

## **MANAGEMENT, MONITORING AND EVALUATION OF THE CRADLE OF HUMANKIND FOSSIL SITES**



**UPDATED FOSSIL SITE MANAGEMENT PLAN  
FOR**

**MOTSETSE**

**2009 - 2013**



**DRAFT**  
**UPDATED SITE MANAGEMENT PLAN FOR MOTSETSE**  
**2009 - 2013**

**Contents**

|       |  |    |
|-------|--|----|
| 1     | INTRODUCTION .....   | 4  |
| 1.1   | Objectives .....   | 4  |
| 1.2   | Method .....   | 8  |
| 1.3   | Administrative information and legal status .....                                | 8  |
| 1.4   | Existing site management .....   | 8  |
| 2     | SITE DESCRIPTION: PHYSICAL FEATURES, VALUES AND SIGNIFICANCE .....               | 10 |
| 2.1   | General site description.....  | 10 |
| 2.2   | Site values .....  | 11 |
| 2.2.1 | Landscape: Geological and geomorphological values.....                           | 11 |
| 2.2.2 | Palaeontological and archaeological values.....                                  | 12 |
| 2.2.3 | Mining and historical values.....  | 12 |
| 2.2.4 | Research values.....   | 12 |
| 2.2.5 | Biodiversity and ecological values .....   | 12 |
| 2.2.6 | Educational, tourism and economic values .....                                   | 13 |
| 2.3   | Original statement of site significance (J Deacon 2002, to be updated 2009)..... | 14 |
| 3     | SITE ANALYSIS: STATUS QUO, RISKS AND THREATS, JULY 2008 .....                    | 15 |
| 3.1   | Physical Environment: Surface .....  | 15 |
| 3.1.1 | Access (legal and physical) .....  | 15 |
| 3.1.2 | Rangeland .....  | 15 |
| 3.1.3 | Erosion .....  | 16 |
| 3.1.4 | Fire management .....  | 16 |
| 3.1.5 | Red Data Species, rare plants and animals .....                                  | 16 |
| 3.1.6 | Alien vegetation.....  | 17 |
| 3.1.7 | Visual aesthetics, site context.....   | 18 |
| 3.2   | Physical Environment: Subterranean.....  | 18 |
| 3.3   | Infrastructure.....  | 18 |
| 3.3.1 | Access roads, culverts, bridges, etc .....                                       | 18 |
| 3.3.2 | Fencing and gates.....   | 18 |
| 3.3.3 | Parking .....  | 19 |
| 3.3.4 | Built environment.....   | 19 |

|       |  |    |
|-------|--|----|
| 3.3.5 | Waste Management .....                                 | 20 |
| 3.3.6 | Energy .....   | 20 |
| 3.3.7 | Water .....  | 20 |
| 3.3.8 | Telecommunications .....                               | 20 |
| 3.4   | Research Environment.....                              | 20 |
| 3.4.1 | Previous and ongoing research and excavations.....     | 21 |
| 3.4.2 | Excavation edges .....                                 | 21 |
| 3.4.3 | Excavation walls.....                                  | 21 |
| 3.4.4 | Access to excavations: steps, ladders, lifts etc. .... | 22 |
| 3.4.5 | Erosion .....  | 22 |
| 3.4.6 | Compliance with conditions of excavation permit.....   | 22 |
| 3.4.7 | Witness sections: .....                                | 23 |
| 3.4.8 | Dumps .....  | 23 |
| 3.4.9 | Repository .....                                       | 24 |
| 3.5   | Site safety and security .....                         | 24 |
| 3.5.1 | Physical safety .....                                  | 25 |
| 3.5.2 | Safety of surface and built environment .....          | 25 |
| 3.5.3 | Safety of excavation area .....                        | 25 |
| 3.5.4 | Subterranean safety.....                               | 25 |
| 3.6   | Presentation of site values .....                      | 26 |
| 3.6.1 | Site interpretation .....                              | 26 |
| 3.6.2 | Visitor numbers .....                                  | 26 |
| 4     | MANAGEMENT OBJECTIVES, DESIRED OUTCOMES.....           | 26 |
| 4.1   | Physical environment, surface .....                    | 26 |
| 4.2   | Physical environment, subterranean.....                | 27 |
| 4.3   | Infrastructure, built environment.....                 | 27 |
| 4.4   | Research environment .....                             | 27 |
| 4.5   | Site safety and security .....                         | 28 |
| 4.6   | Presentation of site values .....                      | 28 |
| 5     | MANAGEMENT AND MONITORING TASKS.....                   | 28 |
| 6     | BIBLIOGRAPHY .....                                     | 49 |

## SUMMARY OF KEY ISSUES

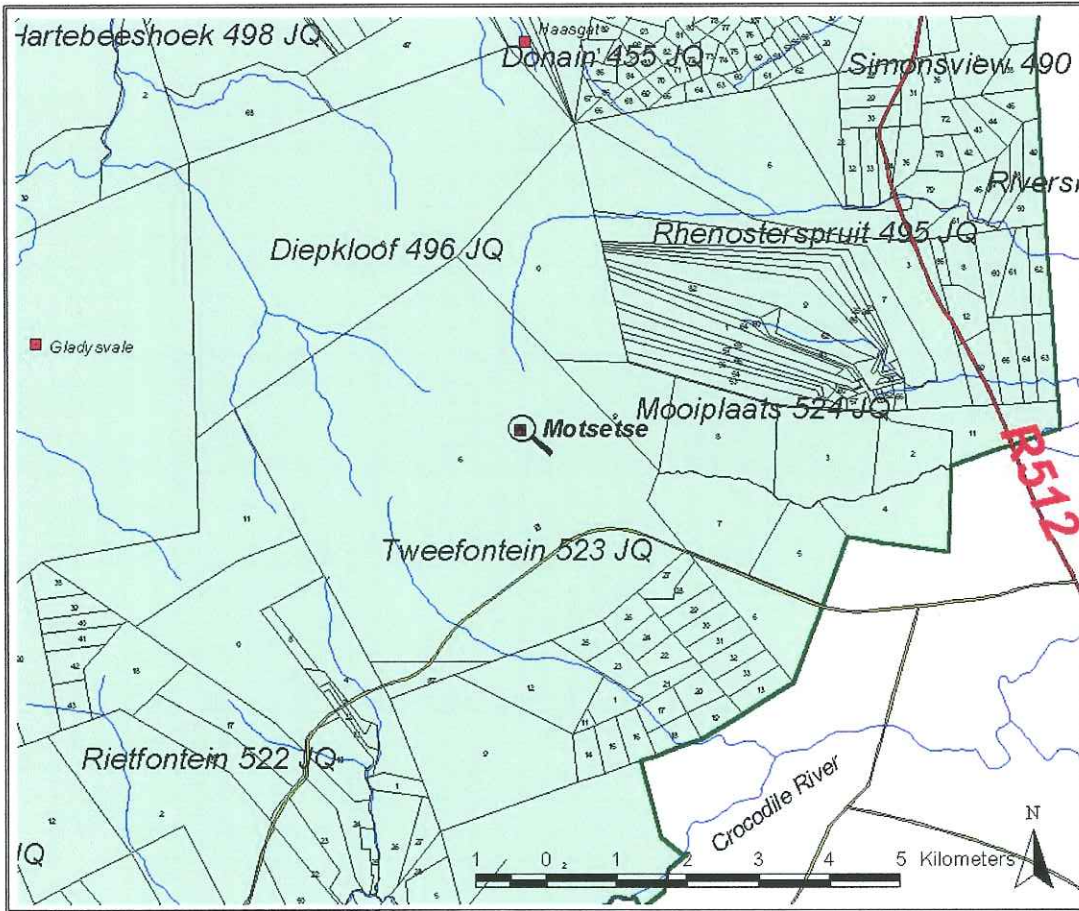
- The re-positioning and mounting of the commemorative plaque needs to be re-negotiated. The plaque is loose and has deteriorated noticeably since it was originally laid (Fig 6).
- Sanitation is a prerequisite for site usage
- The last part of the access road to the fossil site is rough and parking and turnaround is difficult. Vehicles damage vegetation by making different turning circles on different occasions. Frequent vehicular use will damage the existing road.
- The use of the road and other issues need to be addressed, when excavations re-open, by means of a new landowner-researcher agreement. The management issues to be included in such a document have been listed in the generic management plan.
- The fossil site functions as a land-owner operated tourist and educational facility. A record of tourist numbers is required for administrative purposes. The fossil site is not a destination *per se* but a point of interest in a more comprehensive tourist package
- The owner opens the site to visitors under his own terms and provides the necessary site interpretation
- The site provides several other educational and recreational facilities such as game drives and a restaurant
- The owner would welcome scientific exploration of the site

## 1 INTRODUCTION

The fossiliferous nature of the site was first discovered by Prof Lee Berger in late 1999, one of many sites on which he has focused attention. The site has been excavated intermittently since then, and has produced fossils of primates and extinct sabre-toothed cats.

### 1.1 Objectives

- To preserve the full range of natural and cultural heritage values, the site significance and authenticity of the Motsetse fossil site
- To identify and understand the issues that threaten site significance and to provide management measures and monitoring to address them
- To balance opportunities for research, education and tourism without compromising the integrity of the site or the aspirations of the landowner
- To recommend appropriate infrastructure and management strategies to achieve the above goals
- To preserve as much as possible of site context and sense of place in an area that is subject to unprecedented development. Motsetse is excellently situated to demonstrate the Highveld rocky grassland 'Bankenveld' habitat and biological interactions characteristic of this biome
- To foster and maintain communication links between management bodies, landowners and researchers as partners in management and conservation of the fossil site.

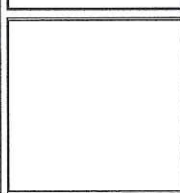


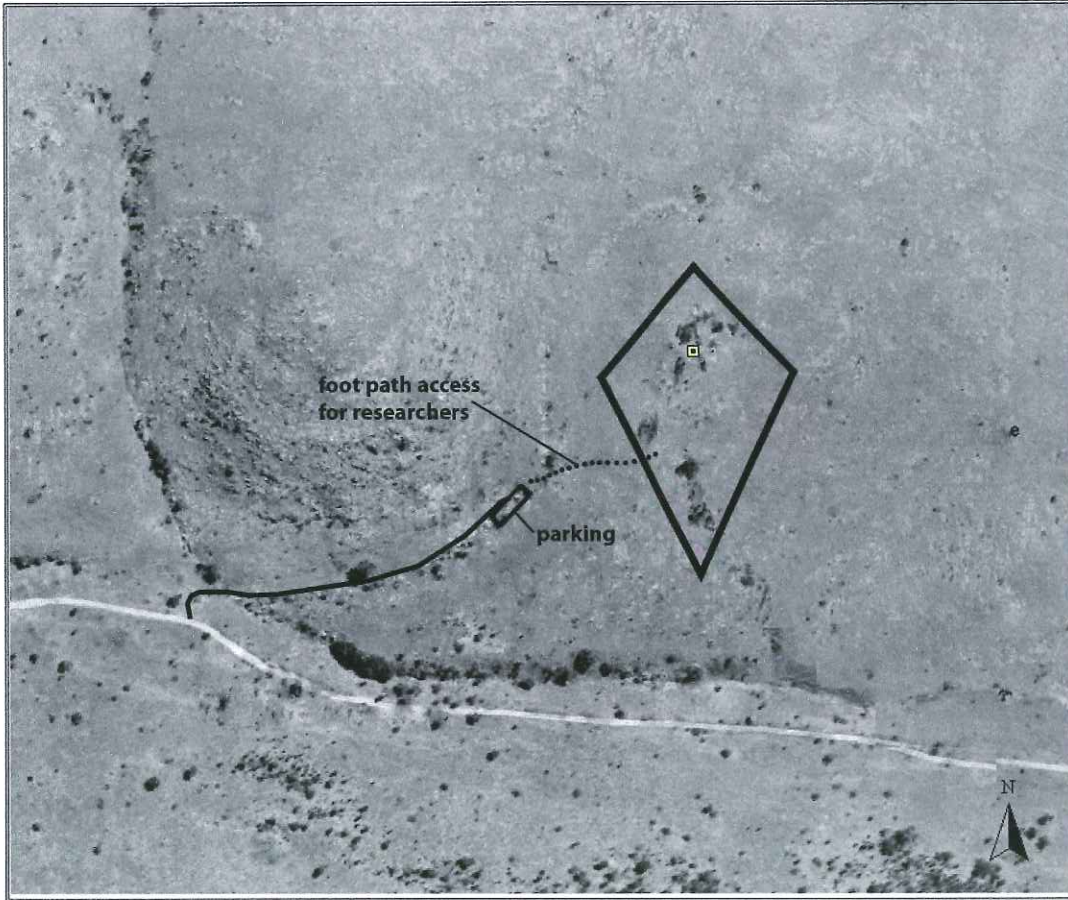
**MOTSETSE SITE  
MANAGEMENT  
PLAN**

- Legend**
- Fossil sites
  - Arterial Road
  - National Road
  - Secondary Road
  - Farm boundaries
  - River
  - World Heritage Site

