

The refurbishment of the existing 132kV
powerline from the Oasis Substation at Keimoes
to the Taaipit Substation at Kakamas, Northern
Cape Province

PALAEONTOLOGICAL DESK TOP STUDY

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3 March 2018

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1. Introduction

The palaeontological heritage of South Africa is unsurpassed and can only be described in superlatives. The South African palaeontological record gives us insight in i.a. the origin of dinosaurs and mammals. Fossils are also used to identify rock strata and determine the geological context of the subregion with other continents and played a crucial role in the discovery of Gondwanaland and the formulation of the theory of plate tectonics. South Africa is probably best known palaeontologically for having more than half of all the hominin specimens in the world, the greatest variety of hominins in a country and the longest record of continuous hominin occupation in the world.

The Heritage Act of South Africa stipulates that fossils and fossil sites may not be altered or destroyed. The purpose of this document is to detail the probability of finding fossils in the study area which may be impacted by the proposed development.

2. Terms of reference for the report

According to the South African Heritage Resources Act (Act 25 of 1999) (Republic of South Africa, 1999), certain clauses are relevant to palaeontological aspects for a terrain suitability assessment.

- **Subsection 35(4)** No person may, without a permit issued by the responsible heritage resources authority-
 - (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
 - (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
 - (c) trade in, sell for private gain, export or attempt to export from the republic any category of archaeological or palaeontological material or object, or any meteorite; or
 - (d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist with the detection or recovery of metals or archaeological material or objects, or use such equipment for the recovery of meteorites.
- **Subsection 35(5)** When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedures in terms of section 38 has been followed, it may-
 - (a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
 - (b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
 - (c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
 - (d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

South Africa's unique and non-renewable palaeontological heritage is protected in terms of the NHRA. According to this act, heritage resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

As areas are developed and landscapes are modified, heritage resources, including palaeontological resources, are threatened. As such, both the

environmental and heritage legislation require that development activities must be preceded by an assessment of the impact undertaken by qualified professionals. Palaeontological Impact Assessments (PIAs) are specialist reports that form part of the wider heritage component of:

- Heritage Impact Assessments (HIAs) called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority.
- Environmental Impact Assessment process as required in terms of other legislation listed in s. 38(8) of NHRA;
- Environmental Management Plans (EMPs) required by the Department of Mineral Resources.

HIAs are intended to ensure that all heritage resources are protected, and where it is not possible to preserve them in situ, appropriate mitigation measures are applied. An HIA is a comprehensive study that comprises a palaeontological, archaeological, built environment, living heritage, etc specialist studies. Palaeontologists must acknowledge this and ensure that they collaborate with other heritage practitioners. Where palaeontologists are engaged for the entire HIA, they must refer heritage components for which they do not have expertise on to appropriate specialists. Where they are engaged specifically for the palaeontology, they must draw the attention of environmental consultants and developers to the need for assessment of other aspects of heritage. In this sense, Palaeontological Impact Assessments that are part of Heritage Impact Assessments are similar to specialist reports that form part of the EIA reports. The standards and procedures discussed here are therefore meant to guide the conduct of PIAs and specialists undertaking such studies must adhere to them. The process of assessment for the palaeontological (PIA) specialist components of heritage impact assessments, involves:

Scoping stage in line with regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involves an **initial assessment** where the specialist evaluates the scope of the project (based, for example, on NID/BIDs) and advises on the form and extent of the assessment process. At this stage the palaeontologist may also decide to compile a **Letter of Recommendation for Exemption from further Palaeontological Studies**. This letter will state that there is little or no likelihood that any significant fossil resources will be impacted by the development. This letter should present a reasoned case for exemption, supported by consultation of the relevant geological maps and key literature.

A Palaeontological Desktop Study – the palaeontologist will investigate available resources (geological maps, scientific literature, previous impact assessment reports, institutional fossil collections, satellite images or aerial photos , etc) to inform an assessment of fossil heritage and/or exposure of potentially fossiliferous rocks within the study area. A Desktop studies will conclude whether a further field assessment is warranted or not. Where further

studies are required, the desktop study would normally be an integral part of a field assessment of relevant palaeontological resources.

