

Palaeontological Impact Assessment in support of Environmental Authorisation for the Proposed Exxaro Belfast Resettlement Project, Mpumalanga Province

Desktop Study

For

**Digby Wells Environmental
on behalf of Exxaro Coal Mpumalanga (Pty) Ltd**

16 April 2017

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Expertise of Specialist

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Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Digby Wells Environmental, Johannesburg, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

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

The proposed Belfast Resettlement Project, as part of the larger Belfast Implementation Project (BIP), is located some 8 km from the Belfast town in Mpumalanga Province. This region is underlain by lithostratigraphy associated with the Vryheid Formation. Based on the palaeontological sensitivity map (PSM) on the South African Heritage Resources Information System (SAHRIS), the potential for fossiliferous material to occur in this region is high and an assessment of possible impacts to these resources is required.

This notwithstanding, considering the nature of the project, the potential impact to possible fossil heritage is low. Recommendations include the implementation of a fossil chance finds and monitoring protocol. This will entail the following:

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

Where the recommendations are implemented, the project may commence from a palaeontological perspective.

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1. Background

Exxaro Coal Mpumalanga (Pty) Ltd (hereinafter Exxaro), as part of the Belfast Implementation Project (BIP), propose the resettlement of various households within the Exxaro Belfast Coal Mine Mining Right Area (MRA) to an area on the farms Zoekop 462 JS Portion 13, Paardeplaats 425 JS RE and Leeuwbank 427 JS Portion 13. The project will entail the construction of 32 housing units on 9 hectares (ha) of land within the aforementioned farm portions.

To comply with the requirements of the National Environmental Management Act (107 of 1998) (NEMA), as amended and the NEMA Environmental Impact Assessment (EIA) Regulations, 2014 (as amended by GNR 326 on 7 April 2017) an application for Environmental Authorisation is required.

i. Heritage

Aurecon South Africa (Pty) Ltd (hereinafter Aurecon) appointed the services of Kudzala Antiquity cc (hereinafter Kudzala) to conduct a Heritage Impact Assessment (HIA) in support of Environmental Authorisation of the proposed Belfast Resettlement Project situated some 8 km from Belfast town in the Mpumalanga Province.

The completed HIA was submitted to the South African Heritage Resources Agency (SAHRA) for Statutory Comment as required in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) in 2016 (Case ID: 10323). The SAHRA Archaeology, Palaeontology and Meteorites (APM) Unit issued interim Statutory Comment and accepted the recommendations provided in the HIA for inclusion into the Environmental Management Programme (EMPr) for the Belfast Resettlement Project.

ii. Palaeontology

Further to the interim Statutory Comments issued for the Belfast Resettlement Project, the SAHRA APM Unit required the completion of a Palaeontological Impact Assessment (PIA) before final comment could be made. As indicated by SAHRA, the project area is underlain by bedrock that has a high possibility of containing fossilised *Glossopteris* flora that must be considered.

To this effect, Digby Wells Environmental (hereinafter Digby Wells) on behalf of Exxaro appointed a palaeobotanist to complete the necessary assessments to address the requirements of SAHRA as stipulated.

This report complies with the requirements of the NHRA, NEMA and NEMA EIA Regulations, 2014 (GNR 982). The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

TABLE 1-1: SPECIALIST REPORT REQUIREMENTS IN TERMS OF APPENDIX 6 OF THE EIA REGULATIONS (2014)

| A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain: | Relevant section in report |
|--|-----------------------------------|
| Details of the specialist who prepared the report | Appendix A |
| The expertise of that person to compile a specialist report including a curriculum vitae | Appendix A |
| A declaration that the person is independent in a form as may be specified by the competent authority | Page 1 |
| An indication of the scope of, and the purpose for which, the report was prepared | Section 1 |
| The date and season of the site investigation and the relevance of the season to the outcome of the assessment | N/A |
| A description of the methodology adopted in preparing the report or carrying out the specialised process | Section 2 |
| The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure | Section iv Figure 3-2 |
| An identification of any areas to be avoided, including buffers | N/A |
| A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers; | N/A |
| A description of any assumptions made and any uncertainties or gaps in knowledge; | Section 5 |
| A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment | Section 4 |
| Any mitigation measures for inclusion in the EMPr | Section 6 |
| Any conditions for inclusion in the environmental authorisation | Section 6 |
| Any monitoring requirements for inclusion in the EMPr or environmental authorisation | Section 6 |
| A reasoned opinion as to whether the proposed activity or portions thereof should be authorised | N/A |
| If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan | N/A |
| A description of any consultation process that was undertaken during the course of carrying out the study | N/A |
| A summary and copies if any comments that were received during any consultation process | N/A |
| Any other information requested by the competent authority. | N/A |

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements stipulated in the Statutory Comments issued on Case ID 10323.