**MOTSETSE**



Figure 1  
Locality map





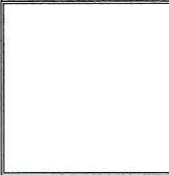
**MOTSETSE SITE  
MANAGEMENT  
PLAN**

**Legend**

-  approximate position of site boundary
-  palaeontological site

**MOTSETSE**

Figure 2  
Aerial view  
of site



PROCLAMATION DIAGRAM

REGISTRATION COPY

| SIDES<br>metres | ANGLES OF<br>DIRECTION | CO-ORDINATES |               |               |            |
|-----------------|------------------------|--------------|---------------|---------------|------------|
|                 |                        | Y            | System: WG 27 | X             |            |
|                 |                        | Constants    | +0,00         | +2 800 000,00 |            |
| A B             | 78,24                  | 317.38.30    | A             | -83 458,96    | +66 929,78 |
| B C             | 121,64                 | 23.42.00     | B             | -83 511,67    | +66 987,60 |
| C D             | 122,07                 | 153.45.40    | C             | -83 462,78    | +67 098,98 |
| D A             | 77,98                  | 220.01.40    | D             | -83 408,81    | +66 989,49 |

SG No.  
2301/2004

Approved



J.S. WEYERS  
for

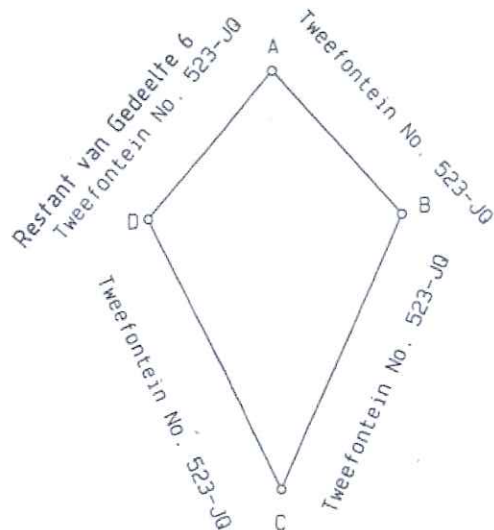
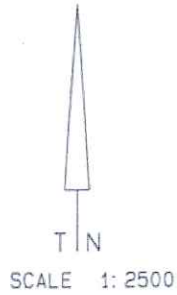
SURVEYOR-  
GENERAL

2004-04-16

| TRIGONOMETRICAL BEACONS |     |   |            |            |
|-------------------------|-----|---|------------|------------|
| BRIT 83                 | 123 | Δ | -86 245,57 | +55 867,43 |
| BRIT 87                 | 299 | Δ | -80 098,13 | +68 249,49 |

BEACON DESCRIPTIONS  
A, B, C, D .. 20mm iron peg

MOTSETSE PALAEOANTHROPOLOGICAL SITE



**Figure 3**  
Proclamation  
diagram

The figure A B C D A represents 8706 square metres of land being a declared area over the Remainder of Portion 6 of the farm TWEEFONTEIN No. 523-JQ Province of Gauteng

Framed for National Heritage Site declaration purposes in terms of the National Heritage Resources Act No. 25 of 1999



Surveyed in January 2004

by me P.H. KOHRS  
Professional Land Surveyor PLS0314

|   |  |                   |
|---|--|-------------------|
| This diagram is annexed to<br>No.<br>d.d.<br>i.f.o.<br>Registrar of | The original diagram is<br>No. 459/1891<br>Transfer<br>Grant<br>C.C.T. | File -/4          |
|   |  | S.R. No. 922/2004 |
|   |  | T.P.              |
|   |  | Comp. JQSZ - 11   |

## 1.2 Method

- Consultation with landowners, researchers, repository institutions and support institutions to reveal concerns, contentious issues, requirements and future plans
- Research and understand the full range of natural, cultural, scientific, educational and ecological values of the site. Collation of information gained from a series of fossil site inspections has been incorporated.
- Provide an updated list of site values
- Refresh statement of site significance, in consultation with scientists
- Provide an illustrated status quo report against which change can be assessed
- Update the list of risks and threats
- Identify desired states and management strategies
- Provide a new management table with management strategies backed, where possible, by operational guidelines for use in the field
- Monitor and evaluate progress at each fossil site inspection, review management strategies where necessary

## 1.3 Administrative information and legal status

|                             |   |
|-----------------------------|---|
| <b>Site:</b>                | Motsetse  |
| <b>Farm Name &amp; No.:</b> | Portion 6 of Tweefontein 523 JQ (Figs 1,2)  |
| <b>Owner:</b>               | Prospero Bailey   |
| <b>Contact details:</b>     | P O Box 792 Lanseria, 1728<br>011 957 0242<br>082 451 5692<br>011 659 1470 (Fax)<br>e-mail prospero@thecradle.co.za |
| <b>Contact person:</b>      | Manager or Mr. Prospero Bailey  |
| <b>Legal Status:</b>        | National Heritage Site, November 2004;<br>World Heritage Site 1999  |
| <b>NHS Boundary</b>         | A diamond shape, ABCD marked with 20mm iron pegs and measuring 8706 square metres                                   |
| <b>Co-ordinates:</b>        | 25 53 44,0 S, 27 46 21.1 E , see proclamation diagram.(Fig 3)   |
| <b>Area:</b>                | 8705 sq metres  |
| <b>Permit holder:</b>       | Lee Berger was the last permit holder- site no longer active  |
| <b>Repository:</b>          | Bernard Price Institute, University of the Witwatersrand  |
| <b>Access to Public:</b>    | Not open , special appointment and guests only  |

## 1.4 Existing site management

Access to the site is controlled and is by appointment only. There is a locked gate with a boom and a full time guard at the Sterkfontein-Lanseria tar road (the D 540) and the site, and all visitors are required to arrange for access. The landowner-scientist agreement, which will become necessary when excavations resume, normally stipulates types of vehicle, times of permitted entry and exit, numbers of visitors, and prior knowledge of visits (see text box below).

The landowner's preference is for as natural an appearance as possible and he is opposed to a perimeter fence (i.e., a fence erected on the gazetted heritage boundary around the site), which in his opinion, would detract from the natural landscape. The site is secure from unauthorized visitors because it is remote, and because the property manager or the landowner always accompanies



private visitors. All other persons visit by appointment only and in the past were accompanied by the permitted scientist. Further surveillance is provided by the excavation team when excavations are in progress. The site is not at risk from unauthorized visitors.

Many management functions are provided by the landowner and his reserve manager, such as rangeland and erosion management, upkeep of access roads, control of alien vegetation and weeds, game management and fire management (although the Motsetse fossil site has been subject to several devastating fires).

Motsetse is notably less infested with alien invasive species and weeds than many of the other fossil sites, although there are a few problem areas.

Visual impact is not an issue at the Motsetse site because the contextual environment is not subject to development pressure and is all owned by the same landowner. ESKOM power lines, often very conspicuous in the COH WHS, are not an issue at the Motsetse site itself.

Additional existing site management includes:

- Visitors are confined to a non-sensitive route through the site, and are under constant supervision of the landowner or his deputy, a professional tourist guide and/or the former permitted scientist (Prof..L Berger)
- The site is not open to the general public. Visits are by appointment only and most people are unaware of the whereabouts of the Motsetse site.
- There is a well designed parking area at the main entrance to the property where all visitors park their vehicles and use one "game ranger" vehicle provided by the landowner. This minimizes the impact of many vehicles to the fossil site. The parking where visitors leave their cars requires carefully selected shade tree planting.
- A SAHRA Permit Committee member inspects the excavation site and ongoing excavations on a twice-annual basis, particularly with a view to assessing compliance with terms and conditions of the permit
- The site inspection team, including COH WHS MA, SAHRA and GDACE officials, plus a contracted specialist service provider, inspects the entire site on a twice-annual basis, monitoring the management criteria noted in the generic site management plan (see Table 1, generic management plan) and particularly Table 1 of this document.
- The COH WHS MA monitors development within the surrounding COH WHS properties with a view to protecting heritage values such as sense of place and visual aesthetics..
- A site safety inspection has been provided for. This is meant to take place on an annual basis and an inspection is planned. The subterranean part of the cave is not at present being explored or excavated.
- GDACE is available for advice to landowners regarding erosion control, fire management, alien vegetation and weed clearance, and preservation of biodiversity
- The landowner burns firebreaks from time to time, but uncontrolled fires sometimes occur and these have the potential to cause extensive and expensive damage. Huts and storage facilities are at risk. The site is on the flank of a natural fire corridor.
- The Heritage Agreement and appended MOU between landowners and permitted scientists addresses issues of mutual management concern and is an important management tool.

The management issues which are normally addressed in the Landowner-Scientist memorandum of understanding have been documented in the generic management plan.

## 2 SITE DESCRIPTION: PHYSICAL FEATURES, VALUES AND SIGNIFICANCE

The fossil site management plan adopts a values-based approach and seeks to ensure that the many and various values of the site are conserved. Site values extend beyond those formally recognized as being of 'universal value' and this section seeks to provide an updated list of old, new and previously unrecorded or unrecognized values (2.2). Section 2.3 provides an updated statement of site significance which was prepared in consultation with permitted scientists working on site.

### 2.1 General site description

The Motsetse Fossil site is situated on a large privately owned property (Figs 1, 2, 3) which is stocked with indigenous game, and which forms part of a more elaborate commercial enterprise including the well-known "Cradle" restaurant and game viewing drives. The name 'Motsetse' is derived from the Sestwana word for the cabbage tree or 'kiepersol', (*Cussonia paniculata*), the latter vernacular name itself an interesting corruption of the Portuguese name for the tree, 'quita-sol' or 'exclude the sun' (Mogg 1975).

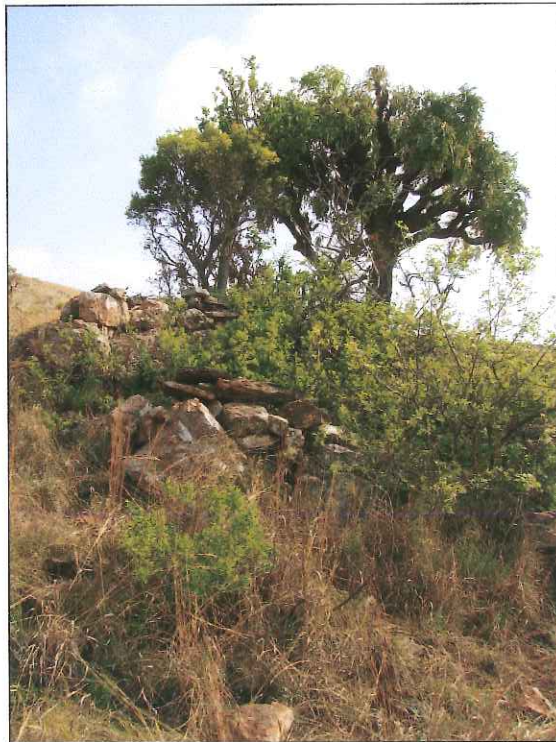
The site itself is an elongated fissure, adjacent to which are the weathering remains of the fill of a once extensive ancient cavern system, now exposed at surface where weathering has removed the original roof. The slot-like fissure forms an entrance to a partially choked younger subterranean system. In front of the entrance are growing some tall indigenous trees (Fig. 4).



