beyond project life (6)	Demolition of structures will continue throughout and possibly beyond the project life.	Consequence: Moderately beneficial	Significance: Moderate – positive

IMPACT DESCRIPTION: Demolition of historic built environment resources older than 60 years				
Dimension	**Rating**	**Motivation**		
Extent	Local (3)	The CS of individual structures and werfs derive additional significance from their surrounding historical, physical and contemporary built environment. Their removal will affect the local environment and other built structures therein.	(13)	(91)
Intensity x type of impact	Moderately high - positive (4)	Proposed mitigations will preserve the structures through record, and maintain the sense-of-place and cultural landscape, resulting in a moderately high positive impact.		
Probability	Certain (7)	The proposed mitigations notwithstanding, it remains certain that select structures within the SKA Core management area will be demolished.		

Table 8-14: Indirect Impacts to Corbelled House Structures within the Site-Specific Study Area

IMPACT DESCRIPTION: Indirect impacts to corbelled house structures within the site-specific area resulting in damage or destruction (BHS 1 & 7)				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	Accidental damage or destruction through indirect impacts to the structure will be permanent	Consequence: Extremely detrimental (-20)	Significance: Minor - negative (-40)

IMPACT DESCRIPTION: Indirect impacts to corbelled house structures within the site-specific area resulting in damage or destruction (BHS 1 & 7)				
Dimension	**Rating**	**Motivation**		
Extent	National (6)	Corbelled buildings are finite, and associated with a particular point in the history of South Africa. Any impacts to these structures will affect the historical record of South Africa		
Intensity x type of impact	Extremely high - negative (-7)	Any unmitigated change to these resources will result in an extremely high negative impact		
Probability	Improbable (2)	Considering the known location of these resources, and the proposed Project, it is improbable that the identified impacts will manifest		
MITIGATION:				
These heritage resources should be considered a 'no-go' area. It is recommended that a 1km buffer around these resources be established and maintained throughout the Project life, within which no project related activities may take place. The structures must be recorded in detail through photographs and measured drawings. With specific reference to the following known corbelled houses: ▪ BHS 1: The corbelled building and successive farm houses are to be retained and enhanced. No limitations are proposed on the types of use of the buildings, as long as the proposed new uses and functions are compatible with the defined CS of the structures; and ▪ BHS 7: The proposed access road must be rerouted to outside the proposed 1km buffer to remove any negative impacts that may manifest. Furthermore, development in the valley to the north must be minimised.				
POST-MITIGATION				
Duration	Transient (1)	Recommended mitigation measures will remove identified negative impact	Consequence: Slightly beneficial (8)	Significance: Minor - positive (48)
Extent	Limited (2)	It will be limited to the specific resources		

IMPACT DESCRIPTION: Indirect impacts to corbelled house structures within the site-specific area resulting in damage or destruction (BHS 1 & 7)				
Dimension	**Rating**	**Motivation**		
Intensity x type of impact	High - positive (5)	Proposed management and mitigation measures will result in a positive change to the heritage resource through continued conservation and preservation through record		
Probability	Highly probable (6)	Where mitigation and management measures are implemented, it is highly probable that the negative impacts will be avoided, and positive impacts enhanced.		

Table 8-15: Indirect Impacts to the Groot Paardekloof Farmstead and School Resulting In Damage or Destruction

IMPACT DESCRIPTION: Indirect impacts to the Groot Paardekloof Farmstead (BHS 5) and School (BHS 6) resulting in damage or destruction				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	Accidental damage or destruction through indirect impacts to the structure will be permanent	Consequence: Extremely detrimental (-19)	Significance: Minor - negative (-38)
Extent	National (6)	The identified negative impact will result in damage or destruction of tangible remains of a heritage place described in the Bleek and Lloyd manuscripts, associated with the /Xam		
Intensity x type of impact	Very high - negative (-6)	The identified impact is considered high and will result in a moderate change to the resource.		

IMPACT DESCRIPTION: Indirect impacts to the Groot Paardekloof Farmstead (BHS 5) and School (BHS 6) resulting in damage or destruction				
Dimension	**Rating**	**Motivation**		
Probability	Improbable (2)	Considering the known location of these resources, and the proposed Project, it is improbable that the identified impacts will manifest		
MITIGATION:				
These heritage resources should be considered a 'no-go' area. It is recommended that a 1km buffer around these resources be established and maintained throughout the Project life, within which no project related activities may take place. The structures must be recorded in detail through photographs and measured drawings. No limitations are proposed on the types of use of the buildings, as long as the proposed new uses and functions are compatible with the defined CS of the structures				
POST-MITIGATION				
Duration	Transient (1)	Recommended mitigation measures will remove identified negative impact	Consequence: Slightly beneficial (8)	Significance: Minor - positive (48)
Extent	Limited (2)	It will be limited to the specific resources		
Intensity x type of impact	High - positive (5)	Proposed management and mitigation measures will result in a positive change to the heritage resource through continued conservation and preservation through record		
Probability	Highly probable (6)	Where mitigation and management measures are implemented, it is highly probable that the negative impacts will be avoided, and positive impacts enhanced.		

Table 8-16: Demolition of Historic Built Environment Resources with Recommended Grading of III B

<table>
<tr><th colspan="5">IMPACT DESCRIPTION: Demolition of historic built environment resources with recommended grading of III B (BHS 8)</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">PRE-MITIGATION</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>Demolition of structures will continue throughout and possibly beyond the project life.</td><td rowspan="4">Consequence: Highly detrimental
(-15)</td><td rowspan="5">Significance: Moderate – negative
(-105)</td></tr>
<tr><td>Extent</td><td>Municipal Area (4)</td><td>The CS of individual structures and werfs derive additional significance from their surrounding historical, physical and contemporary built environment. The removal of this structure will affect the local environment and other built structures therein.</td></tr>
<tr><td>Intensity x type of impact</td><td>Moderately high - negative (-4)</td><td>The demolition of this structure will result in a major change to historic built structures with a low to high CS rating.</td></tr>
<tr><td>Probability</td><td>Certain (7)</td><td colspan="2">It is certain that select structures within the SKA Core management area will be demolished.</td></tr>
<tr><td colspan="5">MITIGATION:</td></tr>
<tr><td colspan="5">Negative impacts to these structures should be avoided as far as possible, and a 50m buffer for III B resources established respectively. It is recommended these buffers be maintained throughout the Project life. The CS of the structures is informed from the placement in the landscape (site), and association with associated buildings (context). These must be retained. Mitigation measures against potential negative impacts on the resources and associated CS must be considered when avoidance of the impacts themselves is not possible. It is recommended these structures be recorded in detail through photograph and measured drawings.
No limitations are proposed on the types of use of the buildings, as long as the proposed new uses and functions are compatible with the defined CS of the structures. Any proposed alterations of structures with a recommended grading of III A and B are subject to the requirements stipulated under Section 34 of the NHRA and regulated by Chapter IV of GN R 548.</td></tr>
</table>

IMPACT DESCRIPTION: Demolition of historic built environment resources with recommended grading of III B (BHS 8)				
Dimension	**Rating**	**Motivation**		
POST-MITIGATION				
Duration	Transient (1)	Recommended mitigation measures will remove the potential negative impacts	Consequence: Slightly beneficial (6)	Significance: Minor - positive (36)
Extent	Limited (2)	Any negative impacts that may manifest will be limited to the specific heritage resources		
Intensity x type of impact	Moderate - positive (3)	Proposed management and mitigation measures will result in a positive change to the heritage resource through continued conservation and preservation in use of the building and records.		
Probability	Highly probable (6)	Where management and mitigation measures are implemented, it is highly probable the identified negative impacts will be avoided, and the positive impacts enhanced.		

Table 8-17: Demolition of Historic Built Environment Resources with Recommended Grading of III A and B

IMPACT DESCRIPTION: Demolition of historic built environment resources with recommended grading of III A and B (BHS 2, 3 & 4)				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	Demolition of structures will continue throughout and possibly beyond the project life.	Consequence: Highly detrimental	Significance: Moderate – negative

IMPACT DESCRIPTION: Demolition of historic built environment resources with recommended grading of III A and B (BHS 2, 3 & 4)				
Dimension	**Rating**	**Motivation**		
Extent	Municipal Area (4)	The CS of individual structures and werfs derive additional significance from their surrounding historical, physical and contemporary built environment. Their removal will affect the local environment and other built structures therein.	(-15)	(-105)
Intensity x type of impact	Moderately high - negative (-4)	The demolition of these structures will result in a major change to historic built structures with a low to high CS rating.		
Probability	Certain (7)	It is certain that select structures within the SKA Core management area will be demolished.		
MITIGATION:				
The nature of the SKA project makes negative impacts to these structures unavoidable. Any proposed demolition of graded structures is subject to the requirements stipulated under Sections 27 & 34 of the NHRA and regulated by Chapter IV of GN R 548. It is recommended the structures only be demolished to their existing floor level, i.e. removal of the walls and superstructure but keeping the buildings foot print to prevent squatting and the need for maintenance. The graded structures and associated adjacent structures must be recorded in detail in support of the application for demolition, and as a method of "preservation through record". Records should consist of photographs and measured drawings. Historic building materials, where in existence and in a good condition (such as door and window frames or fireplaces), should be retained and made available for reuse for other historic structures in the area.				
POST-MITIGATION				
Duration	Transient (1)	Recommended mitigation measures will remove the potential negative impacts	Consequence: Highly detrimental	Significance: Moderate – negative

IMPACT DESCRIPTION: Demolition of historic built environment resources with recommended grading of III A and B (BHS 2, 3 & 4)				
Dimension	**Rating**	**Motivation**		
Extent	Municipal Area (4)	The CS of individual structures and werfs derive additional significance from their surrounding historical, physical and contemporary built environment. Their removal will affect the local environment and other built structures therein.	(-15)	(-90)
Intensity x type of impact	Moderately high – negative (-4)	The demolition of these structures will result in a major change to historic built structures with a low to high CS rating.		
Probability	Certain (7)	It is certain that select structures within the SKA Core management area will be demolished.		