A **Phase 1 Palaeontological Impact Assessment** is generally warranted where rock units of high palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large-scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed project area is unknown. In the recommendations of Phase 1, the specialist will inform whether further monitoring and mitigation are necessary. The Phase 1 should identify the rock units and significant fossil heritage resources present, or by inference likely to be present, within the study area, assess the palaeontological significance of these rock units, fossil sites or other fossil heritage, comment on the impact of the development on palaeontological heritage resources and make recommendations for their mitigation or conservation, or for any further specialist studies that are required in order to adequately assess the nature, distribution and conservation value of palaeontological resources within the study area.

A **Phase 2 Palaeontological Mitigation** involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or the recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before Phase 2 may be implemented.

A **'Phase 3' Palaeontological Site Conservation and Management Plan** may be required in cases where the site is so important that development will not be allowed, or where development is to co-exist with the resource. Developers may be required to enhance the value of the sites retained on their properties with appropriate interpretive material or displays as a way of promoting access of such resources to the public.

The assessment reports will be assessed by the relevant heritage resources authority, and depending on which piece of legislation triggered the study, a response will be given in the form of a Review Comment or Record of Decision (ROD). In the case of PIAs that are part of EIAs or EMPs, the heritage resources authority will issue a comment or a record of decision that may be forwarded to the consultant or developer, relevant government department or heritage practitioner and where feasible to all three.

3. Details of study area and type of assessment:

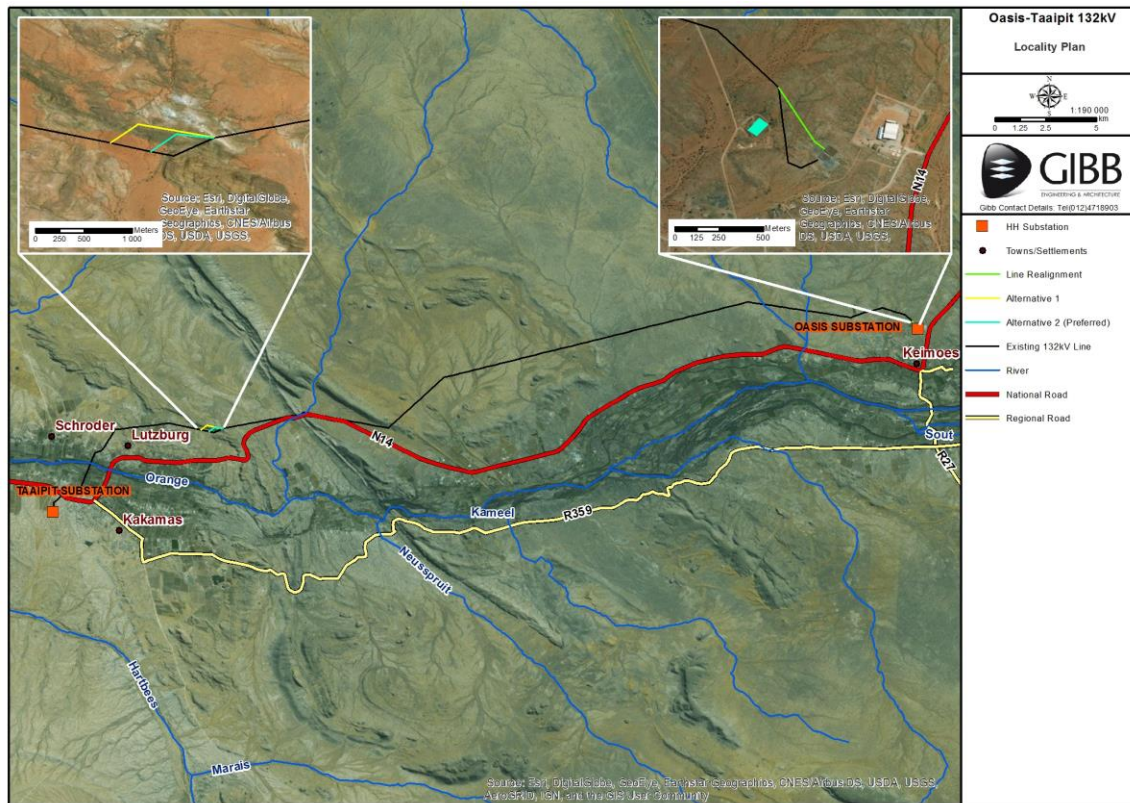
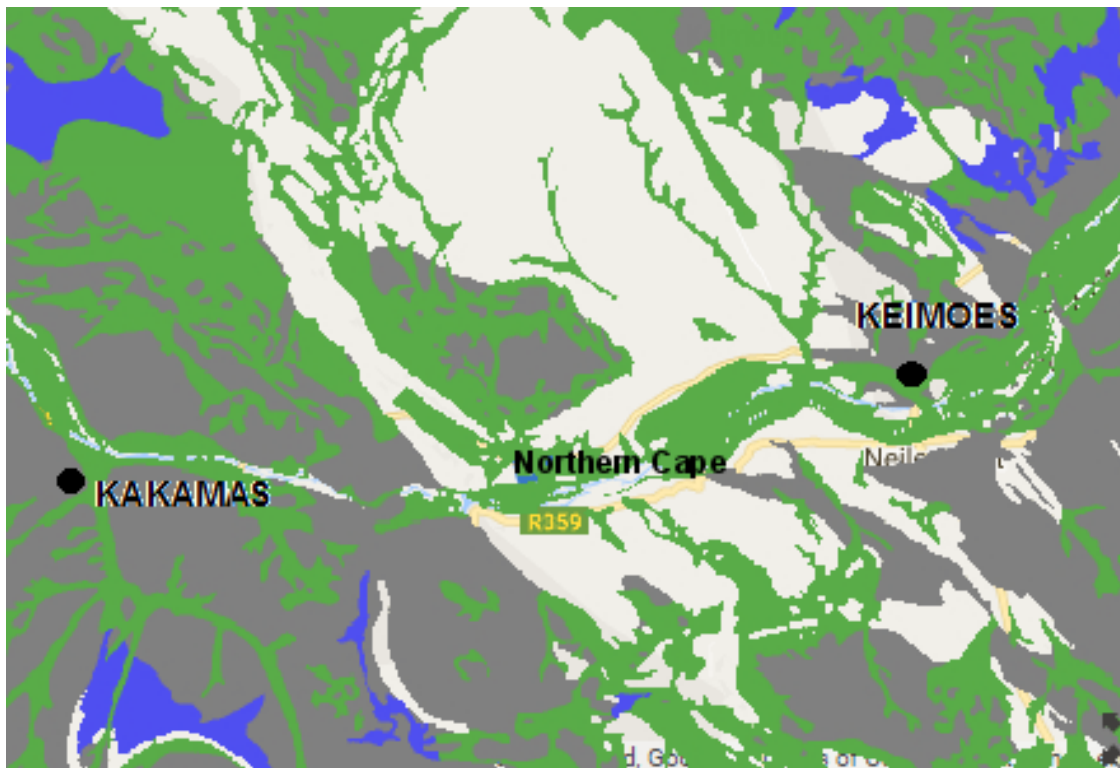