Fig 4: View over the Motsetse fossil site, showing copse of well-grown trees at sinkhole entrance behind figures

It is the second smallest of all the sites in the COH WHS, measuring only 8706 square metres. Only Minnaar's site is smaller.

The site provides excellent views across the Johannesburg metropole and its strategic and commanding position did not go un-noticed during the South African War as attested by the presence of a redoubt or 'schans' facing down the approach to the valley (Fig 5).



*Fig 5: the Motsetse "schans" which dates to the Soth African War and which is a crudely constructed dry stone wall about a metre and a half at its highest*

The site occupies the lower footslope of a rocky dolomite hillside a short distance above a well-marked drainage line separating the site from the much-used access road to the south (Fig. 2). Its exposed position makes the concealment of research-related infrastructure difficult, although the storage hut that remains does not unduly obtrude.

## **2.2 Site values**

Certain values, particularly the World Heritage Values are well documented but others have not been sufficiently recognized until now. Six sets of values have been identified: landscape values, palaeontological and archaeological values, mining and historical values, research values, biodiversity and ecological values and finally, educational and tourism values. The relative importance of these values differ – there are several that have allowed for World Heritage Status and National Heritage Site status while others are of a more regional or local value.

### **2.2.1 Landscape: Geological and geomorphological values**

- The site demonstrates aspects of the formation, processes of sedimentation, calcification and weathering of dolomitic caves.
- The site can also be used to illustrate taphonomic processes such as bone accumulation in the cave catchment and subsequent removal to deeper recesses by a variety of taphonomic processes. The partial skeleton of a large mammal which had fallen into the fissure-like entrance after browsing on trees growing from the mouth of the cave is a case in point. Porcupines as bone accumulators can also be demonstrated

- The site shows a substantial volume of residual fossiliferous breccia which is weathering, and in which fossil bone can be seen
- The geology of the host rock - dolomites and cherts of the Transvaal Supergroup – can be shown, particularly with reference to the wider views across the Witwatersrand to the east-south-east
- Travelling across the site has a great deal of aesthetic value as a 'wilderness' type experience in an increasingly built-up surrounding area.

### 2.2.2 Palaeontological and archaeological values

- Excavations have not proceeded on a sufficiently sustained basis to fully assess the scientific value of the site Extinct fossil sabre-toothed cats and baboons have been recovered so far, which indicate that the deposits may be of the correct age range for finding fossil hominins as well. No hominin material has been discovered to date.
- Many sites need the attention of scientists and funding and expertise limit the amount of exploration and excavation that can be undertaken. Interest in Motsetse is sustained, however, and excavations are likely to resume at some future date.

### 2.2.3 Mining and historical values

- Relics left by lime-workers are few, but include the ruinous remains of a kiln and an overgrown wagon track that is almost obliterated

### 2.2.4 Research values

- The scientific potential of the site has not yet been fully developed and much remains to be done.
- Fossils discovered to date would seem to indicate that there is as much potential at Motsetse as at any of the other sites
- The surrounding landscape and contextual setting of the site preserves several biological interactions such as owl roosts, porcupines, baboons and indigenous wild mammals which offer the possibility of doing actualistic studies especially on topics such as bone accumulations and bone tool experiments.

### 2.2.5 Biodiversity and ecological values

The Highveld grassland biome of the Gauteng Province is everywhere subject to pressure from rampant development. This gives the large area of open space of the Motsetse Private Nature Reserve an enhanced value as an open area, particularly one which has the added asset of a large variety of resident indigenous animals, several intact biological processes as well as a rich fossil site. The site is already set up for receiving visitors and educational groups.

The grassland and rocky hills around Motsetse are likely to contain at least 500 plant species. There are adjacent vleis, wetland, stream and spring areas to push species numbers up, as well as enough altitudinal variation to see zonation of vegetation (for example, with *Protea* occupying mainly the cooler windy south-facing slopes) as well as the effects of aspect and wind exposure. It is recommended that a plant and animal species list be drawn up for the reserve because at the time of writing no such lists were available. In any case, lists are necessary as a frame of reference to interpret palaeoenvironmental evidence coming out of the fossil site.

The rocky grassland is likely to harbor many significant edible, medicinal, poisonous and otherwise economically important species, the tuberous *Brachystelma barberae*, usually found well-concealed

on rocky grassland hillsides, the medicinal and poisonous *Boophane disticha* and *Eucomis autumnalis*, as well as *Haemanthus* spp. and *Scadoxus puniceus*, both used medicinally.

Within the reserve (including the excavation area), the positions of sinkholes and vegetation-choked avens is marked by typical dense copses of vegetation, notably *Celtis africana* trees, as well as *Olea* and *Cussonia* and particularly, *Acacia caffra*. *Pittosporum viridifolium* is often found growing from sinkholes.

There are resident black eagles, baboons and rock hyraxes as well as porcupines, owls and possibly even the occasional leopards and brown hyaena. Many of these species are taphonomically significant and there exists the possibility of doing actualistic studies on key taphonomic species, as mentioned above

The underground caverns may have active biological processes still intact. Here may be bat colonies. Porcupines use the caves from time to time as evidenced by their droppings and shed quills, as well as the occasional gnawed bone. Porcupines are important taphonomic agents and it is an additional bonus that this element of site interpretation can be authentically demonstrated on site.

The biodiversity values of this site are as yet inadequately understood and recorded and it is recommended that faunal and plant species lists be drawn up in order that these values can be better protected and interpreted.

Summary:

- Resident porcupines
- Resident owls
- Free-ranging large mammals on property including several taphonomically significant species
- Many species of edible, medicinal and economically significant plants
- Open grassland with Highveld trees, rich local flora
- Possibility of bat colonies

### **2.2.6 Educational, tourism and economic values**

- Educational and tourism values of the site remain good, because the site can be packaged into an attractive tourist experience. The somewhat obscure value and interest of the fossil site itself can be balanced by a bouquet of other experiences such as game viewing, bird and tree-spotting and the pleasures of a nearby boutique restaurant.
- There are many site assets which can be incorporated into educational experiences, as noted above

The unspoilt nature of the surrounding landscape presents a number of special opportunities. Many different landforms are present and fine views are to be had from the higher lying parts. The presence of resident game provides an added dimension and the property preserves excellent example of Bankenveld and highveld grassland as well as riverine thicket and woodland. A previous survey indicated that a surprising number of edible and medicinal species of plant are present (J Maguire, private notes).

The combination of factors present at Motsetse provides an excellent suite of opportunities for tourism and educationally oriented experiences. The vegetation, landforms present, the resident game and the presence of a dig all combine to enable a diverse tourism product to be put before visitors.

However the fossil site has no obvious heritage content and requires world class site interpretation by a professionally trained guide.

Current land use is a combination of hospitality industry, palaeo-tourism and game-viewing. The fossil site is already part of the tourist route.

In this regard, SAHRA has recently published minimum standards for landowners who wish to open archaeological and palaeontological sites to the general public. It is recommended that SAHRA ensure that the terms laid down are being met.

### **2.3 Original statement of site significance (J Deacon 2002, to be updated 2009)**

(The last permit holder has promised to update statement)

"The fossil site known as Motsetse is a potentially important component of the Cradle of Humankind. The first excavations undertaken there in 2000 found well preserved fossils of primates and false sabre-toothed cats which place it in the same time range as some of the hominin sites.

It was recommended by ICOMOS in 1999 that the fossil sites in the Cradle of Humankind be declared a World Heritage Site because they "contain an exceptionally large and scientifically significant group of sites which throw light on the earliest ancestors of humankind. They constitute a vast reserve of scientific information, the potential of which is enormous."

In terms of the criteria set out in Section 3(3) of the National Heritage Resources Act (Act No. 25 of 1999), and specified for Grade I national heritage resources in the draft SAHRA Regulations on Grading System and Heritage Resources Assessment Criteria, Motsetse qualifies for national heritage status because of its:

- (a) **Importance in the pattern of South Africa's history.** Motsetse has the potential to contribute to the significance of fossils found in the Cradle of Humankind.
- (b) **Possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.** Extinct false sabre-toothed cats and primates have been found amongst the fossils at Motsetse.
- (c) **Potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.** The finds made so far indicate that the deposits are of similar age to others with hominins in the Cradle of Humankind.
- (d) **Importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects.** Some of the fossils found at Motsetse were articulated suggesting that they are particularly well preserved.
- (e) **Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group.** The aesthetic qualities of Motsetse are related to its setting in a nature reserve.
- (f) **Importance in demonstrating a high degree of creative or technical achievement at a particular period.** No stone or bone tools have been found at Motsetse.
- (g) **Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons.** Motsetse is important to all South Africans who are interested in the history of our species and the way in which fossil deposits are formed.
- (h) **Strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.** No special association has yet been established.
- (i) **Significance relating to the history of slavery in South Africa.** The age of the deposits at Motsetse places it well before the time period of slavery in South Africa." (J Deacon 2002)

### **3 SITE ANALYSIS: STATUS QUO, RISKS AND THREATS, JULY 2008**

In order to provide a basis against which change can be assessed, a status quo report is necessary. Ideally, change is assessed by means of comparison of 'fixed point photography' and such fixed points are in the process of being selected and installed. For scientific excavations, the datum point has been used where possible.

In order to assess the management strategies that may be necessary in order to preserve site values, threats and risks to site values have been analysed as part of the status quo, and the next section (Section 4) describes desired states and management outcomes.

#### **3.1 Physical Environment: Surface**

This section addresses the status quo of seven elements of the physical environment, namely physical and legal access to the property, rangeland or veld condition, erosion, fire management, rare plants and animals, alien invasive species and visual aesthetics.

##### **3.1.1 Access (legal and physical)**

Status quo:

- Access is by appointment only, with the landowner or his manager
- Access is strictly controlled at a security gate which is manned
- The host property of the fossil site is securely fenced – the Motsetse private nature reserve
- The fossil site itself has no fence and the landowner is opposed to one. There is no need for a site perimeter fence at present.
- The fossil site is remote and relatively inaccessible except by 4X4.

Threats and risks:

- None at present

##### **3.1.2 Rangeland**

The condition of the rangeland is important because it forms the context of the fossil site.

There is a full-time dedicated reserve manager and rangeland management is under his supervision. It will not form part of this reporting exercise. Monitoring of rangeland by means of fixed point photography does not appear to be necessary for this site

Other aspects regarding rangeland is the compilation of a list of plants and animals still occurring at Motsetse. For plant species, it should be noted which species are edible, which medicinal or magical, and which are of economic importance.

Such lists are in any case basic data important to recording the status quo, and the information is necessary as a framework against which palaeo-ecological information derived from the fossil site excavations can be assessed. Pressures regarding traditional plant medicines and their collection are likely to increase because of increased settlement and concomitant indigenous plant utilization.

Several instances of wild plant collection have been observed recently, and bundles of collected material photographed. Target edible and medicinal species should be mapped and monitored and checks should be made to assess impact of collection, if any.

Status quo:

- Rangeland in good condition, managed as part of main property
- No plant species list available
- No faunal lists available
- Edible, medicinal and economically significant species need to be recorded and monitored, if they occur within the small fossil site area

Risks and Threats:

- Biological values of the site poorly or at best incompletely understood
- No means of assessing impacts of fire and indigenous plant utilization at present

### **3.1.3 Erosion**

Status quo:

- Erosion, which is evident in some places but not as yet problematic, is well managed by the reserve manager and need not be dealt with here. Erosion in and around the excavation area is discussed separately below, as it is a separate issue.