8.4 Visual Impact Assessment

This section considers the assessment of potential visual impacts from the SKA Project. These are summarised in Table 8-18 through Table 8-28 below.

Table 8-18: Assessment of Impact Associated With the Change in Land Use

IMPACT DESCRIPTION: Change of land use from natural vegetation and agriculture to industry/scientific research will have a negative visual impact on the receiving environment.				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain	Consequence: Highly detrimental (-16)	Significance: Major – negative (-112)

IMPACT DESCRIPTION: Change of land use from natural vegetation and agriculture to industry/scientific research will have a negative visual impact on the receiving environment.				
Dimension	**Rating**	**Motivation**		
		indefinitely.		
Extent	Province/ Region (5)	The daytime practical viewshed model indicates that the Project will be visible from a maximum distance of 20 km during the day. The night time practical viewshed model indicates that the Project will be visible from a maximum distance of 8 km at night.		
Intensity x type of impact	Moderately high - negative (-4)	Change of land use will result in a permanent change in the sense of place of the Project area and surrounds.		
Probability	Certain (7)	The impact will definitely occur.		
MITIGATION:				
All mitigation/management actions encapsulated within the VIA report are applicable.				
POST-MITIGATION				
Duration	Permanent (7)	There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.	Consequence: Highly detrimental (-14)	Significance: Moderate – negative (-98)
Extent	Municipal Area (4)	The extent of the impact will be reduced by implementing the mitigation actions listed above.		
Intensity x type of impact	Moderate – negative (-3)	The visual disturbance will be reduced by implementing the mitigation measures		

IMPACT DESCRIPTION: Change of land use from natural vegetation and agriculture to industry/scientific research will have a negative visual impact on the receiving environment.				
Dimension	**Rating**	**Motivation**		
		above.		
Probability	Certain (7)	The impact will definitely occur.		

Table 8-19: Assessment of Impact Associated With the Change in Land Use

IMPACT DESCRIPTION: Change of land use from natural vegetation and agriculture to industry/scientific research will have a positive visual impact on the receiving environment.				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	There will be a permanent positive visual impact on the receiving environment. The removal of alien and invasive vegetation and revegetation of indigenous vegetation will remain indefinitely.	Consequence: Highly beneficial (14)	Significance: Major – positive (98)
Extent	Municipal Area (4)	The daytime practical viewshed model indicates that the Project will be visible from a maximum distance of 20 km during the day. The night time practical viewshed model indicates that the Project will be visible from a maximum distance of 8 km at night.		
Intensity x type of impact	Moderate – positive (3)	Change of land use will result in a permanent change in the sense of place of the Project area and surrounds.		
Probability	Certain (7)	The impact will definitely occur.		
MITIGATION:				
Mitigation will not be required as the activity will have a positive impact on the receiving environment.				

Table 8-20: Assessment of Impact Associated With Site Clearing

IMPACT DESCRIPTION: Site clearing and vegetation removal will have a negative visual impact on the receiving environment.				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Medium term (3)	The impact will occur during the construction phase.	Consequence: Moderately detrimental (-9)	Significance: Moderate – negative (-63)
Extent	Local (3)	Site clearing activities will be visible from the area surrounding the construction site.		
Intensity x type of impact	Moderate - negative (-3)	Site clearing is expected to cause a moderate visual disturbance. The natural vegetation will be cleared to make way for the Project. The Project area will become noticeable to the nearby receptors as it will contrast the surrounding areas.		
Probability	Certain (7)	The impact will definitely occur.		
MITIGATION:				
The clearing of topsoil and vegetation must be limited to the development footprint, and dust suppression techniques implemented. Any topsoil spoils created must be limited in area and height as far as possible, and where necessary, revegetated with indigenous species to reduce the intensity of the visual disturbance.				
POST-MITIGATION				
Duration	Medium term (3)	The impact will occur during the construction phase.	Consequence: Slightly detrimental (-7)	Significance: Minor – negative (-42)
Extent	Limited (2)	The extent of the impact will be reduced by implementing the mitigation actions listed above.		

IMPACT DESCRIPTION: Site clearing and vegetation removal will have a negative visual impact on the receiving environment.				
Dimension	**Rating**	**Motivation**		
Intensity x type of impact	Low - negative (-2)	The visual disturbance will be reduced by implementing the mitigation measures above.		
Probability	Highly probable (6)	It is most likely that the impact will occur.		

Table 8-21: Assessment of Impacts from the Antennas

IMPACT DESCRIPTION: Construction of dish-antennas is expected to have a negative visual impact on the receiving environment.				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.	Consequence: Highly detrimental (-16)	Significance: Major – negative (-112)
Extent	Province/ Region (5)	The daytime practical viewshed model indicates that the Project will be visible from a maximum distance of 20 km during the day.		
Intensity x type of impact	Moderately high - negative (-4)	Construction of the dish-antennas is expected to cause a moderately high visual disturbance.		
Probability	Certain (7)	The impact will definitely occur.		
MITIGATION:				
It is acknowledge that the antennas must configure to specific engineering requirements, therefore heights and other attributes cannot be amended. In as far as possible, any ancillary infrastructure that can be painted with natural hues, must be done to blend in with the surrounding environment.				

IMPACT DESCRIPTION: Construction of dish-antennas is expected to have a negative visual impact on the receiving environment.				
Dimension	**Rating**	**Motivation**		
Construction of the antenna during the night must be avoided as far as possible. Where unavoidable, areas where these activities are taking place should be lit and the number of lights and brightness must not exceed the minimum requirements for safety and security. Down lighting and low-pressure lighting mediums such as sodium light sources must be implemented to minimise light pollution. Lights should be directed inwards towards the Project area and not outwards from the Project area.				
POST-MITIGATION				
Duration	Permanent (7)	There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.	Consequence: Highly detrimental (-14)	Significance: Moderate – negative (-84)
Extent	Municipal Area (4)	The extent of the impact will be reduced by implementing the mitigation actions listed above.		
Intensity x type of impact	Moderate – negative (-3)	The visual disturbance will be reduced by implementing the mitigation measures above.		
Probability	Highly probable (6)	It is most likely that the impact will occur.		

Table 8-22: Assessment of Impacts from the Expansion and Construction of Camps

IMPACT DESCRIPTION: Potential Impacts of Expansion of Losberg Construction Camp and Construction of Bergsig and Swartfontein Construction Camps on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.	Consequence: Highly detrimental (-13)	Significance: Moderate - negative (-91)
Extent	Local (3)	The night time practical viewshed model indicates that the Project will be visible from a distance of up to 8 km at night.		
Intensity x type of impact	Moderate – negative (-3)	Expansion of the Losberg construction camp and construction of the Bergsig and Swartfontein construction camps is expected to cause a moderate visual disturbance.		
Probability	Certain (7)	The impact will definitely occur.		
MITIGATION:				
The development footprint of the construction camps must be limited as far as possible. Existing historical farmstead structures, where present and as applicable, must be maintained and enhanced in accordance with the recommendations of the Historical Built Environment Assessment to promote the continuation of ‘sense-of-place’. Any new metal structures should be painted a low hue colour to blend in with the surrounding natural environment. Construction during the night must be avoided as far as possible. Where unavoidable, areas where these activities are taking place should be lit and the number of lights and brightness must not exceed the minimum requirements for safety and security. Down lighting and low-pressure lighting mediums such as sodium light sources must be implemented to minimise light pollution. Lights should be directed inwards towards the Project area and not outwards from the Project area.				

IMPACT DESCRIPTION: Potential Impacts of Expansion of Losberg Construction Camp and Construction of Bergsig and Swartfontein Construction Camps on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
POST-MITIGATION				
Duration	Beyond project life (6)	The impact will occur during the construction phase and remain for some time after the Project.	Consequence: Moderately detrimental (-10)	Significance: Minor - negative (-60)
Extent	Limited (2)	The extent of the impact will be reduced by implementing the mitigation actions listed above.		
Intensity x type of impact	Low - negative (-2)	The visual disturbance will be reduced by implementing the mitigation measures above.		
Probability	Highly probable (6)	It is most likely that the impact will occur.		

Table 8-23: Assessment of Impacts from the Development of New Roads and Upgrades to Existing Roads

IMPACT DESCRIPTION: Potential Impacts of Upgrade of Existing Roads and Construction of New Roads on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.	Consequence: Highly detrimental (-13)	Significance: Moderate - negative (-91)
Extent	Local (3)	The roads will be visible from the surrounding area.		

IMPACT DESCRIPTION: Potential Impacts of Upgrade of Existing Roads and Construction of New Roads on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
Intensity x type of impact	Moderate - negative (-3)	Upgrade of the existing roads and construction of new roads is expected to cause a moderate visual disturbance.		
Probability	Certain (7)	The impact will definitely occur.		
MITIGATION:				
The development footprints of the roads must be limited to the prescribed widths. To reduce the potential for dust creation, it is recommended that roads be sealed. It is acknowledged that this may not be feasible taking into consideration the linear extent of the roads proposed for this Project. Alternative dust suppression techniques and speed limits must be applied to reduce the generation of dust accordingly.				
POST-MITIGATION				
Duration	Beyond project life (6)	The impact will occur during the construction phase and remain for some time after the Project.	Consequence: Moderately detrimental (-10)	Significance: Minor - negative (-60)
Extent	Limited (2)	The extent of the impact will be reduced by implementing the mitigation actions listed above.		
Intensity x type of impact	Low - negative (-2)	The visual disturbance will be reduced by implementing the mitigation measures above.		
Probability	Highly probable (6)	It is most likely that the impact will occur.		