The methods employed to address the ToR included:

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

3. Geology and Palaeontology

iii. Project location and geological context

The project area for the proposed Belfast Resettlement Project is underlain by the Permian Vryheid Formation. The Vryheid Formation in this region comprises coal deposits across five seams. Of these coal seams, seam 2 and 4 are the thickest and of most value economically (Snyman, 1998). On average the uppermost seam, No 5 is more than 10m below the surface, and seam 4 upper is more than 35m below the surface.

Other notable geological strata within the area under consideration includes:

- Intrusive, volcanic Jurassic dykes;
- Lebowa Granite Suite;
- Selons River Formation, Rooiberg Group.

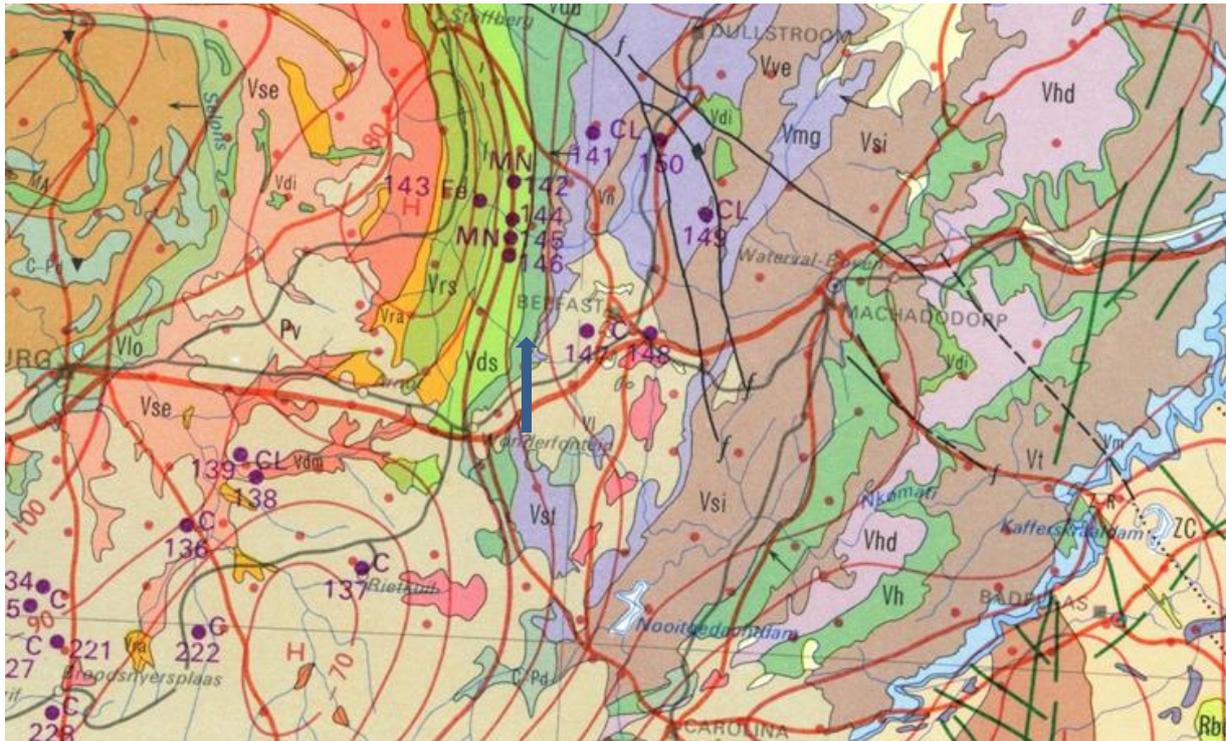


FIGURE 3-1: GEOLOGICAL MAP OF THE AREA BETWEEN BETHAL AND KRIEL (G-NALA) FOR THE PROPOSED MINING OF THE SCHURVEKOP RESOURCE BY MMAKAU COAL (PTY) LTD. THE APPROXIMATE LOCATION OF THE PROPOSED PROJECT IS INDICATED WITH THE ARROW. ABBREVIATIONS OF THE ROCK TYPES ARE EXPLAINED IN TABLE 2. MAP ENLARGED FROM THE GEOLOGICAL SURVEY 1: 1 000 000 MAP 1984.