Risks and Threats:

- Any development including footpath development poses a risk of erosion unless steps are taken to prevent this
- The breccia dump is unstable and has been constructed adjacent to a drainage line, and is cascading downslope into it.
- Natural erosion is causing the exposed faces within the excavation to erode, notably the residual pillars of decalcifying fossiliferous material, portions of which have collapsed.

### **3.1.4 Fire management**

Status quo:

- The reserve manager has implemented a fire control regime.
- There is no active excavation as yet. Permitted scientists are required to address the issue of the control of fires from the excavation precinct in the memorandum with the landowner. The site is in a wind and fire corridor and very hot and destructive fires are known to have occurred.
- It is recommended that fire beaters be kept on hand to put out accidental fires and it is also advisable to burn a fire break around the excavation site should the landowner be amenable to this, at such time when excavations resume. GDACE is available to give advice.

Risks and Threats:

- No framework for assessing the impact of fire as yet exists. This is a generic issue relevant to the whole of the COH WHS.
- Uncontrolled fires entering the property from outside continue to pose a threat to property and rangeland.

### **3.1.5 Red Data Species, rare plants and animals**

Status quo:

- See rangeland management.



- Many rare species of plant and animal are not on the Red Data list.
- There are no plant or animal checklists and little can be said concerning rare and endangered plants and animals

**Risks and threats:**

- There is no up-to-date list or mapping of vegetation. Over 500 species are known to occur in the Sterkfontein area (Mogg 1975) in this type of Highveld grassland. Rare and endangered species cannot be protected if not located and mapped.
- Edible, medicinal and toxic plant species not recorded – full values of site not clearly understood

### **3.1.6 Alien vegetation**

**Status quo:**

- The small fossil site has the usual weeds and invasive species, but being small (a little over 8700 square m), clearance of weeds aliens from the site will not be problematic. Most of the weeds are growing in the disturbed ground of the fossil dump site and around the excavation area.
- The sinkhole is surprisingly free of invasive aliens compared to the choked and inaccessible situation found at some other sites.
- There is as yet no species list of alien species at Motsetse and it is recommended that such a list should be compiled.
- Infestations have not yet been mapped and prioritized and this needs to be done, species by species, in order that systematic clearing and follow-up clearance can be done.
- GDACE has field operational guidelines for alien plants; these are noted in the generic site management plan Appendix. A guideline on the use of herbicides is also being prepared.
- There are usually few weeds in the excavation area and elsewhere on site. However, after the good rainy season of 2007-2008, substantial infestations were noted and control has become necessary.

**Summary:**

- There is no list of alien invasive species occurring on the Motsetse site
- Infestations by different species have not yet been mapped
- Infestations have not been prioritized for clearance
- Field operational guidelines for appropriate eradication treatments for each species are not yet available
- There is no broader plan for alien vegetation control covering the COH WHS as a whole so that re-infestation is likely (by baboons and other widely-ranging mammalian seed dispersal agents)
- Photographic monitoring for clearance programme and its efficacy needs to be set up.
- Weeds in and around the excavation site and work area are usually effectively controlled by the researchers and their field staff when excavations are in progress
- The reserve manager is obviously aware of the weed problem and controls are implemented where necessary

**Risks and threats**

- Invasive plant species will continue to remain on site for some time

### **3.1.7 Visual aesthetics, site context**

The site lies within two ridgelines; one on the north east axis, the other on the west with a north south orientation. This amphitheatre landform provides extensive views in an arc from the south-west to the south east. These views are virtually uncluttered by structures, although the Cradle Restaurant can be seen on the elevated landform to the south-east. Any structure within the minor ridgelines should not be permitted. However, if necessity dictates, these would need to be placed sensitively within the landscape.

Status quo:

- Motsetse has an unblemished visual field and threats to visual aesthetics do not as yet exist. The area within the viewshed belongs to the same landowner and there is general awareness of the pristine quality and value of the view.

Risks and threats:

- None at present

## **3.2 Physical Environment: Subterranean**

Status quo:

- The subterranean environment is not yet an issue at Motsetse. It is neither being explored or excavated at present.

Risks and threats:

- None at present

## **3.3 Infrastructure**

### **3.3.1 Access roads, culverts, bridges, etc.**

Status quo:

- The access road to the site is a relatively well-developed farm track which the landowner uses as part of the game viewing circuit. The only problematic portion is the short extension which would primarily be utilized if the landowner wanted to show his guests the fossil site, or if there were an excavation in progress, by the researchers. The branch road is rocky and crosses a drainage line, terminating indecisively close to the site. There is no defined car park and as the road is a cul-de-sac, drivers have to turn their vehicles around. This has been done at many points and vegetation is suffering as a consequence. Vehicles need to reach the site to offload goods and to pick up fossiliferous blocks. It is recommended that the terms and conditions of use of this stretch of road would be addressed in the updated researcher-landowner agreement when excavations are resumed.

Risks and threats:

- Landowner has requested that vehicles do not proceed beyond the site plaque area
- Unnecessary destruction of vegetation and scarring of landscape at places where vehicles turn

### **3.3.2 Fencing and gates**

Status quo:

- The host property is adequately fenced and gated

- The fossil site is not fenced
- The landowner is not in favour of a perimeter fence around the fossil site

Risks and threats:

- None at present

### **3.3.3 Parking**

Status quo:

- There is no defined parking area at the fossil site itself. Visitors are taken in and out by a game ranger, but scientists, their excavation teams and scientific visitors would all use self-drive vehicles. A parking area (as well as an alternative) were indicated on the site analysis in the original management plan (Fig 2). There is as yet no defined parking area for the fossil site – vehicles park at different points along the branch road to the fossil site

Risks and threats:

- See 3.3.1 above

### **3.3.4 Built environment**

Status quo:

#### ***Sheds and storage***

- There is a small storage shed for excavation equipment, sites close to a large tree

#### ***Accommodation***

- None

#### ***Pathways, walkways and viewing platforms***

- Apart from the excavators' pathways around the site, there are no formally laid out pathways.
- The wooden log which is used to cross from one side of the entrance fissure to the other is becoming rotten and should be removed as it is dangerous
- The wooden ladder providing access to the bottom of the trench should also be removed because it is deteriorating

#### ***Tourist-related, including signage***

- The site plaque indicating the national and World heritage Status of the site has been put in place.
- Its siting and manner of mounting are unsatisfactory as the sign is loose and is deteriorating in the harsh direct sunlight
- There is no tourist-related signage

#### ***Ablutions and sewage***

- There is no toilet on site at present. In the past, a portaloo was used
- There is no water on site and no ablution facilities

**Risks and threats:**

- The wooden storage hut is vulnerable to uncontrolled fires
- Its contents are vulnerable to theft
- The access pathways are too close to the excavation edge and could pose a threat of collapse, where it is friable
- Wooden infrastructure providing access to different parts of the deposit is no longer safe and should be removed (wooden bridge and ladder)
- The site plaque is at risk from further sun damage, and theft, because it is not attached
- Without a toilet, site pollution would become a problem

### **3.3.5 Waste Management**

**Status quo:**

**Sewage**

There is no provision for sanitation and scientists have to make their own arrangements when excavations are in progress

**Litter**

Researchers remove all litter. Bins are placed when excavations are in progress

**Risks and Threats:**

- None at present. See infrastructure above

### **3.3.6 Energy**

The site is not supplied with electricity

### **3.3.7 Water**

There is no water supply to the site, but at least it is possible to bring a water bowser on to site

### **3.3.8 Telecommunications**

No land line. Cell phone reception poor at the fossil site itself.

## **3.4 Research Environment**

**Status quo:**

- A permit to excavate was issued to Prof L Berger in 2000, which expired in September 2005. The final report on the site is almost due.

**Risks and Threats:**

- Lack of funding inhibits research and site potential remains locked
- Lack of dedicated heritage officer in Management Authority prevents follow-through after site inspections and management issues remain unattended – a problem generic to all the fossil sites in the COH WHS.

### **3.4.1 Previous and ongoing research and excavations**

The site was exposed by lime-miners in the early decades of the century, at which stage several tons of travertine or limestone were removed from the underground cavern.

In 1999/2000 Dr Lee Berger obtained a permit to begin the systematic removal of breccia blocks and established the scientific worth of the site. Extinct fossil false sabre-toothed cats and baboons have been recovered so far, providing tantalising evidence that the site is of the correct age to encapsulate hominin remains as well.

Excavation has proceeded on an intermittent basis.

### **3.4.2 Excavation edges**

Status quo:

- The excavation edges are friable in places on account of the high degree of decalcification of parts of the excavation edge.
- The cement 'datum point' marker is becoming undermined and care should be taken to stabilize it so that it does not collapse due to erosion of the foundation area
- The pathway providing access to different parts of the site are in places rather close to the excavation edge and should be sited at least 1 metre or more away from it.
- The pathways should be angled to face away from the excavation edge, to direct run-off away from the dig.
- In other places, the edges appear to be stable. Stability is a function of the degree of calcification of the deposit

Risks and Threats:

- Excavation edges are friable in places at Motsetse and prone to collapse in places, particularly where they surmount long vertical drops.

### **3.4.3 Excavation walls**

Status quo:

- Excavation walls are on the whole adequate although these will become dangerously high on the east side of the main working area if excavation in this area is resumed. Benching out after a 2 metre or more drop is recommended. There are site safety concerns in this area (see below)
- It is recognized that further discussion is required concerning the long-term stabilization of excavation walls when researchers abandon excavations, albeit temporarily or permanently

Risks and threats:

- High excavation walls are prone to collapse particularly if decalcified.
- Boulders projecting from excavation walls may become dislodged causing cascading of site material
- Long-term stability of excavation walls is problematic and stabilization becomes an expensive factor
- High excavation walls are a safety risk

### **3.4.4 Access to excavations: steps, ladders, lifts etc.**

Status quo:

- The wooden plank providing a bridge across the entrance fissure has deteriorated over the years that it has not been in use and it needs to be replaced or removed as it has become dangerous.
- The wooden informal ladder providing access to the base of the entrance fissure is likewise rotting and will require replacement
- The substrate on which the ladder rests is not level or stable and the foot of the ladder should be prevented from sliding out of position
- The top of the ladder should provide some means of safely stepping on to the rungs – a handhold is necessary for safety purposes.
- Benching can be used as a means of getting into excavations but care should be taken that exposed fossils are avoided, and that trampling is not causing sediment to become eroded.

Risks and Threats:

- Old and infirm infrastructure poses a safety threat

### **3.4.5 Erosion**

Status quo:

The well defined earth footpaths in the area are 'routes of desire' and lead straight up and down the hill via the shortest route to the storage shed and site, which is situated on a fairly steep slope. The soil is heavily compacted. No erosion measures have been put in place, such as drains and humps. Soil erosion could become a problem. Those paths situated on the edge of the excavation are sloped towards the site rather than away from it, which means that water is channelled into the dig.

- Apart from the items mentioned above, erosion within the confines of the fossil site is not generally problematic
- The researcher has placed his fossil dump and sieve heap rather close to the drainage line and dumped material is cascading on the drainage line side. This side of the dump should be stabilized and the dump profile flattened so that the sides do not become too steep. The generic management plan provides guidelines on dump construction
- The north-west/ south-east orientated drainage way along the south western boundary of the fossil site must not be obstructed in any way by any new land use, e.g. dumping of fossiliferous breccia, spoil dumps, parking areas or trenches. This linear feature must be regarded as a groundwater recharge area and should have no disturbance of the vegetation within it.

Risks and threats:

- Not a problem at present except in specific cases mentioned elsewhere

### **3.4.6 Compliance with conditions of excavation permit**

Status quo:

A watching brief is kept by the SAHRA representative. Most items are standard for all researchers and include:

- Recording method (a lazer theodolite or 'Total Station' was used at this site so there is no permanent grid.
- Check that the position of all excavations has been committed to plan
- Check witness section and its stability
- Check status of progress report and final reports
- Check that copies of all published papers have been lodged with SAHRA
- Check accessioning and preparation backlogs
- Check that witness sections have been committed to plan
- Check that breccia dumps have been committed to plan.