Table 8-24: Assessment of Impacts Associated With the Solar PV Plants

<table>
<tr><th colspan="5">IMPACT DESCRIPTION: Potential Impacts of Construction of Solar PV Plants on the Receiving Environment</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">PRE-MITIGATION</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.</td><td rowspan="4">Consequence: Highly detrimental
(-13)</td><td rowspan="4">Significance: Moderate - negative
(-91)</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>The solar PV plants will be visible from the surrounding area.</td></tr>
<tr><td>Intensity x type of impact</td><td>Moderate - negative (-3)</td><td>Construction of the solar PV plants is expected to cause a moderate visual disturbance.</td></tr>
<tr><td>Probability</td><td>Certain (7)</td><td colspan="2">The impact will definitely occur.</td></tr>
<tr><td colspan="5">MITIGATION:</td></tr>
<tr><td colspan="5">The Solar PV Plants must be painted a natural hue with matt finish to blend into the surrounding environment as far as possible.

Construction during the night must be avoided as far as possible. Where unavoidable, areas where these activities are taking place should be lit and the number of lights and brightness must not exceed the minimum requirements for safety and security. Down lighting and low-pressure lighting mediums such as sodium light sources must be implemented to minimise light pollution. Lights should be directed inwards towards the Project area and not outwards from the Project area.

Due to ambiguity in the new South African Civil Aviation Authority (SACAA) regulations for solar projects (SACAA, 2017), a Glint and Glare Impact Assessment may be required. This must be investigated further to ensure SARAO are compliant with the regulatory framework.</td></tr>
<tr><td colspan="5">POST-MITIGATION</td></tr>
<tr><td>Duration</td><td>Beyond project life (6)</td><td>The impact will occur during the construction phase and remain for some time after the Project.</td><td>Consequence: Moderately detrimental
(-10)</td><td>Significance: Minor - negative
(-60)</td></tr>
</table>

IMPACT DESCRIPTION: Potential Impacts of Construction of Solar PV Plants on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
Extent	Limited (2)	The extent of the impact will be reduced by implementing the mitigation actions listed above.		
Intensity x type of impact	Low - negative (-2)	The visual disturbance will be reduced by implementing the mitigation measures above.		
Probability	Highly probable (6)	It is most likely that the impact will occur.		

Table 8-25: Assessment of Impacts Associated With the Powerline and Fibre Optic Cable Networks

IMPACT DESCRIPTION: Potential Impacts of Development of the Powerline and Fibre Optic Cable Networks on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.	Consequence: Highly detrimental (-13)	Significance: Moderate - negative (-91)
Extent	Local (3)	The powerline and fibre optic cable networks will be visible from the surrounding area.		
Intensity x type of impact	Moderate - negative (-3)	Development of the powerline and fibre optic cable networks is expected to cause a moderate visual disturbance.		

IMPACT DESCRIPTION: Potential Impacts of Development of the Powerline and Fibre Optic Cable Networks on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
Probability	Certain (7)	The impact will definitely occur.		
MITIGATION:				
The above ground powerline pylons must conform to existing visual mitigation measures in so far as they are galvanised so as to weather to a matt grey finish. Any ancillary surface infrastructure must be painted a natural hue to promote blending into the surrounding landscape. Trenched areas for underground power and fibre optic networks must be rehabilitated through levelling of topsoil over disturbed areas, and revegetating with indigenous species. Construction during the night must be avoided as far as possible. Where unavoidable, areas where these activities are taking place should be lit and the number of lights and brightness must not exceed the minimum requirements for safety and security. Down lighting and low-pressure lighting mediums such as sodium light sources must be implemented to minimise light pollution. Lights should be directed inwards towards the Project area and not outwards from the Project area.				
POST-MITIGATION				
Duration	Beyond project life (6)	The impact will occur during the construction phase and remain for some time after the Project.	Consequence: Moderately detrimental (-10)	Significance: Minor – negative (-60)
Extent	Limited (2)	The extent of the impact will be reduced by implementing the mitigation actions listed above.		
Intensity x type of impact	Low - negative (-2)	The visual disturbance will be reduced by implementing the mitigation measures above.		
Probability	Highly probable (6)	It is most likely that the impact will occur.		

Table 8-26: Assessment of Impacts Associated With the Borrow Pits and Quarries

IMPACT DESCRIPTION: Potential Impacts of Development of Borrow Pits and Quarries on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.	Consequence: Highly detrimental (-14)	Significance: Moderate – negative (-98)
Extent	Local (3)	The borrow pits and quarries will be visible from the surrounding area.		
Intensity x type of impact	Moderately high - negative (-4)	Development of borrow pits and quarries will cause a moderately high visual disturbance.		
Probability	Certain (7)	The impact will definitely occur.		
MITIGATION:				
Dust suppression techniques will be required to minimise dust generation. Where blasting techniques may be employed to obtain material, this should not take place when wind speeds exceed 5.4m/s. Upon ceasing, the disturbed area must be rehabilitated through re-contouring/profiling the topography, and revegetation in accordance with the requirements contained within the Ecological Assessment.				
POST-MITIGATION				
Duration	Beyond project life (6)	The impact will occur during the construction phase and remain until the borrow pits and quarries have been rehabilitated.	Consequence: Moderately detrimental (-11)	Significance: Minor - negative (-66)
Extent	Limited (2)	The extent of the impact will be reduced by implementing the mitigation actions listed above.		

IMPACT DESCRIPTION: Potential Impacts of Development of Borrow Pits and Quarries on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
Intensity x type of impact	Moderate – negative (-3)	The visual disturbance will be reduced by implementing the mitigation measures above.		
Probability	Highly probable (6)	It is most likely that the impact will occur.		

Table 8-27: Assessment of Impacts Associated With the Operation of the SKA Radio Telescope

IMPACT DESCRIPTION: Potential Impacts of Operation of the SKA Radio Telescope on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.	Consequence: Highly detrimental (-16)	Significance: Major – negative (-112)
Extent	Province/ Region (5)	The daytime practical viewshed model indicates that the Project will be visible from a distance of up to 20 km during the day.		
Intensity x type of impact	Moderately high - negative (-4)	Operation of the SKA radio telescope is expected to cause a moderately high visual disturbance.		
Probability	Certain (7)	The impact will definitely occur.		

<table>
<tr><th colspan="5">IMPACT DESCRIPTION: Potential Impacts of Operation of the SKA Radio Telescope on the Receiving Environment</th></tr>
<tr><th>Dimension</th><th>Rating</th><th colspan="3">Motivation</th></tr>
<tr><td colspan="5">MITIGATION:</td></tr>
<tr><td colspan="5">Promote the concept of the 21st Century Scientific landscape as a new layer to the cultural landscape. Educate as widely as possible the benefits of the Project to change perceptions of the receiving environment receptors.
Night time operation of the antennas will not result in any visual impact.</td></tr>
<tr><td colspan="5">POST-MITIGATION</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.</td><td rowspan="4">Consequence: Highly detrimental
(-14)</td><td rowspan="5">Significance: Moderate – negative
(-84)</td></tr>
<tr><td>Extent</td><td>Municipal Area (4)</td><td>The extent of the impact will be reduced by implementing the mitigation actions listed above.</td></tr>
<tr><td>Intensity x type of impact</td><td>Moderate - negative
(-3)</td><td>The visual disturbance will be reduced by implementing the mitigation measures above.</td></tr>
<tr><td>Probability</td><td>Highly probable (6)</td><td colspan="2">It is most likely that the impact will occur.</td></tr>
</table>

Table 8-28: Assessment of Impacts of the Operation of the Construction Camps

IMPACT DESCRIPTION: Potential Impacts of Operation of the Construction Camps on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
PRE-MITIGATION				
Duration	Permanent (7)	There will be a permanent and irreversible negative visual impact on the receiving environment. The SKA radio telescope and associated infrastructure will remain indefinitely.	Consequence: Highly detrimental (-13)	Significance: Moderate - negative (-91)
Extent	Local (3)	The night time practical viewshed model indicates that the Project will be visible from a distance of up to 8 km at night.		
Intensity x type of impact	Moderate – negative (-3)	Operation of the construction camps is expected to cause a moderate visual disturbance.		
Probability	Certain (7)	The impact will definitely occur.		
MITIGATION:				
Activity areas should be lit and the number of lights and brightness must not exceed the minimum requirements for safety and security. Down lighting and low-pressure lighting mediums such as sodium light sources must be implemented to minimise light pollution. Lights should be directed inwards towards the camp and not outwards from the area.				
POST-MITIGATION				
Duration	Project Life (5)	The visual impact will remain as long as the construction camps are operational.	Consequence: Moderately detrimental	Significance: Minor - negative (-54)

IMPACT DESCRIPTION: Potential Impacts of Operation of the Construction Camps on the Receiving Environment				
Dimension	**Rating**	**Motivation**		
Extent	Local (3)	The extent of the impact will be reduced by implementing the mitigation actions listed above.	(-9)	
Intensity x type of impact	Low - negative (-2)	The visual disturbance will be reduced by implementing the mitigation measures above.		
Probability	Highly probable (6)	It is most likely that the impact will occur.		

8.5 Cumulative Impacts on the Cultural Landscape

Cumulative impacts occur from in-combination effects of various impacts on heritage resources acting within a host of processes that result in an incremental effect. The importance of identifying and assessing cumulative impacts is that the whole is often greater than the sum of its parts. This implies that the total effect of multiple stressors or change processes acting simultaneously on a system may be greater than the sum of their effects when acting in isolation. In the context of this assessment, the cumulative impacts considers the SKA Project in relation to proposed developments within the broader regional study area, the cultural landscape defined in Section 5 above, and results of the in-field assessment and specified impacts.