TABLE 3-1: EXPLANATION OF SYMBOLS FOR THE GEOLOGICAL MAP AND APPROXIMATE AGES (BARBOLINI ET AL., 2016; ERIKSSON ET AL., 2006; JOHNSON ET AL., 2006). SG = SUPERGROUP; FM = FORMATION.

| Symbol | Group/Formation | Lithology | Approximate Age |
|--------|---|---|---|
| Jd | Jurassic | Dolerite dykes, intrusive | Jurassic, approx. 180 Ma |
| Pa | Adelaide & Estcourt Fms | Mudstones, shales | Upper Permian, Lower Beaufort (min. 260 Ma) |
| Pvo | Volksrust Fm | shale | Middle Permian, Upper Ecca |
| Pv | Vryheid Fm | Shales, sandstone, coal | Lower Permian, Middle Ecca |
| Pp | Pietermaritzburg Fm | Shale | Lower Permian, Lower Ecca |
| Vrs | Roosenskraal subsuite, upper zone of Rustenburg Layered Suite; Bushveld Complex | Olivine diorite, ironstone, magnetite, gabbro, gabbronorite | >2050 Ma |
| Vds | Dsiate subsuite, main zone of Rustenburg Layered Suite; Bushveld Complex | Gabbronorite, anorthosite | >2050 Ma |
| Vdr | Dwars River subsuite, critical zone of Rustenburg Layered Suite; Bushveld Complex | Anorthosite, pyroxenite | >2050 Ma |

| Symbol | Group/Formation | Lithology | Approximate Age |
|--------|--|---|-----------------|
| Vc | Croyden subsuite, Lower zone of Rustenburg Layered Suite; Bushveld Complex | Harzburgite, bronzitite | >2050 Ma |
| Vdu | Dullstroom Fm, Rooiberg Group | Basalt, andesite | Ca 2000 Ma |
| Vho | Houtenbek Fm, Pretoria Group, Transvaal SG | Mudrock, sandstone, limestone | |
| Vst | Steenkampsberg Fm, Pretoria Group | sandstone | |
| Vn | Nederhorst Fm, Pretoria Group | Mudrock, Hornfels, quartzite, arkose | |
| Vve | Vermont Fm, Pretoria Group | Mudrock, hornfels | |
| Vmg | Magaliesberg Fm, Pretoria Group | quartzite | |
| Vsi | Silverton Fm, Pretoria Group | Basalt, tuff, shale | Ca 2150 Ma |
| Vhd | Dwaalheuveld, Strubenkop and Daspoort Fms; Pretoria Group | Andesite, sandstone, shale | |
| Vh | Hekpoort Fm, Pretoria Group | Basaltic andesite, pyroclastic rocks | 2224 Ma |
| Vti | Timeball Hill and Rooihooft Fm, Pretoria Group | Shale, quartzite, conglomerate, breccia, diamictite | Ca 2420 Ma |
| Vm | Malmani subgroup, Chuniespoort Group | Dolomite, chert | 2642 – 2500 Ma |
| Vbr | Black Reef Fm | Quartzite, conglomerate, shale, basalt | >2642 Ma |

iv. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3-2.

The Lebowa Granite Suite would not preserve any fossils as it is igneous in origin. In contrast the Selons River Formation (Kwaggasnek and Schrikklouf Members; Rooiberg Group) is made up of finer grained sediments that have been deposited in a marginal basin context and may preserve ripple marks but these rocks are far from the project area. These geological strata are therefore not considered further in this assessment.