Risks and Threats:

- Excavation is inevitably a destructive process. Inappropriate excavation techniques, recording techniques, recovery techniques, preparation techniques, inadequate subsequent publication and indifferent conservation of artefacts recovered is perhaps the greatest threat to the fossil sites. This is an issue generic to all the sites in the COH WHS, hence the SAHRA twice-yearly inspections. Non-compliance is not an issue at this site.

### 3.4.7 Witness sections:

Status quo:

- It is not known whether or not a witness section has been selected for this site and the information contained in the final SAHRA report will perhaps refer to this. It could be possible that insufficient excavation has taken place to expose telling sedimentary contacts or sections worthy of permanent preservation.

Risks and Threats:

- Stratigraphic conclusions reached should be independently verifiable. If no witness sections are preserved, this would not be possible
- Dating results need to be independently verifiable. If witness sample sections are not preserved, this will not be possible
- New techniques and analytical procedures are perpetually coming to light. These need to be applied to sites from which earlier conclusions were obtained, in order to verify and expand understanding. If there are no witness sections, this cannot be accomplished.

### 3.4.8 Dumps

Status quo:

- There are several dumps on this site, not all of which are noted on plan and for which there is no provenance and content data (Fig. 6 )
- There is no possibility of storing this material, fossiliferous as it might be, elsewhere at present, and new excavations are going to add to the problem.
- The siting of new dumps is problematic because of the steeply sloping ground and a rather restricted work space.
- Sieve heaps might also need to be accommodated
- Vehicular access to the site is one-way and not drive-through. Loading breccia from the far side (eastern excavations) of the site may become problematic in future. Even turning a vehicle is difficult, let alone one which is loaded
- As new techniques such as trace element analysis become better understood, there is a strong chance that it will become possible to match the dumps to specific areas of *in situ* material and also to date them

Risks and Threats:

- Loss of information concerning the source, author and content of dumps
- Loss of or languishing information, because dumps are not processed for fossil content



Fig 6: All dumps need to be committed to plan and annotated according to source and content

### 3.4.9 Repository

Status quo:

The IHE, Bernard Price Institute for Palaeontological Research, University of the Witwatersrand. The University of the Witwatersrand IHE is the designated repository of the fossil material and artefacts recovered. This institution has been accredited by SAHRA as it has all the necessary controls in place and it conforms to the minimum standards laid down by SAHRA

Risks and threats:

- Loss of, or deterioration of artefacts
- Loss of information concerning artefacts
- Lack of publicized information about artefacts

These threats are not an issue at present.

### 3.5 Site safety and security

Site safety and security needs to be considered from a number of perspectives: Firstly, the physical stability of the valuable site fabric itself, and then from the perspective that site stability (or instability) impacts on the safety of researchers and those visiting the site. The safety of surface features, infrastructure and the special safety risks of subterranean environments all need special consideration.

Site stability is affected by two different threat sources: Firstly, by natural causes which include the ongoing weathering and decalcifying processes, and secondly from man-made influences such as the alteration of surface drainage and poor excavation techniques, or by mining activities which create unstable voids, and blasting, which shatters rock and created fractures. However, it is only by



the inherently destructive twin processes of mining and excavation that site significance was or can be realised.

Site security refers to personal safety and freedom from the depredations of criminals

### **3.5.1 Physical safety**

Status quo:

The Motsetse site is remote and access is strictly controlled. There is excellent surveillance by a dedicated reserve manager. Physical safety is not a factor as it is at the Blaauwbank valley sites.

### **3.5.2 Safety of surface and built environment**

Status quo:

- The surface of the site is rocky and uneven.
- The pathway providing access to the different parts of the dig passes very close to unprotected drops, the edges of which are unstable
- The wooden bridge and ladder are dangerous and should not be used
- There are bees and wasps nests which are hazardous to allergic persons
- There are venomous snakes and a first aid box should be on hand and an evacuation procedure understood by all who work on site.

### **3.5.3 Safety of excavation area**

The excavation is some 3-5m deep in places so sidewalls need to be appropriately supported to minimize sloughing and slumping, especially during times of increased rainfall. The brecciated sections of the sidewall are competent thanks to a reasonable degree of calcification. However, in other less stable parts of the deposit the potential exists for sidewall failure and the sidewall should be protected and stabilized. As and when excavation takes place, mechanical props should be installed sidewall to sidewall as a safety precaution (this is a recommendation of the former site safety officer).

Status quo:

- The walls are generally stable except for a few places
- Areas which are prone to collapse are obvious and should be stabilized.
- A sump has been created in which water can collect. Rain water is decalcifying the now exposed and unprotected surface of the excavation – a small piece collapsed during 2006.
- The wooden bridge and ladder should be replaced

### **3.5.4 Subterranean safety**

This is not an issue at present

Threats and risks: surface, subterranean and infrastructure

- Lack of site safety inspections increases the risk of unintentional safety risks being incurred (in the excavation area)
- Unprotected drops create a safety hazard
- The report on site safety of surface features, infrastructure and the subterranean environment by a professional site safety officer is awaited

### **3.6 Presentation of site values**

#### **3.6.1 Site interpretation**

Status quo:

- The landowner is not in favour of the general public visiting the site and therefore increased tourism is not an option. Nevertheless, many international and local specialists, students, field schools, and other people visit the site. The landowner takes his private visitors to the site as part of a wider site experience
- There is no site interpretation in the form of signage or interpretation boards
- Limited site visitation and thus limited site interpretation is taking place
- Site interpretation is entirely oral by the tour operator, tourist guide, permitted scientist, or landowner
- The site does not have its significant heritage values presented anywhere in the Cradle of Humankind and very few people know of the discoveries that have been made at this site. New information has come to light and this needs to be made public if palaeoanthropology is to be kept in the public psyche
- Tourist activities on World Heritage Sites and National Heritage Sites also needs the approval of the Management Authority
- There are restrictions on the filming and capturing of images on World Heritage Sites and a procedure needs to be put in place to regulate this requirement of the NHRA Act

Threats and risks:

- Lack of site interpretation diminishes tourist experience – tourism is limited to special groups at present
- Lack of site interpretation restricts dissemination of knowledge concerning the site and inhibits its presentation to a wider audience as required in terms of the WHC
- Lack of presentation of site values to a wider audience prevents information concerning site significance from reaching public psyche
- Potential funders might not know about site significance
- Public not educated about full range of COH WHS values

#### **3.6.2 Visitor numbers**

This figure is currently not available. The numbers are not estimated to be very high as the site is not on the open tourist market but 'view by appointment'

Status quo:

- There is no formal procedure set up for recording site visitor numbers at present.

Risks and threats:

- Visitor numbers are required for management purposes

## **4 MANAGEMENT OBJECTIVES, DESIRED OUTCOMES**

### **4.1 Physical environment, surface**

Desired management outcomes include

*Rangeland:*

- To ensure that contextual veld conditions and rangeland in immediate vicinity of fossil site is maintained in as good a condition as possible.

*Erosion:*

- To ensure that the fossil site and its environs are free from active erosional problems and that existing areas of erosion are analysed, remedied, rehabilitated and monitored for follow-up action if necessary

*Fire management:*

- To ensure that a proper fire regime appropriate to Bankenveld is maintained on the fossil site.
- To ensure that fossil site users (when the site is active) are aware of fire hazards and can control on-site fires.
- To ensure that the fossil site does not constitute a fire hazard and that activities taking place there do not create fire hazards
- To ensure that the basic data necessary to assess the long-term impact of frequent fires is available, which information is necessary to feed back into appropriate fire management

*Biodiversity, rare plants and animals:*

- To ensure that a database of plant and animal species present on site is available, because biological values are as yet poorly understood
- To assess which of these are target species for use as food, medicines, economic reasons, etc., and to what extent they are being collected
- To identify, record and map special species in order to ensure their protection

*Alien vegetation:*

- Desired outcome is a fossil site which is free from alien invasive species, and, as far as possible, from weeds

*Visual aesthetics:*

- Desired outcome is protection of viewshed and contextual environment

## **4.2 Physical environment, subterranean**

Desired outcomes include

- a subterranean environment which, if it is being visited or excavated, is safe for all site users.
- A further desired outcome is a subterranean environment in which the substrate, geological features and micro- and macrobiota are properly conserved. This implies a detailed knowledge of cavern systems.

## **4.3 Infrastructure, built environment**

There are no specific desired management outcomes in this category at present

## **4.4 Research environment**

Desired outcomes include the following:

- To ensure that lack of funding does not inhibit research opportunities and prevent site potential from being realised
- To ensure that the Management Authority has in-house heritage expertise which allows for the follow-up of fossil site inspection observations and recommendations

- To ensure that all dumps, old and new, are committed to plan, with appropriate annotations
- To ensure that new dumps are appropriately sited and properly constructed
- To ensure that excavations are safely executed and compliant with permit terms and conditions
- To ensure that appropriate witness sections are left and stabilized
- To ensure that sample sites are properly recorded and that results are independently verifiable
- To ensure safe excavation edges, walls and bases, and that these are stabilized when work ceases.
- To ensure that dump management becomes part of the permit application; such as indications as to dump site selected, construction method, long-term future of dump.
- To ensure that fossils are carefully and properly prepared, catalogued, curated and housed in a safe repository
- To ensure that regular site safety inspections take place

#### **4.5 Site safety and security**

- Desired outcomes include the provision of safety interventions recommended by the professional site safety officer after inspection of the surface and subterranean environment has taken place to ensure safe working and visiting conditions

#### **4.6 Presentation of site values**

Desired outcomes include:

- To ensure that the many heritage and natural values of the site are interpreted and made available to as wide a public as possible
- To ensure that the old mining relics are properly recorded descriptively and in the form of measured drawings, photographs and mapping

### **5 MANAGEMENT AND MONITORING TASKS**

The following are operational management tasks and issues that need to be addressed now or in the future as part of on-going management actions, and in order to achieve the desired outcomes recorded above. Their funding is still problematic.

The development of research at the fossil sites has been limited by the unfortunate perceptions that the State may not fund development on privately owned property and that the scientists are 'site-users'. This needs to change as it must be seen as the responsibility of the authorities to foster research and necessary associated development on these sites. It is recommended that in future, scientists be viewed rather as 'value adders' and thus eligible for some easement for the funding of heritage site management interventions which they are currently expected to fund, for example, fencing. In effect, the state has been expecting others to finance the protection of the COH WHS fossil sites.

Sites which have no active scientist are generally neglected – this is an indication of the positive influence which scientists have on fossil sites.

The following table has been drawn up with the specific aim of clarifying who should do what, and when, on the heritage site. The Table also provides some indication of priority ratings. It has been constructed in such a way as to incorporate all the key management issues, strategies and monitoring criteria so that it may be used independently of the text.

The relative priority of the management measures has been identified based on ICCROM definitions as follows:

- Immediate – to be attended to urgently as it constitutes a danger to the public or a resource;
- Urgent - to be attended to urgently to protect the resource;
- Necessary - to be attended to, to protect the resource;
- Desirable to be attended to from a development perspective;
- Keep watch - to be monitored to see if the problem is serious.