The SKA Project is unique in its nature. It, however, occurs within a landscape in which several Renewable Energy Development Zones (REDZ) have been defined. The South African Renewable Energy EIA Application (REEA) Database provides the specific delineations of approved and proposed solar PV and wind energy projects in the surrounding area (Department of Environmental Affairs, 2018). The in-combination cumulative impacts will be additive, synergistic and space-crowing in nature as the sum of the effects from the individual developments will interact to produce a total effect that is greater than the sum of the effects when considered in isolation. This enforces over time a high spatial density of impacts on individual heritage resources and the scenic and cultural landscape as a whole.

The scenic character and temporal palimpsests of the cultural landscape as represented by the intangible and tangible resources within the boundaries of the various study areas evoke a specific ‘sense-of-place’. Oberholzer (2005) considers the unique, distinct identity of a place the defining quality that determines the ‘sense-of-place’. This is sometimes referred to as the *genius loci* or spirit of place. In the context of this assessment, the SKA Project is

located within a cultural landscape comprising several layers that contribute to the spirit of place. These include:

- The natural landscape comprising flat plains and mountainous features;
- The palaeontological record associated with various fossil remains;
- The archaeological record associated with ESA and MSA lithic artefacts;
- The archaeological record associated with LSA artefacts attributed to the /Xam group;
- The archaeological record associated with Rock Art engravings attributed to various San groups, and the /Xam in particular;
- The archaeological record associated with LSA artefacts and pottery attributed to Khoekhoe groups;
- The archaeological record associated with Rock Art paintings attributed to Khoekhoe groups;
- 18th and 19th century settlement of Xhosa groups in the Northern Cape, and their interactions with the /Xam, Korana and Griqua;
- Migrations of the frontier farmers from the Cape Colony into the region;
- The present-day farming and rural landscape; and
- A limited 21st century scientific environment with the introduction of the MeerKat and KAT-7 radio-telescopes.

A temporal palimpsest as considered in this assessment, i.e. several layers contributing to the sense-of-place, cannot be viewed as static. Rather, each temporal layer and the associated tangible markers partially obscure its predecessor but does not remove or sterilise it. Therefore, we consider the sense-of-place as fluid and each identified layer as an equal contributor to the present cultural landscape.

Including an additional 133 antenna into the landscape will result in additive, synergistic and neutralising cumulative impacts that will reinforce and enhance the "21st century scientific" layer of the landscape, and reduce the aesthetic, archaeological, historical and current sense-of-place commonly associated with the scenery, /Xam, Khoekhoe and frontier / present stock farming respectively. Current landowners, occupiers and users in the region may interpret this cumulative impact as a loss of identity, where their defined identity is intrinsically associated with a landscape that has remained relatively unchanged for more than 100 years.

At a site-specific and development footprint level, the SKA Project will result in cumulative effects. Space crowding within the SKA Core area will be the most prominent, as the inclusion of the new antenna in a high-density configuration is envisaged to transform the visual landscape to the point that other landscape layers will be sterilised. Similarly, any negative direct impacts to identified heritage resources will reduce the integrity, and in

extreme instance, remove tangible material remains that contribute to the palaeontological, archaeological and historical layers of the landscape. These can be interpreted as additive and synergistic, culminating in the CS enhancement of remaining heritage resource regardless of their integrity.

Conversely, the SKA Project will result in positive cumulative effects in light of the recommendations contained within this assessment and the proposal to declare the SKA Core a protected area in terms of the NEM: PAA. In these instances, the proactive management measures to manage and mitigate known heritage resources will result in additive cumulative impacts in so far that:

- Identified heritage resources will be managed *in situ* as far as feasible to promote the enhancement of their CS and consequently that of the defined cultural landscape;
- Where *in situ* conservation is not feasible in the context of the specific requirements of the SKA Project, the tangible heritage resources will be recorded in detail and conserved in record; and
- In the event that previously unidentified heritage resources are accidently exposed during project related activities, mechanisms proposed will promote the detailed recording and preservation through record.

Table 8-29: Identified potential cumulative impacts in respect of the cultural landscape

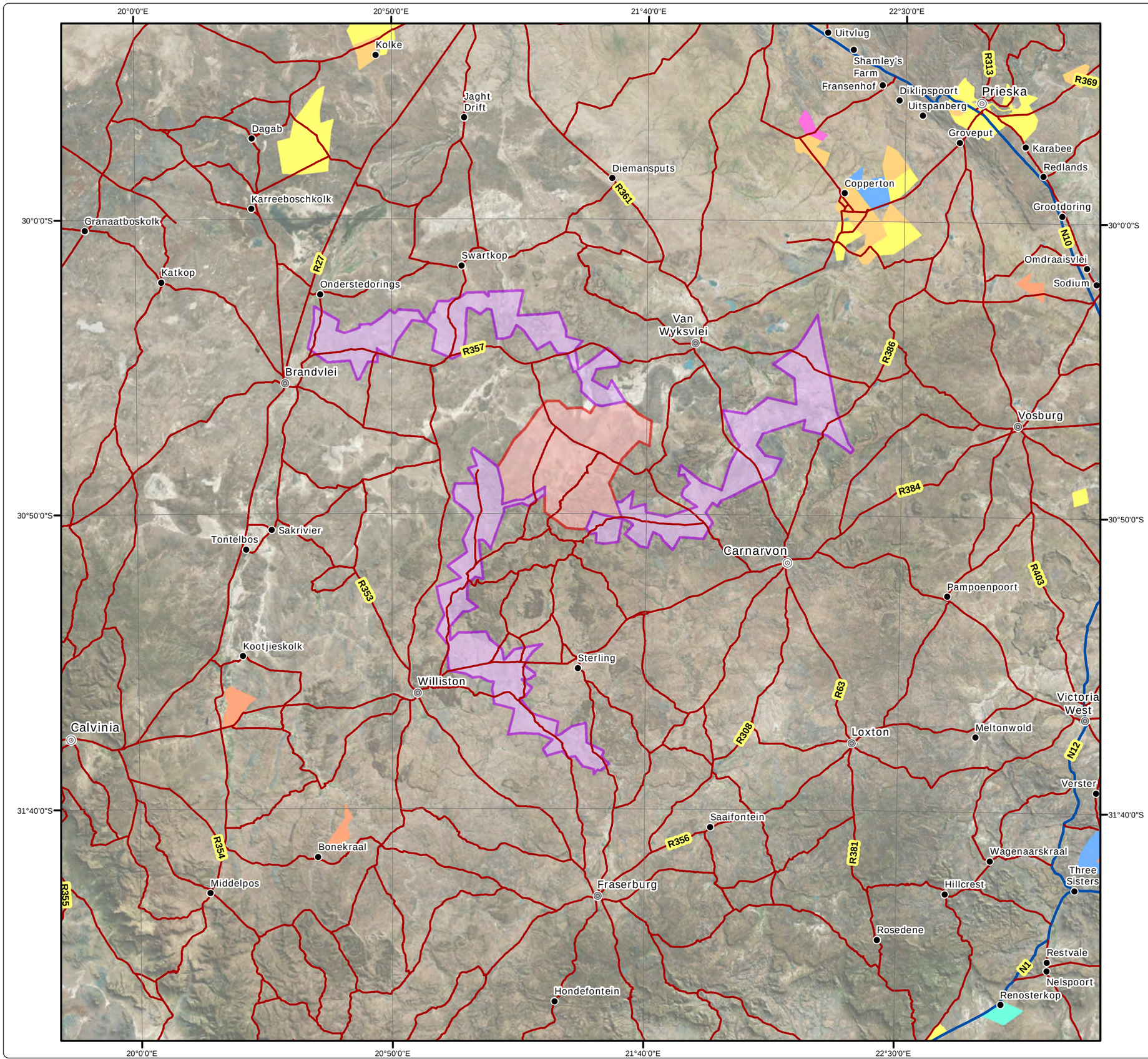
Type	Cumulative Impact	Direction of Change	Extent of Impact
Additive; synergistic and space crowding	SKA Project development in relation to the proposed and approved REDZ and other developments within the regional context will result in, in-combination effect on the scenic (aesthetic) character, cultural landscape sense-of-place, and increase the visual disturbance.	Negative	Regional
Additive, synergistic	The enhancement of a 21st century scientific layer to the landscape will obscure the sense-of-place associated with the preceding temporal layers.	Negative	Regional
Additive	The SKA Project in conjunction with proposed and approved developments within the region will affect the integrity of *in situ* heritage resources and consequently the CS as encroachment increases.	Negative	Regional
Additive, synergistic and neutralising	Remaining *in situ* archaeological heritage resources within the site-specific and local study area will increase in significance regardless of their integrity as more tangible heritage resources are removed from the landscape.	Negative	Local

Type	Cumulative Impact	Direction of Change	Extent of Impact
Additive, synergistic and neutralising	Remaining historical built environment resources within the site-specific and local study area will increase in significance regardless of their integrity as more tangible heritage resources are removed from the landscape.	Negative	Local
Additive, Synergistic	The partial or total demolition of the historic built environment within the site-specific study area will degrade the frontier and present day stock farming landscape at a local level.	Negative	Local
Space crowding	Sterilisation of landscape layers through high density configuration of the SKA antenna	Negative	Site-specific
Additive, synergistic	Encroachment and removal of tangible material remains associated with palaeontological, archaeological and historical aspects enhance the CS of remaining *in situ* resources regardless of their integrity	Negative	Site-specific
Neutralizing	Proactive management and mitigation measures will promote the conservation of known palaeontological and archaeological resources *in situ*, and where not feasible, preservation through record to counter sterilisation of the cultural landscape.	Positive	Site-specific
Neutralizing	Proactive management and adaptive reuse of historical built environment resources that remain *in situ* will maintain the defined CS of these resources, particularly with respect to the Grade II structures.	Positive	Regional