Figure 1: Map indicating study sites (GIBB, 2018)

The study area lies near the Orange River between the towns of Kakamas (Taaipit Substation) and Keimoes (Oasis Substation) (see Figure 1). The area slopes with a low gradient towards the river and the area on the banks of the Orange River is under cultivation.

The study area is classified as being of Moderate Palaeontological Sensitivity by SAHRA (see Figure 2). The relevant literature and geological maps have been studied for a Desk Top Study.



Colour	Palaeontological Significance	Action required
Green	Moderate	desktop study is required
Blue	Low	no palaeontological studies are required however a protocol for finds is required
Grey	Zero	no palaeontological studies are required
White	Unknown	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 2: Palaeontological sensitivity of the study area between Kakamas and Keimoes (PalaeoSensitivity Map at: <http://www.sahra.org.za/sahris/map/palaeo>)

4. Geological setting

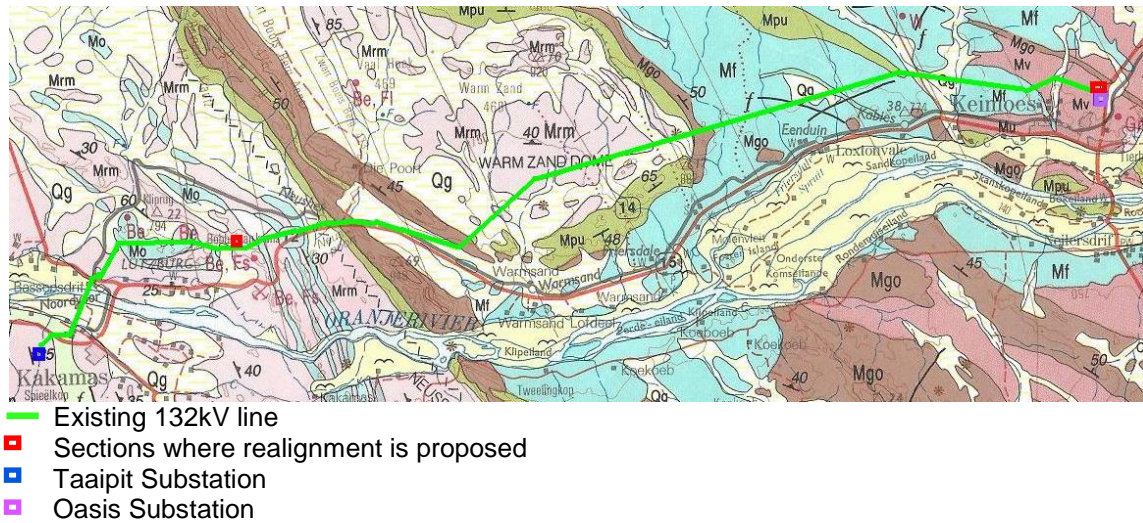


Figure 3: Geological map of the study area and surroundings (adapted from the 2820 Upington 1: 250 000 Geology Map (Geological Survey, 1988))

LEGEND

	Lithology	Formation		Age
	Alluvium			
Qg	Red-brown windblown sand and dunes	Gordonia	Kalahari Group	Quaternary
	Calcrete			Tertiary
Mu	Blue-grey quartzite, cross-bedded in places	Uitdraai	Brulpan Group	Mokolian and older
Mso	Fine to medium grained biotite gneiss, muscovite gneiss and sillimanite-bearing gneisses	Sout Rivier		
Mgo	Quartzite, lenses of conglomerate	Goedehoop	Korannaland Group	
Mpu	Quartz-rich and mafic calc-silicate rocks	Puntsit	Biesje Poort Subgroup of the Korannaland Group	
Mo	Leucocratic quartz-microcline and amphibolite gneiss, quartzite	Omdraai		
Mke	Migmatic, porphyroblastic biotite gneiss with amphibolite lenses, leucogneiss, marble and pelitic gneiss	Kenhardt migmatite	Hartbeesterivier Complex	
INTRUSIVE ROCKS				
Mf	Chamockitic adamellite	Friersdale Chamockite	Keimoes Suite	
Mv	Mesocratic, well-foliated adamellitic granite gneiss	Vaalputs granite		
Mrm	Pink-weathering granite gneiss	Riemvasmaak Gneiss		

The study area is underlain by metamorphic rocks of the Kakamas Terrane of the Namaqua-Natal Province. These Mokolian (Proterozoic) aged rocks are covered in places by layers of Quaternary age sand and alluvium (Partridge *et al.*, 2009).

The Korannaland Group consists of various lithologies of which the Puntsit and the Omdraai Formations of the Biesje Poort Subgroup and the Goede Hoop Formation are found in the study area. The Puntsit Formation which consists of calc-silicate and marble is found near the top of the subgroup. It is overlain by the megaquartzites of the Goede Hoop Formation (Cornell *et al.* 2006).

The area has been subjected to extensive intrusions and resultant thermal metamorphism of the Mokolian aged rocks. The Friersdale Chamockite and Vaalputs granite of the Keimoes Suite underlie the eastern part of the study area while the Riemvasmaak Gneiss dominates the western part of the study area (see Fig. 3).

Quaternary dunes, windblown sand and alluvium also occur in the study area and overlie the Mokolian aged metamorphic rocks and intrusives (see Fig. 3).

5. Palaeontological assessment of the region

The geological formations that are found in the study area are part of the Namaqua / Natal Province which contain the igneous and metamorphic rocks formed or metamorphosed during the Namaqua Orogeny approximately 1200 - 1000 Ma ago (Cornell *et al.*, 2006).