## **TABLE 1 FOLLOWS: MANAGEMENT AND MONITORING TASKS**



**TABLE 1 MANAGEMENT AND MONITORING TASKS**

| Issues   | Threats or Risks  | Desired outcomes (*) and Management Measures  | Priority       | Responsibility                    | Monitoring Criteria   | Monitoring frequency |
|--|---|---|----------------|-----------------------------------|---|----------------------|
| <b>Surface environment</b>                     |   |   |                |                                   |   |                      |
| Access - legal access to property              | <ul style="list-style-type: none"> <li>• Access needs to be by appointment only.</li> <li>• Landowner is particular about access</li> </ul>   | <ul style="list-style-type: none"> <li>• <b>Maintenance of cordial relations with landowners regarding access (*)</b></li> <li>• Ensure that properly negotiated access, preferably written permission, is obtained by all site users or those in charge</li> <li>• Ensure that access conditions are part of landowner-researcher agreement</li> </ul> | Future concern | Permitted scientists              | <ul style="list-style-type: none"> <li>• Check if access issue has been addressed in MOU's between landowner and research scientists</li> </ul>   | Annual               |
| Unauthorised access (not a problem at present) | <ul style="list-style-type: none"> <li>• Removal of rock, fossils breccia and artefacts</li> <li>• Removal of edible and medicinal plants</li> <li>• Theft of moveable property</li> </ul>          | <ul style="list-style-type: none"> <li>• <b>No unauthorised visitation to site (*)</b></li> <li>• Research and field staff to maintain surveillance when present – unauthorised access not a problem at present</li> </ul>  | Future concern | Permitted scientists, field staff | <ul style="list-style-type: none"> <li>• Check stockpiled breccia</li> <li>• Check for signs of digging out of plants</li> <li>• Maintain surveillance over movable property</li> </ul>   | Future concern       |
| Rangeland condition                            | <ul style="list-style-type: none"> <li>• Deterioration of rangeland due to overstocking, overgrazing, trampling or too frequent fires</li> <li>• Rangeland values imperfectly understood</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Rangeland in optimum condition</b></li> <li>• GDACE available for advice</li> <li>• Plan for acquiring baseline data against which impacts can be assessed</li> <li>• Plant species list required</li> </ul>  | Desirable      | Landowner                         | <ul style="list-style-type: none"> <li>• Check for trampled bare areas (biospheres around watering places</li> <li>• Check for loss of palatable grasses and forbs</li> <li>• Check for encroachment of unpalatable species such as steekgras</li> <li>• Check for encroachment by <i>Aloe greebheadii</i> var <i>davyana</i> (spotted grass aloe) which is an indication of overgrazing</li> </ul> | Ongoing              |

| Issues  | Threats or Risks  | Desired outcomes (*) and Management Measures   | Priority  | Responsibility                       | Monitoring Criteria  | Monitoring frequency |
|---|---|--|-----------|--------------------------------------|--|----------------------|
| Retention of topsoil, surface drainage, surface erosion | <ul style="list-style-type: none"> <li>Loss and dispersal of topsoil makes re-vegetation difficult</li> </ul>   | <ul style="list-style-type: none"> <li><b>Fossil site free of erosion (*)</b></li> <li>Stockpile all topsoil if removed for any purpose</li> <li>Check all tracks and pathways for erosion, create mitre drains and humps where necessary</li> <li>Slope roads and pathways appropriately to direct run-off</li> <li>Check surface drainage and distribution of runoff over surface</li> <li>Check for signs of surface erosion</li> </ul> | desirable | Research scientists, landowner       | <ul style="list-style-type: none"> <li>Check for worn patches of vegetation where cars habitually park</li> <li>Check for erosion gulleys in tracks and paths</li> <li>Check for patches of exposed soil</li> <li>Check sides of dumps</li> </ul>                                  | Ongoing              |
| Fire Management   | <ul style="list-style-type: none"> <li>Too frequent fires have a negative effect on vegetation</li> <li>Blackened areas are unsightly.</li> <li>Fire is a threat to wooden structures and caravans, trailers, etc parked in the site area</li> <li>Fire is a threat to moveable property</li> </ul> | <ul style="list-style-type: none"> <li><b>Proper fire regime for Bankenveld maintained (*)</b></li> <li>Implement a fire management policy</li> <li>Record fire frequency and intensity</li> <li>Take precautionary measures to contain 'domestic' fires started on site</li> <li>Provide suitable beaters for research staff and scientists</li> </ul>  | desirable | Landowner, research scientist, GDACE | <ul style="list-style-type: none"> <li>Check that a rangeland study for base-line data against which fire impact can be assessed has been done</li> <li>Check that a fire frequency recording programme has been set up</li> <li>Ensure that beaters are always on hand</li> </ul> |                      |



| Issues   | Threats or Risks  | Desired outcomes (*) and Management Measures  | Priority  | Responsibility   | Monitoring Criteria  | Monitoring frequency                      |
|--|---|---|-----------|--|--|---|
| Red data species, rare and economically significant plants | <ul style="list-style-type: none"> <li>Loss of edible and medicinal plants</li> <li>Many important plant species are not on RED DATA list.</li> </ul> | <ul style="list-style-type: none"> <li><b>Preservation of biodiversity (*)</b></li> <li>Incorporate special plants into tourist experience</li> <li>Educate site users on the need to protect these plants</li> <li>Surveillance of indigenous plant use</li> <li>Draw up a species list of medicinal, poisonous, edible and economically significant species</li> <li>Locate and map occurrence and preferred microhabitats</li> <li>Monitor collection and utilization</li> </ul> | desirable | Landowner, researchers and their staff (if within excavation area). COH MA to identify this as a worthwhile research project | <ul style="list-style-type: none"> <li>Check for signs of digging geophytes out by the roots</li> <li>Check local roadside vendors for plants on sale</li> <li>Check against map that toxic, medicinal and edible species are still present</li> </ul> | Best done at fruiting or flowering season |

| Issues                                  | Threats or Risks   | Desired outcomes (*) and Management Measures   | Priority  | Responsibility   | Monitoring Criteria  | Monitoring frequency |
|---|--|--|-----------|--|--|----------------------|
| Invasive alien plant species.           | <ul style="list-style-type: none"> <li>• Invasion of avens and other habitats by alien species</li> <li>• Loss of biodiversity</li> <li>• Unattractive landscape</li> </ul>  | <ul style="list-style-type: none"> <li>• <b>Fossil site free of invasive alien species(*)</b></li> <li>• Make a list of all invasive plant species</li> <li>• Map and prioritise infestations</li> <li>• Set up a photographic baseline</li> <li>• Determine best eradication or control programme. GDACE available for assistance</li> <li>• Liaise with working for water (for watties and other tree species)</li> <li>• Assess costs and find budget</li> <li>• Begin control according to guideline provided in generic management plan</li> <li>• Enlist expertise of GDACE</li> <li>• Implement control and clearance programme</li> <li>• Monitor and follow up as required</li> <li>• Research is needed into the dispersal agents of the various species – such as starlings for <i>Pyracantha</i> and baboons for <i>Opuntia</i></li> </ul> | necessary | Landowner, research scientists (in work environment)       | <ul style="list-style-type: none"> <li>• Visual checks for infestations and incidence density</li> <li>• Monitor with fixed point photography</li> <li>• Checks for re-invasion</li> </ul> | Ongoing              |
| Weeds & shrub growth in excavation site | <ul style="list-style-type: none"> <li>• Roots destabilize breccias in time</li> <li>• Plants reduce visibility of noteworthy sections</li> <li>• Weeds give a negative visual experience and project an air of dereliction</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Weed-free fossil site or site in which weeds are not problematic (*)</b></li> <li>• Pull weeds by hand, or 'skoffel' – not on fossiliferous surfaces</li> <li>• Pull weeds by hand from fossil deposits – taking care not to disrupt potentially fossiliferous sediment</li> <li>• Destroy in a manner that does not spread seed further</li> </ul>  | Necessary | Landowner, research scientists (in excavation environment) | <ul style="list-style-type: none"> <li>• Visual checks for weed infestations</li> <li>• Fixed point photography for controls</li> <li>• Visual checks for re-infestations</li> </ul>       | Ongoing              |

| Issues  | Threats or Risks  | Desired outcomes (*) and Management Measures  | Priority      | Responsibility  | Monitoring Criteria   | Monitoring frequency |
|---|---|---|---------------|---|---|----------------------|
| Invasive kikuyu grass, <i>Pennisetum clandestinum</i>       | <ul style="list-style-type: none"> <li>Category 2 declared invader</li> <li>Must be controlled and eradicated where possible</li> <li>Prohibited within 30m of the 1:50 year floodline of watercourses</li> </ul> | <ul style="list-style-type: none"> <li><b>Fossil site free of invasive alien species(*)</b></li> <li>Eradicate wherever possible</li> </ul>   | necessary     | landowner   | <ul style="list-style-type: none"> <li>Check site for presence of kikuyu</li> </ul>   | ongoing              |
| Development in 'viewshed'                                   | <ul style="list-style-type: none"> <li>Negative visual impact</li> <li>Destroys visual aesthetics of the site as well as 'sense of place'</li> </ul>  | <ul style="list-style-type: none"> <li><b>Preservation of sense of place and natural qualities of viewshed (*)</b></li> <li>COH WHS to monitor all new development plans</li> <li>Prevent development along skyline or within viewshed</li> <li>Owner is unlikely to plan or sanction such developments</li> </ul>                          | Not a problem | COH WHS MA  | <ul style="list-style-type: none"> <li>Check plans for visual impact on viewshed of site</li> </ul>   | Ongoing              |
| Habitat protection: Removal of stromatolites.               | <ul style="list-style-type: none"> <li>Loss of Heritage material and site significance.</li> <li>Loss of micro-habitats (mosaic of sunny and shady areas).</li> </ul>   | <ul style="list-style-type: none"> <li><b>Preservation of Pelindaba Stone and fossil stromatolites and associated microhabitats (*)</b></li> <li>Landowner, Research scientists and field staff to maintain surveillance</li> <li>Heritage Monitors to be alerted</li> <li>Not problematic at this site because of closed access</li> </ul> | Not a problem | Landowner, permitted scientists, field staff, Heritage Inspectors | <ul style="list-style-type: none"> <li>Check for signs of disturbed soil, exposed patches of soil, overturned and disturbed rock</li> </ul> | Ongoing              |
| <b>SUBTERRANEAN ENVIRONMENT – Not an issue at this site</b> |   |   |               |   |   |                      |

| Issues  | Threats or Risks  | Desired outcomes (*) and Management Measures   | Priority              | Responsibility                               | Monitoring Criteria  | Monitoring frequency  |
|---|---|--|-----------------------|--|--|-----------------------|
| <p>Interpretation of subterranean environment</p> | <ul style="list-style-type: none"> <li>Lack of information regarding the significance of caves to science of palaeontology impoverishes visitor experience</li> <li>Lack of appreciation of the significance and sensitivities of the subterranean environment</li> </ul> | <ul style="list-style-type: none"> <li><b>Importance and significance of subterranean environments made clear to site visitors (*)</b></li> <li>Incorporate caves and ecology of subterranean environment into site interpretation</li> <li>Liaise with caving groups and request assistance with education</li> </ul>   | <p>Future concern</p> | <p>Researchers, tourist guides</p>           | <ul style="list-style-type: none"> <li>Check that subterranean environments are suitably interpreted</li> </ul>  | <p>Future concern</p> |
| <p>Presence of breeding colonies of bats</p>      | <ul style="list-style-type: none"> <li>Possible loss of colony – sensitive to human interference</li> <li>Species involved (Miniopterus natalensis) is declining in numbers</li> </ul>  | <ul style="list-style-type: none"> <li><b>Conservation of bat colonies, whether breeding hibernacula or not (*)</b></li> <li>Take care when extending excavations into the area of the bat roost</li> <li>Ensure that excavation only takes place when risk of disturbing breeding season is low</li> <li>Ensure that bats have free access into and out of cave</li> <li>Ensure that diesel fumes (from generator) cannot be drawn into cave</li> <li>GDACE can offer advice</li> </ul> | <p>Future concern</p> | <p>Research scientists, GDACE to monitor</p> | <ul style="list-style-type: none"> <li>GDACE to establish monitoring criteria for breeding colony</li> <li>Check for presence and numbers of bats</li> </ul> | <p>Future concern</p> |
| <p>Porcupine lairs and owl roosts</p>             | <ul style="list-style-type: none"> <li>Disturbance and displacement of animals</li> <li>Porcupine lairs are important as modern analogues for taphonomic processes of the past</li> </ul>   | <ul style="list-style-type: none"> <li><b>Preservation of porcupine lairs and owl roosts for actualistic studies (*)</b></li> <li>Protect any porcupine lairs on site</li> <li>Encourage that their behavior and lair contents are studied without disturbing animals</li> </ul>   | <p>desirable</p>      | <p>All site users</p>                        | <ul style="list-style-type: none"> <li>Check that porcupine lairs remain active – note presence of quills, droppings, gnawed bones</li> </ul>                | <p>Ongoing</p>        |