Plan 7

SKA Project

Cumulative Impacts



Legend

Project Area

- SKA Phase 1 Core
- SKA Phase 1 Spiral Arms
- Secondary Town
- Other Town
- Settlement
- Main Road
- National Road

South African Renewable Energy EIA Application Database (DEA, 2018)

- Solar PV, Approved
- Solar PV, In process
- Solar PV, Withdrawn/Lapsed
- Wind, Approved
- Wind, Withdrawn/Lapsed
- Unknown, Withdrawn/Lapsed

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9 Socio-Economic Benefit versus Heritage Impacts

This section provides a summary of the Socio-Economic Assessment (Atkinson, et al., 2017) completed in support of the SEA and IEMP for the SKA Project. The most salient points of the assessment are considered against the identified heritage impacts discussed in Section 8 above

The international SKAO intends to construct the world's largest radio telescope, projected to be 50 times more sensitive than any current instruments, co-located in Africa and Australia. The South African component is a National Key Strategic Development that feeds into the Department of Science and Technology (DST) Ten Year Innovation Plan (2008 – 2018). The DSTs Innovation Plan identifies space science and technology as a major priority, recognising the Northern Cape as a world-class region for astronomical observations (*recognised in the Astronomy Geographic Advantage Act [2007] protecting the Northern Cape radio frequency interference*). The SKAO envisage this initiative to generate the largest data volumes ever created, thereby stimulating and contributing to major advancements in scientific data methods and computational power.

Considering the macroeconomics of the SKA Project, and amount of € 352 million (*i.e. approximately ZAR 5 205 000 000.00*) has been allocated to South Africa for the establishment during Phase 1. The design and costing process for the full scope of Phase 2 could top € 3 billion. As part of the SKA design work, an amount in excess of ZAR 50 million has been injected into the South African industry to upscale, upskill and innovate. This has resulted in new technologies locally built with locally held intellectual property. During construction, South African companies will establish infrastructure where the primary national and local expenditure multipliers will be in respect of civil infrastructure, engineering and construction. Considering the aforementioned technologies produced within South Africa, it is suggested the national economic multipliers on selected SKA technologies could be quite high.

The Socio-Economic Assessment (Atkinson, et al., 2017) summarised the macroeconomic key positive impacts as follows:

- International recognition of the South African scientific and skills capabilities;
- National economic benefit due to the net foreign direct investment and spending in South Africa;
- National development benefits through enhanced engineering capabilities; and
- National development benefits through Human Capacity Development Programmes.

At the regional and local level, however, there is conflict in respect of the social and economic impact of the inclusion of the SKA Project to the present astronomy developments comprising the Southern African Large Telescope (SALT), and the KAT-7 and 64-dish MeerKAT investments in Sutherland and north-west of Carnarvon respectively.

At the municipal levels, the synergies in respect of infrastructures, service delivery and job opportunities to address the significant level of social and economic inequality is not clearly defined. This is further compounded by proposed radio frequency interference restrictions and the consequent loss of existing services, the perceived impacts to the "Karoo lamb brand" by land procurement resulting in a change in existing activities and farming economies; potential increase in unemployment in the agricultural sector. A challenge is to coordinate with local authorities in terms of effective spatial planning and development, address increased pressures on infrastructures and service delivery, and identify the effects to regional tourism.

These challenges notwithstanding, the existing astronomy developments have already fuelled developments include *inter alia*:

- Upgrade of provincial road networks;
- Local job creation;
- Local supplier programmes;
- Capital development programmes;
- Establishment of the Carnarvon Community Knowledge Centre; and
- Funding of teachers and educational material development.

The identified challenges can further be remediated through implementation of recommendations encapsulated in the Socio-Economic Assessment (Atkinson, et al., 2017). These are summarised in Table 9-1.

Table 9-1: Recommendations contained within the Socio-Economic Assessment (Atkinson, et al., 2017)

Recommendation	Details
Facilitate partnerships between state entities and civil society	State and non-state agencies promote an energetic, creative, committed and sustained participation in sectors such as Education, Health and Economic Development to enable positive impacts which are not directly related to the SKA project in the Astro-Region.
Collaborate to investigate optimal communications technology and provide modern services to the region	Evaluate possible available technical communications options to reconcile SKA's and local residents' requirements for radio communications, and include local investors in the decision-making process to find cutting edge and adequate solutions for telecommunication devices and services in line with SKA RFI requirements in the region and to sustain and promote local economic diversification and job creation.

Recommendation	Details
Optimise the retention of sustainable agriculture	State and non-state agencies promote sustainable agriculture practices in the region with various incentives and support to the local farmers; unions and related organisations.
Promote the development of the tourism sector in the region	Northern Cape Government involve key role-players and local communities of the region in the development of a state-of-the-art Science Visitor Centre in Carnarvon which can stimulate local investments by local stakeholders such as regional tourism marketing, science education, and linkages with Sutherland. Furthermore it is recommended that the development of the tourism and retail sectors receive support from government in order to balance the reduction in agricultural activities in the area.
Optimise the investments into the Education sector	SARAO, the Department of Science and Technology and the Northern Cape Government collaborate to establish a long-term strategic plan to optimise and align the various investments already made by SKA and other state agencies in the region.
Support farm worker career pathing.	SARAO continue to provide support to the farm workers affected by the land acquisition process in terms of job opportunities at SKA or assistance to determine their own career choices and training needs.
Increase the effectiveness of local government	Local, district and provincial authorities align their strategies and spatial planning to promote a positive development of the towns in the region especially in terms of local economic development facilitation and tourism. IDPs, SDFs and PGDS processes must be aligned throughout the three spheres of government in order to coordinate and implement beneficial and efficient planning in the Astro-Region. Support must be provided to the Local Municipalities in terms of capacity, resources and political support to actively participate and engage in the SKA Project as well as catalyse the changes and coordination required to assist in realising the benefits of the SKA project in the region.
Establish a locally based SARAO office in the region	SARAO establish a permanent SKA presence in Carnarvon with experts able to interact with local stakeholders and visitors. These experts should have regular meetings with local municipal councillors and staff, with civil society, and with Provincial and National Government.

Of particular relevance to this assessment is the development of tourism within this region of the Northern Cape to benefit the tourism industry and local communities. At the time of compilation of the Socio-Economic Assessment (Atkinson, et al., 2017), the data suggested that there was a general and widespread tourism growth within the Karoo. Significantly, Sutherland is one of the most successful tourism towns in the Karoo, where accommodation establishments have increased more than ten times in the last 17 years.

The Karoo Highlands Tourism Route serves as the primary artery connecting towns with thematic astronomy links, such as Sutherland and Fraserburg, to the SKA Project and the directly affected towns of Carnarvon and Williston. To build on the identified theme, the Northern Cape Department of Economic Development and Tourism (NC-DEDT) investigated the establishment of a Science Visitor Centre (SVC) in Carnarvon, securing the required funding in 2016. It is envisaged the SVC provide patrons with information and participatory activities associated with themes such as:

- Origins of the universe;
- The nature of infinity;
- The nature of radio waves;
- The history of radio astronomy;
- Deep universal history;
- Dark matter; and
- “Big Data”.

Of further relevance is the SKA land acquisition programme, with the aim to procure an additional 117 594 ha of land to form the SKA Core Area. SARAO intends to declare this land as a Protected Area under the NEM: PAA. Furthermore, the NRF Board have approved appointing the South African National Parks (SANParks) as the land management authority. This suggested approach is in line with the Northern Cape Protected Area Expansion Strategy (2017 – 2021) because the presence of the Nama Karoo biome is presently underrepresented in conservation areas and there is a general lack of biodiversity and biophysical characteristics knowledge of the area. The declaration will also facilitate the protection and management of cultural heritage resources within the area.

This summary of the socio-economic benefits that may be derived from the SKA Project suggest they are greater than the heritage impacts identified in Section 8 above. This statement is support by the following reasoning:

- The physical development footprint of the SKA Project infrastructure is limited in areal extent;
- The majority of known heritage resources can be maintained *in situ* and managed through the proposed recommendations and consequent Conservation Management Plan;

- Heritage resources that may be impacted upon by the SKA Project can be mitigated through the proposed recommendations;
- The proposal to declare the SKA Core Area will create strong opportunities between landownership, exclusion requirements, and expected conservation outcomes in respect of biodiversity and cultural heritage; and
- The SKA Project will contribute at a macro and local economic level to the benefit of South Africa and community members in the local study area.

10 Consultation

The consultation process affords I&APs the opportunity to engage in the HRM process. The objectives of the PPP include the following:

- To ensure that I&APs are informed about the project;
- To provide I&APs with an opportunity to engage and provide comment on the project;
- To draw on local knowledge;
- To involve I&APs in identifying methods in which concerns can be addressed;
- To verify that stakeholder comments have been accurately recorded; and
- To comply with the legal requirements.

Dissemination of information in support of this HIA was completed as per the methods described in Table 10-1.

Table 10-1: Distribution of information to Stakeholders

Method	Description
Introductory Meeting	SARAO introduced the HRM process and lead team members to the Landbou Aksie Groep (LAG) at a meeting in Carnarvon, Northern Cape on 23 January 2018.
Newspaper advertisement	Project notifications were placed in the Noordwester and The Citizen newspapers, published on 02 March 2018.
Notification letters	Invitation letters to participate in the HRM process were distributed to I&APs previously registered for the SEA process on 2 March 2018 via email.
BID	A BID was developed and distributed to I&APs previously registered for the SEA process on 2 March 2018 via email.