The Namaqua/Natal Province is subdivided into a number of tectonostratigraphic subprovinces and terranes based on marked changes in the lithostratigraphy across structural discontinuities. The study area falls in the Kakamas Terrane which was deposited in an intracratonic basin between the Kaapvaal Craton and the Namaqua continental mass. Over time the sediments were buried and metamorphosed due to increasing pressure and temperature. The collision between the newly formed Kakamas Terrane and the Bushmanland segment with the Kaapvaal Craton caused folding of this region. The Keimoes Suite igneous rocks intruded the metasedimentary rocks of the Kakamas Terrane when subduction and collision occurred (Shunqukela, 2014).

The study area is covered in part with the reddish sand of the Gordonia Formation of the Kalahari Group and alluvium associated with the Orange River which overlie the metamorphic rocks of the region. The fossil record of the Kalahari Group is sparse, occurs sporadically and is low in diversity. Although no fossils have been reported for the study area, fossils such as root casts, burrows, termitaria, ostrich egg shells, mollusc shells and isolated bones have been discovered in the Kalahari Group elsewhere (Almond & Pether 2008; Partridge *et al.*, 2006).

References:

- Almond, J.E. & Pether, J. (2008) Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.
- Cornell, D.H.; Thomas, R.J.; Moen, H.F.G.; Reid, D.L.; Moore, J.M. & Gibson, R.L. (2006). In: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (eds.), The Geology of South Africa. Geological Society of South Africa, Johannesburg/Council for Geoscience, Pretoria. 325-397.
- Geological Survey (1988) 2820 Upington 1: 250 000 Geology Map.
- Partridge, T.C., Botha, G.A. & Haddon, I.G. (2006). Cenozoic Deposits of the Interior. In: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (eds.), The Geology of South Africa. Geological Society of South Africa, Johannesburg. Council for Geoscience, Pretoria. 585-604.
- Shunqukela, T. (2014). A study of the structural geology of an area between the Neusspruit shear zone and the Brakfontein shear zone near Kakamas, Northern Cape. Unpublished MSc dissertation, University of Cape Town.

6. Conclusion and recommendations:

The overall palaeontological sensitivity of the study areas is considered to be moderate. The igneous rocks at the study sites are devoid of fossils. Fossils may occur but are rare in the aeolian sands of the Gordonia Formation of the Kalahari Group which overlie the igneous rocks in places at the study sites.

Due to the very low probability of fossils occurring in the study area it is recommended that the project should be exempted from further palaeontological studies.

In the unlikely event that fossils are found in the soil and sand cover in the study area the ECO should take the following steps:

PROCEDURE FOR CHANCE PALAEONTOLOGICAL FINDS

Extracted and adapted from the National Heritage Resources Act, 1999 Regulations Reg No. 6820, GN: 548.

The following procedure must be considered in the event that previously unknown fossils or fossil sites are exposed or found during the life of the project:

1. Surface excavations should continuously be monitored by the ECO and any fossil material be unearthed the excavation must be halted.
2. If fossiliferous material has been disturbed during the excavation process it should be put aside to prevent it from being destroyed.
3. The ECO then has to take a GPS reading of the site and take digital pictures of the fossil material and the site from which it came.
4. The ECO then should contact a palaeontologist and supply the palaeontologist with the information (locality and pictures) so that the palaeontologist can assess the importance of the find and make recommendations.
5. If the palaeontologist is convinced that this is a major find an inspection of the site must be scheduled as soon as possible in order to minimise delays to the development.

From the photographs and/or the site visit the palaeontologist will make one of the following recommendations:

- a. The material is of no value so development can proceed, or:
- b. Fossil material is of some interest and a representative sample should be collected and put aside for further study and to be incorporated into a recognised

fossil repository after a permit was obtained from SAHRA for the removal of the fossils, after which the development may proceed, or:

c. The fossils are scientifically important and the palaeontologist must obtain a SAHRA permit to excavate the fossils and take them to a recognised fossil repository, after which the development may proceed.

7. If any fossils are found then a schedule of monitoring will be set up between the developer and palaeontologist in case of further discoveries.

7. Declaration of Independence:

I, Jacobus Francois Durand declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.



Palaeontological specialist:

Dr JF Durand (Sci. Nat.)