| Issues   | Threats or Risks   | Desired outcomes (*) and Management Measures  | Priority       | Responsibility  | Monitoring Criteria  | Monitoring frequency |
|--|--|---|----------------|---|--|----------------------|
| <b>INFRASTRUCTURE – There is no permanent infrastructure at this fossil site</b> |  |   |                |   |  |                      |
| Access road  | <ul style="list-style-type: none"> <li>Persistent use may cause deterioration of surface</li> <li>Drainage line crossing is vulnerable</li> </ul>  | <ul style="list-style-type: none"> <li><b>Access road well maintained and free from erosion (*)</b></li> <li>Ensure that use of roads is addressed in landowner-researcher agreement</li> <li>Monitor branch road to site for signs of erosion or collapse</li> <li>Establish regular turning circle and parking space</li> </ul> | Future concern | Landowner, researcher                                   | <ul style="list-style-type: none"> <li>Check condition of branch road</li> </ul>   | Future concern       |
| Culverts, bridges, drainage line crossings                                       | <ul style="list-style-type: none"> <li>See above</li> </ul>  | <ul style="list-style-type: none"> <li>See above</li> </ul>   | N/A            | N/A   | <ul style="list-style-type: none"> <li>N/A</li> </ul>  | N/A                  |
| Perimeter fence  | <ul style="list-style-type: none"> <li>Landowner is opposed to perimeter fence</li> </ul>  | <ul style="list-style-type: none"> <li>N/A. landowner is opposed to perimeter fence</li> </ul>  | N/A            | N/A   | <ul style="list-style-type: none"> <li>N/A</li> </ul>  | N/A                  |
| Toilets, abluition   | <ul style="list-style-type: none"> <li>A toilet is a perquisite to further work being undertaken on the site</li> </ul>                            | <ul style="list-style-type: none"> <li><b>Environmentally acceptable toilet in use (*)</b></li> <li>VIP or Environloo to be installed in time</li> </ul>  | Future concern | Landowner and researchers (for excavators and tourists) | <ul style="list-style-type: none"> <li>Check type of toilet</li> <li>Check efficacy, odours, flies</li> </ul>  | Future concern       |
| Waste management and disposal  | <ul style="list-style-type: none"> <li>Litter</li> <li>Cattle and wild animals die from ingesting plastic bags</li> <li>Water pollution</li> </ul> | <ul style="list-style-type: none"> <li><b>Site free from litter</b></li> <li>Provide litter bins, more when extra people are expected</li> <li>Collect and remove all litter regularly</li> <li>Best practice would require sorting and recycling litter</li> </ul>   | Future concern | All site users  | <ul style="list-style-type: none"> <li>Check for left litter</li> <li>Check that litter bins have been installed</li> <li>Check removal schedule</li> <li>Check that litter stored on site cannot be wind distributed</li> <li>Encourage recycling</li> <li>Check for proper toilet use</li> </ul> | Future concern       |

| Issues   | Threats or Risks   | Desired outcomes (*) and Management Measures   | Priority       | Responsibility         | Monitoring Criteria  | Monitoring frequency |
|--|--|--|----------------|------------------------|--|----------------------|
| Pathways for site users and visitors   | <ul style="list-style-type: none"> <li>• Pathways too close to excavations can cause collapse</li> <li>• Visitors falling into excavations or avens</li> <li>• Pathways can cause erosion</li> <li>• Pathways act as a drainage channel</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Safe pathways and route through site (*)</b></li> <li>• Capping with thin layer of cement where surface ad excavation edges are friable</li> <li>• Psychological barriers to protect unprotected drops</li> <li>• Use safe retaining area for visitors</li> <li>• Provide anti-erosion measures at sensitive areas, such as mitre drains on pathways and humps to direct run-off, slope paths away from excavations</li> <li>• Proper planning and contouring</li> </ul> | Future concern | Researchers            | <ul style="list-style-type: none"> <li>• Check visitor pathways, boardwalks, viewing platforms for safety - of visitors and of site fabric</li> <li>• Check pathways for wear and tear and channeling/erosion</li> <li>• Check mitre drains, humps and slope of paths</li> </ul> | Future concern       |
| Site plaque recognizing World heritage Site status and National Heritage Site Status | <ul style="list-style-type: none"> <li>• Required in terms of the WHC Act and NHRA.</li> <li>• Enhances site status</li> </ul>   | <ul style="list-style-type: none"> <li>• <b>Site plaque permanently mounted (*)</b></li> <li>• Select appropriate position, agreed by researchers and landowner (Done)</li> <li>• SAHRA to re- install</li> </ul>  | Necessary      | SAHRA                  | <ul style="list-style-type: none"> <li>• Check that plaque is re-installed</li> <li>• Check plaque condition and safety (brass plaques liable to theft)</li> </ul>   | Ongoing              |
| Signage: adequacy  | <ul style="list-style-type: none"> <li>• Poor tourist experience if site not adequately interpreted</li> </ul>   | <ul style="list-style-type: none"> <li>• <b>Behavioural modification signage and site interpretative signage adequate (*)</b></li> <li>• Site not open to general public, specialist tour operator and permitted scientist provide site interpretation</li> </ul>  | Future concern | Researchers, landowner | <ul style="list-style-type: none"> <li>• Check quality of signage</li> <li>• Check quality of site interpretation</li> </ul>   | Future concern       |

| Issues  | Threats or Risks   | Desired outcomes (*) and Management Measures  | Priority       | Responsibility         | Monitoring Criteria   | Monitoring frequency |
|---|--|---|----------------|------------------------|---|----------------------|
| Visitor impacts   | <ul style="list-style-type: none"> <li>• Littering</li> <li>• Pollution</li> <li>• Erosion of pathways</li> <li>• Disturbance of excavations</li> <li>• Theft of fossils</li> <li>• Graffiti</li> </ul>      | <ul style="list-style-type: none"> <li>• <b>Litter-free fossil site (*)</b></li> <li>• Provide bins and toilets</li> <li>• Ensure proper site supervision of all visitors</li> <li>• Create barriers to prevent abrasion, touching or trampling of excavation walls and floors</li> <li>• Keep valuable fossils in locked store or remove to laboratory</li> <li>• These potential impacts all adequately attended at Motsetse</li> <li>• Toilet facilities non-existent</li> </ul> | Future concern | Researchers, landowner | <ul style="list-style-type: none"> <li>• Check for littering</li> <li>• Check for pollution of site</li> <li>• Check all walkways for wear and tear</li> <li>• Check for visitor disturbance of excavations or equipment</li> <li>• Check for tampering with and removal of stored fossils</li> <li>• Check for Graffiti</li> </ul> |                      |
| Telecommunications  | <ul style="list-style-type: none"> <li>• Telephone necessary for responsible tourism</li> <li>• Poor cellphone signal</li> <li>• No landline</li> </ul>  | <ul style="list-style-type: none"> <li>• <b>Adequate tele-communication possible (*)</b></li> </ul>   | Future concern | COH WHS MA             | <ul style="list-style-type: none"> <li>• None</li> </ul>  | Future concern       |
| <b>RESEARCH ENVIRONMENT: There is no active excavation at Motsetse at present</b> |  |   |                |                        |   |                      |
| Alteration of surface topography, drainage  | <ul style="list-style-type: none"> <li>• Excavation has created a sump, into which water is directed</li> <li>• Collapse of the footwall is a risk.</li> <li>• Unprotected drops may be dangerous</li> </ul> | <ul style="list-style-type: none"> <li>• <b>To ensure that excavation does not cause erosion problems(*)</b></li> <li>• Create appropriate drainage in area peripheral to excavation area which directs runoff away from sump</li> <li>• Situation appears to be in hand at the site</li> </ul>   | necessary      | Researcher             | <ul style="list-style-type: none"> <li>• Monitor sump for floodwater and ponding (usually drains underground)</li> <li>• Mark off no-go areas to direct visitors away from these</li> </ul>   | Future concern       |

| Issues                                | Threats or Risks  | Desired outcomes (*) and Management Measures  | Priority  | Responsibility | Monitoring Criteria  | Monitoring frequency |
|---------------------------------------|---|---|-----------|----------------|--|----------------------|
| Safety of heritage material, pathways | <ul style="list-style-type: none"> <li>• Trampling by visitors</li> </ul>   | <ul style="list-style-type: none"> <li>• <b>Site safety and safety of fossils and site fabric (*)</b></li> <li>• Check a suitable route around excavation site for exposed fossils and provide a boardwalk or pathway that can be relocated as excavation develops</li> </ul>   | desirable | researchers    | <ul style="list-style-type: none"> <li>• Monitor site for trampling, particularly in pathway areas</li> </ul>  | Future concern       |
| Excavation edges                      | <ul style="list-style-type: none"> <li>• Decalcifying breccia results in the excavation walls having friable edges</li> <li>• Unstable edges collapse</li> <li>• This poses a risk of physical danger as well as of information loss</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Excavation edges that are stable and not crumbling (*)</b></li> <li>• provide physical barrier or psychological barrier to prevent visitors getting too close</li> <li>• do not site pathways too close to excavation edges</li> <li>• cap unstable edges with lime cement</li> </ul> | desirable | Researcher     | <ul style="list-style-type: none"> <li>• Researchers to monitor every time they are digging</li> <li>• Monitor for fallen and slumped wall deposit. Check footwall for fallen debris.</li> <li>• Annual professional assessment</li> </ul> | Ongoing              |



| Issues           | Threats or Risks   | Desired outcomes (*) and Management Measures   | Priority  | Responsibility     | Monitoring Criteria  | Monitoring frequency |
|------------------|--|--|-----------|--------------------|--|----------------------|
| Excavation walls | <ul style="list-style-type: none"> <li>• Unstable walls, particularly if decalcified tend to slump and collapse</li> <li>• Collapse poses a threat to site users below unstable areas</li> <li>• Collapse poses a threat to site significance because of mixing</li> <li>• Very high walls are difficult to stabilize when excavation is terminated or completed</li> <li>• Very high walls are susceptible to problems noted above</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Stable excavation walls, free of collapse or slumping (*)</b></li> <li>• Excavation walls at Motsetse are 3-5 m high already and site safety officer has noted instability</li> <li>• Deep excavations should be "Benched", quarry-style.</li> <li>• Unstable walls should be stabilised - geotextile or sandbagging with 10% cement, or by using interventions recommended in site safety report</li> <li>• Install metal tendons as per original site safety report</li> <li>• Install sidewall to sidewall mechanical props when excavations begin</li> <li>• Brow edges to be levelled off</li> <li>• Use pinch bar to bar down unsupported large rocks projecting from sidewall</li> <li>• Ensure that annual site safety inspection takes place</li> </ul> | Necessary | SAHRA, researchers | <ul style="list-style-type: none"> <li>• Check degree of calcification of breccia – hard breccia can take higher walls than decalcified material</li> <li>• Check unsupported wall height and recommend benching out if it appears unstable</li> <li>• Check sidewalls for sloughing (calving) and collapse</li> <li>• Check that excavation does not go deeper without benching out</li> <li>• Check wall for loose rocks and boulders and bar down if necessary</li> <li>• Bevel off friable excavation edges</li> <li>• Check that excavation walls have necessary support - metal tendons, etc.</li> </ul> | Ongoing              |