Method	Description
Site Notices	Site notices were placed at six strategic locations within the regional study area during the week of 23 February to 2 March 2018. These locations were as follows: ▪ Brandvlei Post Office; ▪ Vanwyksvlei Post Office; ▪ SKA site northern access; ▪ Carnarvon Spar Notice Board; ▪ SKA site southern access; and ▪ Williston Post Office.
Websites	Placement of all relevant PPP material on the Digby Wells, SARAO and Heritage Portal on 5 March 2018. The applicable links are as follows: Digby Wells: http://www.digbywellsdocs.com/PublicDocuments/?downloads=nrf4874-the-south-african-radio-astronomy-observatory-bid SARAO: http://www.ska.ac.za/northern-cape-communities/heritage-resources-management-process/ Heritage Portal: http://www.theheritageportal.co.za/notice/heritage-resources-management-process-south-african-radio-astronomy-observatory-square

At the time of compilation, the following comments were received from I&APs. Please refer to Table 10-2 for the comments and responses applicable to the HRM process:

Table 10-2: Comments and Responses Related to Heritage

Category	Comment Raised (sic)	Contributor	Date	Method	Heritage Response	SARAO Response
Notification	The NEMA regulations was circumvented by the SG Strategic Environmental Assessment. Therefore this process is unstable.	Gous Wilson	05 March 2018	Email	Your comment is noted. The HRM Process is being undertaken independently of the Environmental Authorisation process as regulated under the NEMA and NEMA Regulation (2017) (GN R 982, as amended by GN R 326). The HRM Process was completed to comply with the requirements encapsulated in the SKA IEMP, and Section 38(1) of the NHRA. A detailed summary of the applicable regulatory framework is presented in Section 2 of the HIA.	SARAO submitted the Integrated Environmental Management Plan (IEMP) to the Minister of Environmental Affairs for consideration for adoption as an environmental management instruments in terms of Section 24(2)(e) of the NEMA. The intention of the adoption of this instrument (i.e. the IEMP) will allow for the development of the identified activities associated with the development of the SKA within the geographical scope indicated in the document, without environmental authorisation, but in line with the environmental management principals and measures of the plan. These principles and management measures have been proposed based on the assessment of possible environmental sensitivities and impacts and their mitigation and management measures undertaken through a strategic environmental assessment process. The application for exemption in terms of Section 24(2)(e) of the NEMA has been granted and gazetted (Please refer to Government Gazette No. 41498/213). Therefore, no listed activities are considered in this application.
Farm: Moffy's Dam	Require that any SKA Representative or sub-contractor submit to in writing, when they wish to come onto his property, and what activities they will be undertaking. Once received, I will liaise with my advisors as to whether or not to allow access.	Pierre (Ace de Klerk)	27 February 2018	Site Visit	Thank you for your comment. In the event that access to your property is required, Digby Wells will submit a written request in line with the SARAO Access Protocol prior to the field assessment to secure access.	-
Farm: Dassies Kloof & Oest	I would like to obtain more information as to the visual impact of the proposed dish SKA 130 on the neighbouring farm, Koega owned by Francois Louw. My major concern is how the RFI policy will impact upon me as it is not clearly explained, and no certainties have been provided by SARAO.	Dawid Louw	28 February 2018	Site Visit	Thank you for your comment. During the field assessment, the visual assessor considered the visual impact of SKA 130 from your residence on Oest Farm. A summary of the Visual Assessment is provided within the consolidated HIA Report, and in the specialist Visual Impact Assessment provided as an appendices.	-

Category	Comment Raised (sic)	Contributor	Date	Method	Heritage Response	SARAO Response
Notification	“Thanks but no thanks” The area loses revenue, because SKA never informed stakeholders of all the negative impacts. We are projected to lose approximately 8 million Rand each year if you considering farming practices and salaries. SKA will not give the money back. Carnarvon is going to become a ghost town. Furthermore, no indication was provided as to the loss of cellphone signal.	Stephen Coetzee	06 March 2018	Telephonic call	Your comment is noted. As part of the SEA, a detailed Socio-Economic Assessment was undertaken that considered the potential impact of the SKA Project and provided recommendations to mediate against these. Of relevance to the HRM process was the identification of tourism as a potential industry that could benefit the local communities. This was considered in respect of thematic themes associated with astronomy along the Karoo Highlands Route. In this instance, palaeontology and the archaeological heritage associated with the /Xam specifically can further contribute to this industry. Furthermore, it was identified that Carnarvon, as the central "hub" for the SKA Project is positioned to benefit from the development of the Project. Based on the findings, it is not envisaged that Carnarvon will become a "ghost town". Please refer to Section 9 of the HIA Report for a detailed summary of the socio-economic benefit of the Project versus the identified heritage impacts.	-
Concerns	The project so far was not transparent in planning	Guillau du Toit	08 March 2018	Written Comment	Your comment is noted. The HRM process was announced to the Landbou Aksie Groep on 23 January, and advertised in both local and national newspapers on 2 March 2018 to ensure the widest distribution of information as possible to all potential stakeholders. Furthermore, Notification Letters were distributed to all previously registered I&APs, and Site Notices were placed in various public places requesting all I&APs to register as such. The objectives of the PPP was to ensure all I&APs are informed of the HRM Process, and provided an opportunity to engage in the process. A detailed summary of the PPP process is provided in Section 10 of the HIA Report.	-
	The project will have a negative economic impact				Your comment is noted. As part of the SEA, a detailed Socio-Economic Assessment was undertaken that considered the potential impact of the SKA Project and provided recommendations to mediate against these. Of relevance to the HRM process was the identification of tourism as a potential industry that could benefit the local communities. This was considered in respect of thematic themes associated with astronomy along the Karoo Highlands Route. In this instance, palaeontology and the archaeological heritage associated with the /Xam specifically can further contribute to this industry. Furthermore, it was identified that Carnarvon, as the central "hub" for the SKA Project is positioned to benefit from the development of the Project. Based on the findings, it is not envisaged that Carnarvon will become a "ghost town". Please refer to Section 9 of the HIA Report for a detailed summary of the socio-economic benefit of the Project versus the identified heritage impacts.	-

Category	Comment Raised (sic)	Contributor	Date	Method	Heritage Response	SARAO Response
Paleontological	I am the curator of the Fraserburg Fossil Museum housing one of a kind fossil heritage. I have an interest in the palaeontological heritage in respect of this Project. It would be appreciated if the HRM process could contributed to the conservation of palaeontology in the area.	Marthinus Kruger	08 March 2018	Written Comment	Thank you for your comment. This HRM Process considered the palaeontological context of the regional study area, with specific focus on the Lower Beaufort Group lithostratigraphic units in the southern portion of the site-specific study area. As part of this assessment, two palaeontological resources were identified, and the potential fossil heritage considered in the assessment. The palaeontological context can be found under Section 5.1 of the HIA Report. The proposed recommendations are provided under Section 11.	-
Registration	I am a resident of Williston in the Northern Cape and am interested in the Project. Please will you register me as an interested and affected party and provide me with all the relevant documentation.	R Bartholomew	08 March 2018	Email	Your comment is noted. You have been registered as an I&AP. The notification letter and BID have been distributed to you on 8 March 2018. You can access all relevant project documentation at the following links: http://www.digbywellsdocs.com/PublicDocuments/?downloads=nrf4874-the-south-african-radio-astronomy-observatory-bid http://www.ska.ac.za/northern-cape-communities/heritage-resources-management-process/	-
Access to Documents	Dankie vir hierdie epos. Kan u asb aandui waar ek die 'kennisgewingbrief en agtergrondinligtingsdokument vir hierdie projek', waarna u verwys, kry?	Nestie & JD Smit	16 April 2018	Email	Thank you for your comment. You can access all relevant project documentation at the following links: http://www.digbywellsdocs.com/PublicDocuments/?downloads=nrf4874-the-south-african-radio-astronomy-observatory-bid http://www.ska.ac.za/northern-cape-communities/heritage-resources-management-process/	-

11 Recommendations

As demonstrated in the preceding sections, the SKA Project occurs within a sensitive cultural landscape. To manage or mitigate against the identified impacts presented in Section 8 above, several recommendations have been made. This chapter summarises the specific recommendation in relation to known heritage resources within the site-specific study area, as well as general recommendations that consider best practice principles and potential impacts to previously unidentified heritage resources.

These are discussed separately in the subsequent sections.

11.1 Specific Recommendations

Specific recommendations made in relation to the known heritage resources are presented in Table 11-1.

Table 11-1: Specific Recommendations

Aspect	Recommendation	Description
Archaeology	*In situ* conservation of identified archaeological resources	Identified archaeological resources must remain *in situ. Where new infrastructure occurs within proximity to the resource,* a minimum buffer of 50 m must be observed during construction and operational activities. The extent of the buffer area must be clearly demarcated, and signage placed to indicate the presence of the resource. Where infrastructure realignment is possible, this must be undertaken to exclude the buffer area from development footprints. This recommendation is applicable to the following known archaeological resources: HER-SKA014; HER-SKA056; MXD-001; MXD-002; MXD-003; SA-001; SA-002; SA-005; SA-006; SA-007; SA-009; SA-012; SA-013; SA-014; SA-015; SA-017; BGG-001; BGG-002; RA-003, RA-004, RA-006, RA-007, RA-008, RA-009 and RA-010; HER-SKA004; HER-SKA013; HER-SKA068; HER-SKA069; HER-SKA008; HER-SKA016; HER-SKA027, and burial grounds and graves associated with farmsteads within the core area.
	Detailed recording of identified archaeological resources	Where new infrastructures that are not capable of realignment (i.e. antennas) are situated within the defined 50 m buffer, the identified heritage resources must be recorded in detail prior to the construction phase. This may include inter alia, distribution and density mapping, surface collection and test excavations subject to the approval of a Section 35 Permit. This recommendation is applicable to the following identified heritage resources: SA-005, SA-006, SA-012, SA-014, SA-015 and SA-017.