BSc Botany & Zoology (RAU), BSc Zoology (WITS), Museology Dipl. (UP), Higher Education Diploma (RAU), PhD Palaeontology (WITS)

Palaeontological assessments:

- Urban development in Cradle of Humankind World Heritage Site (Gauteng): Letamo, Honingklip, Windgat, Sundowners, Ekutheni
- Urban development at Goose Bay, Vereeniging, Gauteng
- Urban development on Portions 98, 99, 179, 236, 284 and 364 of the farm Waterkloof 306 JQ, Rustenburg, North West Province
- Upgrade of R21 between N12 and Hans Strydom Drive, Gauteng
- Vele Colliery, Limpopo Province
- De Wildt 50 MW Solar Power Station, Gauteng
- 10 MW PV Plant Potchefstroom, North West Province
- Omega 342 50MW Solar Power Station, Viljoenskroon, Free State
- Springfontein wind and solar energy facility, Free State
- Solar power plant, Bethal, Mpumalanga
- Diamond mine on Endora, Limpopo Province
- Development at Tubatse Ext.15, Limpopo Province
- Manganese mine south of Hotazel, Northern Cape
- Wind energy facility at Cookhouse, Eastern Cape
- Energy facility at Noupoort, Northern Cape
- Fluorspar mine near Wallmannsthal, Gauteng
- ESKOM power line, Dumo, KwaZulu-Natal
- ESKOM Gamma-Omega 765KV transmission line, Western Cape
- ESKOM 44KV power line at Elandspruit near Middelburg, Mpumalanga
- ESKOM Makopane Substation, Limpopo Province
- ESKOM Platreef Substation and power lines to Borutho MTS Substation, Limpopo Province
- Solar energy facility at Prieska, Northern Cape.
- Marang B - a 3 x 500MVA 400/132kV Main Transmission Substation east of Rustenburg, North West Province
- Upgrading of storm water infrastructure in Valencia, Addo, Eastern Cape

- Development of a 10 MW Solar Energy facility on the Farm Liverpool 543 KQ Portion 2 at Koedoeskop, Limpopo Province
- Development of a fluorspar mine at Wallmannsthal, North of Pretoria
- Extension of limestone mine on the farms Buffelskraal 554 KQ Portion1 and Krokodilkraal 545 KQ, Limpopo Province
- Lesego Platinum Mine, Sekhukhune Area, Steelpoort, Limpopo Province
- Mine at Hotazel, Northern Cape
- Pollution control dams at Transalloys in Clewer, Emalahleni, Mpumalanga
- Erection of spill points on the Farm Kwikstaart 431 KQ Portion 2, Thabazimbi, Limpopo Province
- Construction of dam at Ethemba, Swaziland
- Construction of bridge at Busingatha, KwaZulu Natal
- Water Reticulation System - Kei Road and Berlin General, Eastern Cape
- Development at Kromdraai, COHWHS (Portion 26 of the Farm Kromdraai, West Rand Municipality)
- Construction of Nhlezi Bridge, KwaZulu Natal
- Erection of spill point and dam on the Farm Faure 72 KQ Portion 8, Makoppa near Thabazimbi, Limpopo Province
- Colliery on the Farm Goedeheop near Piet Retief, Mpumalanga
- Erection of spill points on the Farm Diepwater 302 KQ Portions 4 -8 near Thabazimbi, Limpopo Province
- Construction of 2 MW photovoltaic power plant on the farm De Hoek 32, Pixley ka Seme District Municipality, Northern Cape Province
- Road upgrade near Magogo, KwaZulu/Natal
- Construction of haul road & waste dump: Lylyveld, Sishen, Northern Cape
- Construction of 4 weirs and a road culvert on Portion 3 of the Farm Roodekrans 133JT, Dullstroom Area, Mpumalanga
- Construction of a solar energy facility on Blaubospan near Groblershoop, Northern Cape
- Construction of road from Macengeni to Macijo, KwaZulu/Natal
- Construction of the John Taole Gaetsewe school and hostels in Dithakgong, Northern Cape
- Development at Duduza Township, Gauteng
- Construction of roads near Ndanyana KwaZulu/Natal
- Development of colliery on the farm Goedeheop near Piet Retief, Mpumalanga
- Development of orchards on the Farm Kromdraai, near Thabazimbi, Limpopo Province.
- Upgrade of Section 3 and Section 4 of the National Route R75, Eastern Cape.
- Construction of Concentrated Power Plants at Olyvenhout Drift, Upington, Northern Cape.
- Borrow pit at New Payne in Mthatha, Eastern Cape.
- Borrow pit for rural road to Centuli Clinic, Eastern Cape.
- Juno Gromis 400kV power line (West Cape and North Cape).
- Barberton IAPS Waste Water Treatment Works, Barberton, Mpumalanga.