| Issues   | Threats or Risks  | Desired outcomes (*) and Management Measures  | Priority       | Responsibility     | Monitoring Criteria   | Monitoring frequency    |
|--|---|---|----------------|--------------------|---|-------------------------|
| Access to bottom of excavation                 | <ul style="list-style-type: none"> <li>• Steps, ladders, etc. must be safe and stable</li> <li>• Wooden bridge is weathered and unsafe</li> <li>• Wooden ladder is rotten and unsafe</li> <li>• Substrate on which ladders rests is not level</li> <li>• Ladder does not have a 'step-on' handhold</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Safe access to all parts of the excavation, and access which does not compromise site fabric (*)</b></li> <li>• Make benching shallow enough to use as steps</li> <li>• Create and cap steps with protective layer</li> <li>• Ensure ladders are safe by leveling substrate and securing base</li> <li>• Provide handhold to get on ladder safely</li> <li>• Replace wooden bridge , preferably in metal with handrail</li> </ul> | Future concern | Researchers        | <ul style="list-style-type: none"> <li>• Check access routes to excavation base for safety and stability</li> </ul> | Future concern          |
| Compliance with terms and conditions of permit | <ul style="list-style-type: none"> <li>• Loss of information and site significance</li> </ul>   | <ul style="list-style-type: none"> <li>• <b>Full compliance with all terms and conditions of SAHRA permit (*)</b></li> <li>• Check all permit terms and conditions</li> </ul>   | necessary      | SAHRA, researchers | Check all terms and conditions of the permit  | At each site inspection |

| Issues           | Threats or Risks  | Desired outcomes (*) and Management Measures   | Priority  | Responsibility | Monitoring Criteria   | Monitoring frequency |
|------------------|---|--|-----------|----------------|---|----------------------|
| Witness sections | <ul style="list-style-type: none"> <li>Loss of information and site significance</li> </ul> | <p><b>Appropriately selected and well-stabilised witness sections and sample sites (*).</b></p> <ul style="list-style-type: none"> <li>Ensure that selection of appropriate witness sections are a requirement in terms of the permit</li> <li>Ensure that the researcher provides adequate criteria for the election of witness sections</li> <li>Ensure that all significant features are covered by or included in witness sections proposed</li> <li>Ensure that witness sections are not prone to collapse and that they are stabilized on closure of excavation</li> <li>Ensure that witness section is committed to plan</li> </ul> | Necessary | Researcher     | <ul style="list-style-type: none"> <li>Check that a witness section has been designate</li> <li>Check that witness section has been stabilised</li> </ul> | Ongoing              |

| Issues        | Threats or Risks  | Desired outcomes (*) and Management Measures   | Priority  | Responsibility     | Monitoring Criteria   | Monitoring frequency |
|---------------|---|--|-----------|--------------------|---|----------------------|
| Breccia Dumps | <ul style="list-style-type: none"> <li>• Loss of information concerning source and contents of dumped material (NB)</li> <li>• Footprint site of dumps not checked for significant plants</li> <li>• Position unacceptable to landowner</li> <li>• Position obscures significant part of deposit</li> <li>• Dump causes visual impact</li> <li>• Dump built over cave infill</li> <li>• No proper toe to dump or careless containment</li> <li>• Dump is cascading due to incorrect angle of repose</li> <li>• Dump origin not recorded</li> <li>• Dump contents not recorded</li> <li>• Duration of dump on site not recorded</li> <li>• Dump built over or too close to drainage line</li> <li>• Unrecorded and unrecovered fossil material discarded in dumps</li> </ul> | <ul style="list-style-type: none"> <li>• <b>All dumps recorded, committed to site plan and annotated (*)</b>.</li> <li>• <b>All dumps properly sited and constructed (*)</b></li> <li>• SAHRA to request that the scientist explain how dumped material – whether sterile or fossiliferous and 'in transit' – is to be managed. This dump management plan to become part of permitting requirement.</li> <li>• Discuss dump siting with Landowner</li> <li>• Check dump footprint for valuable plant species</li> <li>• Ensure footprint is in proportion to completed height</li> <li>• Ensure dump not in drainage line</li> <li>• Etc.</li> </ul> | Necessary | SAHRA, researchers | <ul style="list-style-type: none"> <li>• Check placement of dump on landscape</li> <li>• Ensure that positioning is acceptable to landowner</li> <li>• Check planned position and ultimate size for possible problems with visibility of significant site features</li> <li>• Check to ensure dump is not planned to be situated over cave fill</li> <li>• Check that dump has containment toe</li> <li>• Check footprint area in relation to planned height – cascading must not happen</li> <li>• Check that source of material is recorded</li> <li>• Check that contents of dump are recorded</li> <li>• Check that dump does not slump or erode into drainage line</li> <li>• Check that all dumps are recorded and annotated on a plan of the site</li> <li>• Monitor all the products of excavation, their recording (3D) and storage</li> </ul> |                      |

| Issues                                     | Threats or Risks  | Desired outcomes (*) and Management Measures  | Priority  | Responsibility | Monitoring Criteria   | Monitoring frequency |
|--|---|---|-----------|----------------|---|----------------------|
| Security of breccia piles                  | <ul style="list-style-type: none"> <li>Exposed fossiliferous breccia is at risk to scavenging by souvenir hunters, many small pieces lying about</li> </ul> | <ul style="list-style-type: none"> <li><b>Fossil dumps safe from pilfering and tampering (*)</b></li> <li>Portable blocks should be stored under lock and key</li> <li>Tourist groups should not free-range: provide site guide</li> <li>Keep groups to a size than can be properly supervised</li> <li>Importance of every fossil should be taught – signage that outlines appropriate behaviour</li> <li>Control access to excavation area strictly</li> <li>Valuable fossil should be removed from site</li> </ul> | Necessary | Researchers    | <ul style="list-style-type: none"> <li>Monitor for security of fossiliferous breccia. Only non-portable blocks should be left in accessible places</li> <li>Monitor site for vulnerable pieces and remove for safe keeping</li> </ul> | Ongoing              |
| Dump rehab. (soil dumps as in sieve heaps) | <ul style="list-style-type: none"> <li>Unattended dumps erode</li> </ul>  | <ul style="list-style-type: none"> <li><b>Appropriate processing and disposal of dumped material if necessary (*)</b></li> <li>Use soil blanket to assist rehabilitation – natural fibre blankets to be laid over exposed soil areas.</li> <li>Revegetate according to advice from GDACE</li> </ul>   | necessary | researcher     | <ul style="list-style-type: none"> <li>Check that abandoned soil dumps are rehabilitated</li> </ul>   |                      |

| Issues                                     | Threats or Risks   | Desired outcomes (*) and Management Measures  | Priority       | Responsibility                         | Monitoring Criteria  | Monitoring frequency |
|--|--|---|----------------|--|--|----------------------|
| Sieved residues, sterile                   | <ul style="list-style-type: none"> <li>• Could be placed where they will inconvenience landowner</li> <li>• Placed where they will constitute a visual impediment</li> <li>• Built in such a way that they will erode or become unstable</li> <li>• See points recorded for dumps above</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Appropriate processing and disposal of sieved waste (*)</b></li> <li>• Could be used for road and erosion repair if really sterile and in places suited to nature of sieved waste residues</li> <li>• Sieved material EIA to become part of permit application – see recommendation regarding dumps above</li> </ul>      | Necessary      | SAHRA, researchers                     | <ul style="list-style-type: none"> <li>• Check location of sieved waste material</li> <li>• Check for stability and erosion</li> <li>• Apply same monitoring criteria as noted for dumped breccia above</li> </ul> | Ongoing              |
| Repository                                 | <ul style="list-style-type: none"> <li>• Poor repository policies can result in information loss</li> <li>• Poor repository policy can result in problems of locating fossils</li> </ul>   | <ul style="list-style-type: none"> <li>• <b>Safe long-term conservation of fossils and artefacts recovered (*)</b></li> <li>• Monitor repositories according to 'Minimum Standards for Repositories' guideline as prepared by SAHRA</li> </ul>  | necessary      | SAHRA                                  | <ul style="list-style-type: none"> <li>• Monitor repositories according to 'Minimum Standards for Repositories' guideline as prepared by SAHRA</li> </ul>  | Ongoing              |
| <b>Site safety, security and stability</b> |  |   |                |  |  |                      |
| Signage, site safety and warnings          | <ul style="list-style-type: none"> <li>• Lack of appropriate signage can expose visitors to unexpected hazards, e.g. that there is a bees' nest</li> </ul>   | <ul style="list-style-type: none"> <li>• <b>Safe fossil site (*)</b></li> <li>• Install appropriate behavior modifiers and site safety signage as and when this becomes necessary</li> <li>• Appropriate safety signage is a requirement of Public (Occupational) Health and Safety Act</li> <li>• Maropeng even warns against possible presence of snakes</li> </ul> | Future concern | Researchers, landowner, tour operators | <ul style="list-style-type: none"> <li>• Check for installation and appropriate wording</li> <li>• Check for appropriate location of signs, design and durability</li> </ul>                                       | Ongoing              |

| Issues   | Threats or Risks  | Desired outcomes (*) and Management Measures   | Priority                                     | Responsibility                         | Monitoring Criteria  | Monitoring frequency |
|--|---|--|--|--|--|----------------------|
| Subterranean environments at Motsetse : adjacent caves | <ul style="list-style-type: none"> <li>• Instability due to previous mining activities and blasting</li> <li>• Natural instability</li> </ul>   | <ul style="list-style-type: none"> <li>• <b>Safe fossil site (*)</b></li> <li>• No-go areas for students, visitors and tourists; specialist caving groups only</li> </ul>  | Necessary                                    | Researchers, landowner, tour operators | <ul style="list-style-type: none"> <li>• Check that no-go instruction is being obeyed</li> </ul>   | Ongoing              |
| Bees, "Kransbye", Wasps                                | <ul style="list-style-type: none"> <li>• The numerous cavities and hollows are home to several bee hives and wasps' nests. Many people are allergic to bee stings in particular.</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Safe fossil site (*)</b></li> <li>• Ensure that the necessary antihistamines are on hand.</li> <li>• Destroy or have hives removed if these are where people frequently work.</li> <li>• Post warning signage</li> <li>• Provide first aid post</li> </ul> | Necessary                                    | Researcher, Tour Operator              | <ul style="list-style-type: none"> <li>• Monitoring should include checking the route for insect problems.</li> <li>• Monitor speed at which an emergency case could reach appropriate medical help</li> </ul> | Ongoing              |
| Accidental falls                                       | <ul style="list-style-type: none"> <li>• Tourists suing the operator</li> </ul>   | <ul style="list-style-type: none"> <li>• <b>Safe fossil site (*)</b></li> <li>• Ensure that walkways are as even as possible. Provide handrails and steps at vertical drops and changes of level.</li> <li>• Keep group sizes small enough to control at all times</li> </ul>                          | Necessary if tourism is taking place on site | Tourist operator, researcher           | <ul style="list-style-type: none"> <li>• Monitor route by walking it regularly to check for flaws in routing, infrastructure</li> </ul>  | Ongoing              |
| First aid  | <ul style="list-style-type: none"> <li>• Emergency situations such as bee attack, snake bite, allergic reaction, asthma attack, broke limb, etc.</li> </ul>                                 | <ul style="list-style-type: none"> <li>• <b>Safe fossil site (*)</b></li> <li>• Ensure that person in charge has been briefed on how to react</li> <li>• Have a well understood evacuation and forward notification procedure</li> </ul>   | necessary                                    | researchers                            | <ul style="list-style-type: none"> <li>• Monitor first aid kit</li> <li>• Monitor evacuation and emergency procedures</li> </ul>   |                      |

| Issues       | Threats or Risks  | Desired outcomes (*) and Management Measures   | Priority       | Responsibility                         | Monitoring Criteria   | Monitoring frequency |
|--------------|---|--|----------------|--|---|----------------------|
| Theft, crime | <ul style="list-style-type: none"> <li>The isolated situation makes the site prone to theft of excavation and other equipment.</li> </ul> | <ul style="list-style-type: none"> <li><b>Safe fossil site (*)</b></li> <li>Access to the site is well controlled and theft ought not to be a problem</li> <li>Provide secure lock-up facilities on -site for researchers equipment – lock-up garage required</li> <li>Control on all persons entering the area</li> </ul> | Future concern | Researchers, landowner, site residents | <ul style="list-style-type: none"> <li>Security checks</li> </ul> | Future concern       |

**GENERIC ISSUES RELATING TO FOSSIL SITE EXCAVATIONS: not at present relevant specifically to Motsetse site, common to all sites being actively excavated. See Generic Management Plan**



## **6 BIBLIOGRAPHY**

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(permit holder has promised an updated bibliography)