Aspect	Recommendation	Description
	Phase 2 Archaeological Mitigation	The heritage resource SA-016 is situated within the development footprint of antenna SKA-027. The assessor acknowledges that realignment of this infrastructure is not feasible in the context of the SKA Project, and preservation of the site in situ as a management measure being a challenge. In this instance, the identified impact cannot be removed or avoided, but the intensity of the impact to SA-016 can be reduced through adoption of the following recommendations: ▪ SA-016 must be recorded in detail prior to the construction phase. This may include *inter alia*, distribution and density mapping, and test excavations subject to the approval of a Section 35 Permit; and ▪ A Watching Brief undertaken by a suitably qualified and accredited archaeologist must be completed during earth moving activities to record all material cultural remains that may be exposed. The results of the Watching Brief must be compiled into a Watching Brief Report and submitted to SAHRA for noting.
Built Environment	*In-situ* conservation of identified Built Heritage resources within the SKA Core area	This recommendation is applicable to the following heritage resources: BHS 1, BHS 5 and BHS 6. The identified Historical Built Environment resources must remain *in situ* and a minimum buffer of 1 km must be established around these resources. This buffer zone must be considered a 'no-go' area within which no Project-related activities are to take place. These resources must be recorded in detail through photographs and measured drawings prior to the commencement of the construction phase.
	Establish buffers around identified Built Heritage resources within the site-specific study area	This recommendation is applicable to the following heritage resources: BHS 7 and BHS 8 Buffers around the identified Historical Built Environment resources must be observed. The following buffers and requirements are applicable: ▪ BHS 7: a minimum buffer of 1 km must be established around these resources. This buffer zone must be considered a 'no-go' area within which no Project-related activities are to take place. ▪ BHS 8: a minimum buffer of 50 m must be established this resource. This buffer zone must be considered a 'no-go' area within which no Project-related activities are to take place.

Aspect	Recommendation	Description
	Conservation through records for buildings to be demolished	This recommendation is applicable to the following heritage resources: BHS 2, BHS 3 and BHS 4 Any proposed demolition of graded structures is subject to the requirements stipulated under Sections 27 & 34 of the NHRA and regulated by Chapter IV of GN R 548. The graded structures and associated adjacent structures must be recorded in detail in support of the application for demolition, and as a method of "preservation through record". Records should consist of photographs and measured drawings. It is recommended the structures only be demolished to their existing floor level, i.e. removal of the walls and superstructure but keeping the buildings foot print to prevent squatting and the need for maintenance. Historic building materials, where in existence and in a good condition (such as door and window frames or fireplaces), should be retained and made available for reuse for other historic structures in the area.
Visual	Limit light pollution of the construction camps	Lighting of the construction camps at night must not exceed the minimum requirements for safety and security. Down lighting and low-pressure lighting mediums such as sodium light sources must be implemented. Lights must be directed inwards to the camp area and not outwards

11.2 General recommendations

General recommendations are considered in Table 11-2.

Table 11-2: General Recommendations

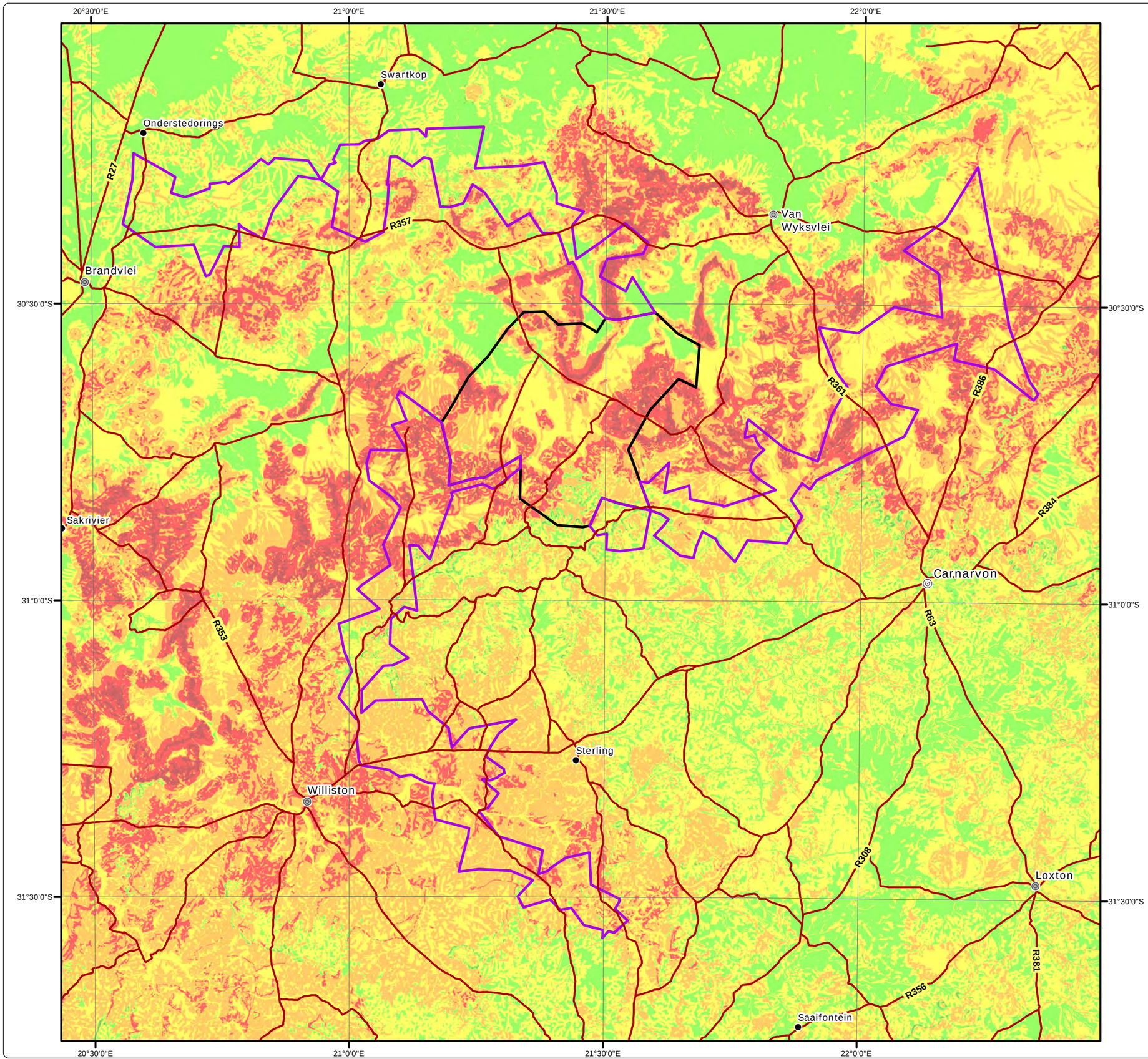
Recommendation	Description
Develop a Conservation Management Plan and Chance Find Protocol for implementation	A project specific CMP including CFPs must be developed and implemented as part of this Project that considers the project related activities in relation to the specified infrastructures. The CMP and CFPs must consider the sensitivity of the landscape in terms of palaeontology (Refer to Figure 4-1) and archaeology (Refer to Plan 8). This is currently part of the scope of the HRM Process and will be submitted to SAHRA and NC-PHRA for adjudication and approval.
Declaration of Built Heritage resources	Built Heritage resources with a recommended field rating of Grade II be formally declared or Grade III included in the national inventory.

Recommendation	Description
Establish buffers around Built Heritage resources within the site-specific study area as per Section 6.4 of the specialist Built Environment Assessment (Appendix F)	The significance of these resources will inform the size of the recommended buffer to be implemented around the structures intended for retention. Grade II resources will require a 1 km buffer, retained Grade III A resources will require a 150 m buffer zone and retained Grade III B and III C resources require a 50 m buffer. These buffer zones must be implemented during construction and operation phases.
Structures older than 60 years are subject to permitting requirements	Structures are older than 60 years are afforded general protection and subject to permitting requirements stipulated under Sections 27 & 34 of the NHRA and regulated by Chapter IV of GN R 548. . Individual permit applications must therefore be submitted for each protected building proposed for demolition. The affected structures must be recorded in detail prior to their alteration or destruction. This will include *inter alia* photographs and measured drawings.
Rehabilitate after construction	The development footprint must be rehabilitated as far as possible to reduce the intensity of the visual disturbance. This may include the following activities: ▪ Limiting heights of any topsoil spoils that may be created ▪ Trenched areas must be re-contoured ▪ Borrow pits and quarries must be profiled to a natural topography ▪ Disturbed areas must be revegetated with indigenous species in accordance with the requirements contained within the Ecological Assessment
Reduce visual disturbance during construction	Dust suppression techniques should be employed as far as possible to limit dust pollution during construction activities.
	Construction during the night must be avoided as far as possible. Where unavoidable, areas where these activities are taking place should be lit and the number of lights and brightness must not exceed the minimum requirements for safety and security. Down lighting and low-pressure lighting mediums such as sodium light sources must be implemented to minimise light pollution. Lights should be directed inwards towards the Project area and not outwards from the Project area.