Coal associated with the Vryheid Formation is formed through processes of heat and compression on plant material. These processes alter the plant material to the point that no plant structures can be identified. The coal seams are therefore of no interest to palaeontological research. Rather, as recorded in the literature (see list in Johnson et al.,

2006) and personal experience on South African coal mines, fossil plants are preserved in the shales, mudstones and partings between and within some coal seams. Here impressions or compressions of leaves of the *Glossopteris* plants, lycopods, sphenophytes and ferns can be preserved. They are of interest to palaeobotanists but in general the distribution of these resources is extremely sporadic and unpredictable requiring an extensive amount of time and opportunistic finds to identify. Furthermore, coal flora plant species are not a rare as they have been recovered from other sites. It takes time and opportunistic finds to locate any pockets of preserved plants. Fossil vertebrates of this age are extremely rare and there are no known occurrences of vertebrate fossils associated with coals in southern Africa. Insect wings can occur with the leaves but they are extremely rare and difficult to find.

Furthermore, the associated flora is well known in the recorded literature. This notwithstanding, there is always a very small possibility that some new taxa may be discovered. To date no fossils have been reported from the Belfast area.

The general study area is disturbed through previous anthropogenic activities, such as mining and road construction. There does however remain a small chance that fossil plants may be identified where new excavations are made.

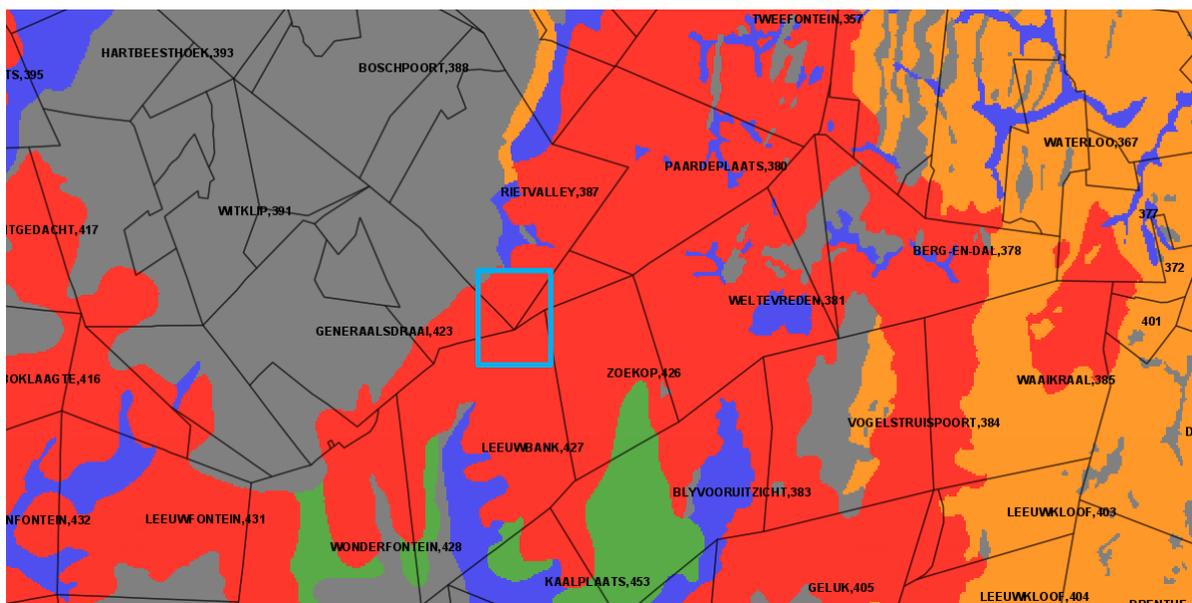


FIGURE 3-2: SAHRIS PALAEOSENSITIVITY MAP FOR THE AREA AROUND BELFAST. THE PROPOSED RESETTLEMENT SITE IS WITHIN THE BLUE RECTANGLE, IN THE NARROW PORTION (TOP LEFT) THAT IS JUST NORTH OF THE N4 HIGHWAY (ORANGE LINE). COLOURS INDICATE THE FOLLOWING DEGREES OF SENSITIVITY: RED = VERY HIGHLY SENSITIVE; ORANGE/YELLOW = HIGH; GREEN = MODERATE; BLUE = LOW; GREY = INSIGNIFICANT/ZERO.