- Development of orchards on the Farm Kromdraai, Thabazimbi, Limpopo Province.
 - Erection of spill points on the farm Knoppieskop, Limpopo Province.
 - Development at O.R. Tambo International Airport, Gauteng.
 - Development on Portion 12 of the Farm Tregaron in the Sundays River Municipality, Eastern Cape
 - Development of spill points and dam on the Farm Fairfield 306 KQ, Makoppa near Thabazimbi, Limpopo Province
 - Development of 800 ha dry lands on Farm Hoylesdale 163 KQ portion 1, Makoppa, Thabazimbi Local municipality, Limpopo Province
 - Construction of solar energy facility on Blauwpospan near Groblershoop, Northern Cape.
 - Development of the Doornhoek Fluorspar Mine near Zeerust, Northwest.
 - Development on the Farm Haakdoringdrift, 373 KQ Portion 3, Thabazimbi, Limpopo Province.
 - Development of bulk sewer line, Motherwell, Eastern Cape.
 - Erection of spill points on the Farm De Hoop, Koedoeskop, near Thabazimbi, Limpopo Province,
 - Construction of Tiger Solar power plant near Windsorton, Northern Cape,
 - Development of Amandelbult Open Cast Mine near Thabazimbi, Limpopo
 - Development at The Shed in the Cradle of Humankind World Heritage Site
 - Development of 800 ha dry lands on Farm Hoylesdale 163 KQ portion 1, Makoppa, Thabazimbi Local municipality, Limpopo Province,
 - Construction of solar energy facility on Blauwpospan near Groblershoop, Northern Cape,
 - Proposed development at Jeffreys Bay, Eastern Cape,
 - Development of the Doornhoek Fluorspar Mine near Zeerust, Northwest,
 - Development on the Farm Haakdoringdrift, Thabazimbi, Limpopo,
 - Proposed improvement of National Route R510 Section 2 from Bierspruit Bridge to Thabazimbi, Limpopo Province,
 - Development at O.R. Tambo International Airport, Gauteng.
 - Development on Portion 12 of the Farm Tregaron in the Sundays River Municipality, Eastern Cape,
 - Proposed development at Erasmus Park, Pretoria, Gauteng,
 - Development of spill points and dam on the Farm Fairfield 306 KQ, Makoppa near Thabazimbi, Limpopo Province,
 - Electrification project in the Taung Skull Site buffer zone in Buxton, North West Province,
 - Erection of spill points on the Farm Faure near Thabazimbi, Limpopo Province,
 - Development of Marang Solar Energy Facility on Blauwbospan near Groblershoop, Northern Cape.
 - Construction of the Sorata-Witsieshoek 132kV Power Line, Free State.
 - Development of remaining extent of Holding 22 Waterval Small Holdings JQ, Rustenburg, North West Province.
 - Road upgrade at Matla Coal Mine near Kriel, Mphumalanga.
-

- Mining right (diamonds) on the Farm Palmietfontein 208JP, near Pilanesberg, Moses Kotane Local Municipality, Bojanala District, Northwest.
- Construction of a power line from Foskor MTS near Phalaborwa to Spencer MTS near Tzaneen and the establishment of a transformation yard at Spencer MTS, Limpopo.
- Mining development on Thorncliffe and Helena Farms near Steelpoort, Sekhukhune District Municipality, Limpopo Province

Palaeontological research:

- Gauteng: Wonder Cave
- KwaZulu/Natal: Newcastle, Mooi River, Rosetta, Impendle, Himeville Underberg, Polela & Howick Districts, Sani Pass
- Eastern Cape: Cradock District, Algoa Basin
- Western Cape: Clanwilliam District
- Free State: Memel & Warden Districts
- Limpopo Province: Nyalaland (KNP), Vhembe Reserve, Pont Drift
- Zimbabwe: Sentinel Ranch, Nottingham