Plan 8

SKA Project

Heritage Sensitivity



Legend

Project Area

- SKA Phase 1 Core
- SKA Phase 1 Spiral Arms
- Secondary Town
- Other Town
- Settlement
- Main Road

Heritage Sensitivity

- Very High
- High
- Moderate
- Low
- Very Low
- Negligible

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Datum: WGS 1984	Revision Number: 1
Central Meridian: 21°E	Date: 07/05/2018

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Kilometres

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12 Summary and Conclusion

This report constitutes the detailed HIA in support of the SKA Project, as required in terms of the IEMP. The aim of the HRM process was to comply with the SoW as presented in the SKA PEP 6 001/2017 brief, statutory comments on Case ID: 10314[24], interim comments on Case ID 12292[25] and the regulatory requirements encapsulated with Section 38 of the NHRA. To achieve this aim, several tasks were undertaken including:

- A pedestrian survey of the site-specific study area in accordance with the reasoning and methodology presented in Section 4.3 above;
- Defining the CS of the landscape and recommending field ratings as applicable to identified heritage resources through use of a robust methodology (Refer to Section 4.2 above and Appendix B);
- As far as possible, identifying potential impacts as relevant to the HRM process that may manifest from the SKA Project and providing reasonable recommendations to manage and mitigate these;
- Consideration of the socio-economic benefits of the SKA Project in relation to the identified heritage impacts to provide a reasoned motivation for the approval of the Project; and
- A detailed PPP to comply with the requirements encapsulated in Section 38(3)(e) of the NHRA.

Through consideration of the contents of the HIA, and where the recommendations presented in Chapter 11 above are implemented, Digby Wells is of the opinion that the SKA Project can proceed.

[24] Available at: http://www.sahra.org.za/sahris/cases/csir-ska-phase-1

[25] Available at: http://www.sahra.org.za/sahris/sites/default/files/casedecisions/Case%2012292%20-%20Response%20to%20NID.pdf

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Appendix A: Specialist CVs

Appendix B: HIA Methodology

Appendix C: Stakeholder Engagement

Appendix D: Site descriptions and Photographs

Table 13-1: Detailed descriptions of identified heritage resources

Site Reference	Abbreviated Description	Detailed description
BGG-001	Possible burial ground: ≤10 graves	Two potential LSA burials (that may have been disturbed to a greater or lesser extent). They are marked by piles of rocks (roughly 0.5 m in diam.) that would have to have been placed there. An Achulean flake was found nearby.
BGG-002	Possible burial ground: Single grave	LSA grave. Low-density surface scatter as well, including potential Achulean lithics. Low density of MSA and LSA artefacts around the grave.
MXD-001	Site: low complexity, multiple components <25 sq. m / 5 x 5 m	Archaeological site including stonewalling and a (low-density) scatter of broken glass (historical). The stonewalling occurs as a circle approximately 3 m in diameter.
MXD-002	Site: high complexity, multiple components >2500 sq. m / 50 x 50 m	A large and extremely weathered (fragmented) boulder with material culture remains around it, including: chalcedony (introduced), pieces of white and green historic glass and OES fragments. Boulder as hairline engraving on the one side, which appears to have been there before a large fracture occurred in the rock (or may have followed the weathering).
MXD-003	Site: high complexity, multiple components >2500 sq. m / 50 x 50 m	Another large, cracked boulder surrounded by material culture. Material culture includes: more chalcedony, freshly-flaked (LSA) tool, OES fragments, historical glass and what may be ochre. One fragment [of the boulder] has been smoothed and some lines have been etched into it. There are a lot of OES fragments around this stone in particular.

Site Reference	Abbreviated Description	Detailed description
RA-003	Rock art: engraving	Engraved lines on a boulder. Hairline engraving.
RA-004	Rock art: engraving	Engraved lines on a boulder, including some hairline cross-hatching. Same designs on two areas of the same boulder.
RA-006	Rock art: engraving	Pecking on a boulder.
RA-007	Rock art: engraving	Hairline scratching on a boulder.
RA-008	Rock art: engraving	Scratched hairline lines.
RA-009	Rock art: painting	Finger painting in shelter above a water-course. Finger painting includes black and white images as well as a human-like figure in red and black. Material culture found in the shelter included stone flakes, OES fragments, imported ceramic and historical glass.
RA-010	Rock art: painting	Finger-painting in a shelter along the same watercourse as RA-009. Images are in red and white in two panels within the shelter (the second panel is around a curve in the shelter). No artefacts visible. A stone wall had been erected near one edge of the shelter (age of wall unknown).
SA-001	MSA open-air site consisting of a low-density surface scatter (<10:1 sq. m).	Low-density scatter of stone tools. OES found in proximity. MSA open-air site consisting of a low-density surface scatter.
SA-002	Low density surface scatter (<10:1 sq. m) associated with the Stone Age.	Low-density scatter of stone tools (± 4 artefacts/sq. m), associated with the Stone Age (indeterminate).

Site Reference	Abbreviated Description	Detailed description
SA-004	Isolated surface find including two lithics. One lithic has a patina and the other appears younger (possibly LSA).	Stone Age isolated surface. Includes two pieces, both made of hornfels. One lithic is older (has a patina) and the second is younger, possibly LSA. Near a water course. A further 2 lithics (with patina) were found ±10m away.
SA-005	Low density surface scatter (<10:1 sq. m) of what appear to be LSA lithics, including two bladelets.	Low-density scatter (8 lithics/sq. m) of LSA material across approximately 15 m (diameter), including two bladelets. Lithics were made of hornfels. OES and thin-walled pottery.
SA-006	Low density surface scatter (<10:1 sq. m) of what appear to be LSA lithics, including two bladelets.	Low-density scatter of LSA flakes, including two bladelets, across an area approximately 15 m in diameter. Lithics are made of hornfels. Scattered OES fragments also found here.
SA-007	High density surface scatter (>20:1 sq. m) representing the MSA and LSA.	High-density scatter of lithics representing the LSA and MSA. Approximately 35 LSA and 8 MSA lithics were found in one sq. m.
SA-009	Stone Age low density surface scatter (<10:1 sq. m)	Low-density scatter representing the MSA and LSA, including three cores and sixteen MSA flakes across approximately 4 m.
SA-010	Isolated surface find of two LSA lithics, including one broken bladelet and one flake core.	Low-density Stone Age Scatter, including three older flakes. Also found near a water course (most likely wash).
SA-012	MSA low density surface scatter (<10:1 sq. m)	Low-density scatter of MSA lithics, including one unifacial point.
SA-013	Low density surface scatter (<10:1 sq. m) of Stone Age artefacts.	Low density scatter of lithics. Three lithics were found: a quartz flake and two hornfels flakes. They occurred across a wide area and it is likely there are more lithics at this location.

Site Reference	Abbreviated Description	Detailed description
SA-014	Site: low complexity, multiple components <25 sq. m / 5 x 5 m	Low complexity site including: lithic scatter (including three quartz flakes and one hornfels); two upper grindstones, one lower grindstone, OES fragments and pottery. An additional lower grindstone was found a little way from the site.
SA-015	Low density surface scatter (10:1 sq. m) representing the ESA, MSA and LSA.	Low-density surface scatter including ESA, MSA and LSA. One handaxe and some MSA lithics. Lithics are made of quartz and hornfels. OES and a lower grindstone were also found at this point.
SA-016	High density surface scatter (>20:1 sq. m) of Stone Age artefacts, some of which may be LSA.	High-density scatter of Stone Age flakes and OES (± 45 lithics/sq. m; ± 35 OES frags/sq. m). Includes a high frequency of blades and cores (LSA). Lithics are made on hornfels and quartz. Some OES fragments represented unfinished beads The area does have some deposit which may be covering more material.
SA-017	Low density LSA surface scatter (<10:1 sq. m).	LSA scatter including flakes on hornfels and one flake on quartz. Some examples of backed pieces.
SA-018	Isolated surface find of one lithic which may represent the MSA.	Isolated lithic (most likely MSA). David Morris suggests it could represent the Albany industry, which has not been seen in this area. Isolated surface find of one lithic which may represent the MSA.

Photographs of these are included on the following pages. Photographs of the built heritage, palaeontological and visual resources are included in Chapter 6 of the built heritage report (Appendix F), Chapter 4 of the PIA report (Appendix E) and Chapter 8 of the VIA report (Appendix G) respectively. Please note that photography of some sites was not possible in compliance with the RFI policy.

Photographs of individual sites

Figure 13-1: LSA grave (BGG-001)

Figure 13-2: Lithic found within the vicinity of BGG-001

Figure 13-3: LSA grave (BGG-002)

Figure 13-4: Lithics found within the vicinity of BGG-002

Figure 13-5: Lithics found within the vicinity of BGG-002

Figure 13-6: Material culture identified at HST-001 near BHS-7. Includes class, European ceramics, expended ammunition and metal pieces.

Figure 13-7: Material culture identified at HST-001. Includes class, European ceramics and metal pieces.

Figure 13-8: Glass fragment embedded in soil at HST-001 (reads –WERIES")

Figure 13-9: Button found at HST-001

Figure 13-10: Boulder with scratched hairline engraving at RA-008

Figure 13-11: Close-up to show engraved lines at RA-008

Figure 13-12: Black and white finger-painted images in a shelter (RA-009) near BHS-7 and HST-001

Figure 13-13: Close-up of a red and black figure at RA-009

Figure 13-14: Material culture found at RA-009. Includes glass, OES, lithics and European ceramic

Figure 13-15: Red and white finger-painted images at RA-010

Figure 13-16: Stone tools identified at SA-014

Figure 13-17: Lower grindstone identified at site SA-014

Figure 13-18: Lower grindstone identified at site SA-014

Figure 13-19: Lithics identified at site SA-015

Figure 13-20: OES and LSA lithics identified at SA-015

Figure 13-21: Lithics identified at SA-016

Figure 13-22: OES beads broken during the manufacturing process. Identified at site SA-016

Figure 13-23: Lithics identified at SA-017

Figure 13-24: Stone tool identified at SA-018

Appendix E: PIA Report

Appendix F: Built Environment Report

Appendix G: VIA Report