Wide and narrow Glossopteris leaves



Narrow Glossopteris leaves



Lycopod stem with leaf abscission scars



Asterotheca (fern)

Hammanskraal fossil plants

FIGURE 3-3: : EXAMPLES OF FOSSIL LEAF IMPRESSIONS AND COMPRESSIONS OF THE GLOSSOPTERIS FLORA (ECCA GROUP) THAT MAY OCCUR WITHIN THE STUDY AREA.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 4-1:

TABLE 4-1: CRITERIA FOR ASSESSING IMPACTS

| PART A: DEFINITION AND CRITERIA | | |
|---|-----------|--|
| Criteria for ranking of the SEVERITY/NATURE of environmental impacts | H | Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action. |
| | M | Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. |
| | L | Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. |
| | L+ | Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. |
| | M+ | Moderate improvement. Will be within or better than the recommended level. No observed reaction. |
| | H+ | Substantial improvement. Will be within or better than the recommended level. Favourable publicity. |
| Criteria for ranking the DURATION of impacts | L | Quickly reversible. Less than the project life. Short term |
| | M | Reversible over time. Life of the project. Medium term |
| | H | Permanent. Beyond closure. Long term. |
| Criteria for ranking the SPATIAL SCALE of impacts | L | Localised - Within the site boundary. |
| | M | Fairly widespread – Beyond the site boundary. Local |
| | H | Widespread – Far beyond site boundary. Regional/ national |
| PROBABILITY (of exposure to impacts) | H | Definite/ Continuous |
| | M | Possible/ frequent |
| | L | Unlikely/ seldom |

TABLE 4-2: IMPACT ASSESSMENT

| PART B: ASSESSMENT | | |
|---------------------------|-----------|--|
| SEVERITY/NATURE | H | - |
| | M | - |
| | L | Excavation for water, sewerage, foundations, road access and infrastructure would not penetrate down to Seam 2. If these activities penetrate the shales closely associated with the coal the chance of finding fossil plants would be very small so there would be minor deterioration of the surface of sites and a minor impact on any potential fossils. Therefore the SEVERITY/NATURE of the environmental impact would be low. |
| | L+ | - |
| | M+ | - |
| | H+ | - |
| DURATION | L | - |
| | M | - |
| | H | Where manifest, the impact will be permanent. |
| SPATIAL SCALE | L | Since only the possible fossils within the area would be fossil plants such as leaf impressions from the <i>Glossopteris</i> flora in the shales, the spatial scale will be localised within the site boundary. |
| | M | - |
| | H | - |

| PART B: ASSESSMENT | | |
|--------------------|---|---|
| PROBABILITY | H | - |
| | M | - |
| | L | There is a very small chance of finding leaf fossils in the shales between coal seams because these have been reported from the same formations but not in this particular area. However, the probability of affecting any fossils is unlikely or seldom: L |

Based on the nature of the project, surface activities may impact on fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are sedimentary and of the correct age for fossil heritage to occur. One must consider however, the general project area is already highly disturbed through agricultural activities and various road works, as well as the potential fossiliferous seams are located well below the ground level. Taking account of the defined criteria, the potential impact to fossil heritage resources is low.

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the basement rocks, dolomites, sandstones, shales, coals, quartzites, basalts and volcanic rocks are typical for the country and do not contain any fossil material. The shales of the Vryheid Formation could contain impression fossils of plants of the *Glossopteris* flora, however, they have yet to be recorded from the proposed site for the resettlement of the various households.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is unlikely that any fossils will be identified in the proposed Belfast Resettlement Project area. Nonetheless lithostratigraphy associated with the Vryheid Formation are potentially fossiliferous, as indicated in the SAHRIS palaeosensitivity map. As there is a potential for chance finds, a monitoring protocol is recommended.

The following monitoring protocol must be adopted and implemented during earth moving activities:

1. The following procedure is only required if fossils are seen on the surface and when excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, plants, insects, bone, coal) should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
3. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones. This information will be built into the EMP's training and awareness plan and procedures.

4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. On a regular basis, to be agreed upon by the developer and the qualified palaeontologist sub-contracted for this project, the palaeontologist should visit the site to inspect the selected material and check any overburden dumps from construction activities where feasible. The frequency of inspections should be monthly until foundations are complete. However, if the onsite designated person is diligent and extracts the fossil material then inspections can be less frequent.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections would be necessary a final report by the palaeontologist can be sent to SAHRA.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Where the recommendation contained herein are adopted and implemented, the proposed development can go ahead from a palaeontological perspective. Any further palaeontological assessment would only be required after construction activities have commenced and fossils are found by the environmental personnel.

7. References

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