Phase 1 Palaeontological Impact Assessment of a proposed new 132 kV transmission line between the Harvard and Noordstad Substations, Bloemfontein, Free State Province.

Dr. L Rossouw
National Museum
PO Box 266
Bloemfontein
9300
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Summary

At the request of Enviroworks Environmental Consultants, a Phase 1 Archaeological Impact Assessment was conducted for a proposed new 36km-long, 132 kV overhead transmission line from the Harvard to Noordstad Substations located west and north of Bloemfontein in the Free State Province. The powerline footprint traverses existing road reserves, degraded farmland and areas formerly disturbed by the residential developments. The associated distribution center footprints are located on degraded farmland, areas formerly disturbed by the residential developments and relatively undisturbed patches of open veld. A pedestrian survey of the distribution center and aboveground powerline footprints revealed no evidence of palaeontologically sensitive outcrop, especially associated with high relief topography in the case of the Tierberg Formation and Adelaide Subgroup. They are also regarded as of low palaeontological significance with regards to dolerite contact zones as well as the overlying Quaternary component. The reason for the latter is mainly due to a lack of suitable alluvial/fluvial deposits along the routes. As far as the palaeontological heritage is concerned, proposed development with regard to the distribution center and aboveground powerline footprints may proceed with no additional heritage assessments necessary, provided that excavations do not exceed areas larger than 1 m^2 and depths >1 m into fresh sedimentary bedrock. If so, such excavations , will need further monitoring by a professional palaeontologist as part of a follow-up Phase 1 Palaeontological Impact Assessment during the construction phase of the project. As far as the palaeontological heritage for the Underground Section between Olivier and Mimosa is concerned, the proposed development may proceed with no additional heritage assessments necessary at this stage. However, excavations into fresh sedimentary bedrock will need further monitoring by a professional palaeontologist as part of a follow-up Phase 1 Palaeontological Impact Assessment during the construction phase of the project.

Contents

Introduction

At the request of Enviroworks Environmental Consultants, a Phase 1 Palaeontological Impact Assessment was conducted for a proposed new 36km-long, 132 kV overhead transmission line from the Harvard to Noordstad Substations located west and north of Bloemfontein in the Free State Province (**Fig. 1**). Planned development also includes the construction of 6 distribution centers, each covering approximately 1ha (**Fig. 2 & 3**).

The assessment is required as a prerequisite for new development in terms of the National Environmental Management Act and is also called for in terms of the National Heritage Resources Act (NHRA) 25 of 1999. The region's unique and non-renewable archaeological heritage sites are 'Generally' protected in terms of the National Heritage Resources Act and may not be disturbed at all without a permit from the relevant heritage resources authority. As many such heritage sites are threatened daily by development, both the environmental and heritage legislation require impact assessment reports that identify all heritage resources in the area to be developed, and that make recommendations for protection or mitigation of the impact of such sites.

Terms of Reference

The task involved the following:

- Identify and map possible heritage sites and occurrences using available resources.
- Determine and assess the potential impacts of the proposed development on potential heritage resources;
- Recommend mitigation measures to minimize potential impacts associated with the proposed development.

Methodology

The heritage significance of the affected area was evaluated on the basis of existing field data, database information and published literature. This was followed by a field assessment by means of a pedestrian survey. A Garmin Etrex Vista GPS hand model (set to the WGS 84 map datum) and a digital camera were used for recording purposes. Relevant publications, aerial photographs (incl. Google Earth), geological maps and site records were consulted

and integrated with data acquired during the on-site inspection.

Assumptions and Limitations

The presentation of geological units present within the study area is derived from the 1:1 000 000 scale map of South Africa and the 1:250 000 scale geological maps 2926 Bloemfontein and 2826 Winburg, which may vary in their accuracy. It is also assumed, for the sake of prudence, that fossil remains are always uniformly distributed in fossil-bearing rock units, although in reality their distribution may vary significantly.

Locality data

1: 50 000 scale topographic map: 2926AA Bloemfontein

1:250 000 scale geological maps 2926 Bloemfontein and 2826 Winburg.

The development footprint is located on the northwestern outskirts of Bloemfontein between the R64 provincial road going northwest to Dealesville and the R30 provincial road going north to Brandfort (**Fig. 3**).

Site coordinates:

Existing Harvard Substation: 29° 6'6.34"S 26° 7'51.95"E
Existing Noordstad Substation: 29° 3'14.62"S 26°13'38.54"E
Outspan Distribution Centre: 29° 4'11.28"S 26° 8'28.35"E
Rooidam Distribution Centre: 29° 2'38.50"S 26° 8'44.97"E
Olivier Distribution Centre: 29° 3'1.89"S 26°10'11.97"E
Tevrede Distribution Centre: 29° 1'8.37"S 26°10'17.59"E
Mimosa Distribution Centre: 29° 0'41.37"S 26°13'58.18"E
Hillandale Distribution Centre: 29° 2'17.43"S 26°12'45.58"E

Geology

According to the geological maps the proposed power line routes are located on Early Permian shales and subordinate, fine-grained sandstone of the Ecca Group, Tierberg Formation (*Pt,* (Karoo Supergroup), outcropping to the west of the footprint and Late Permian mudstone layers of the overlying Adelaide Subgroup (*Pa,* Karoo Supergroup,

Beaufort Group) (Theron 1966; Nolte 1995; Johnson 2006) (**Fig. 4**). These sedimentary rocks form the base on which younger, superficial deposits of Quaternary age have been deposited (Partridge *et al*. 2006). Thick deposits of Quaternary windblown sand mantle the study area to the west and northwest. The wind-blown sands represent the latest geological phase and are made up of the characteristically red-brown Kalahari sands (Hutton sands). In addition to the aeolian sand, superficial sediments consist mainly of well-developed, residual soils disturbed by modern farming practices and human activities. Alluvial deposits are generally are well-developed, especially along the Modder River and its tributaries north of Bloemfontein. Dykes and sills of resistant Jurassic dolerite intrusions are common in the area.

Background

The local palaeontological footprint is primarily represented by Early to Late Permian Karoo plants, ichnofossils and vertebrate fauna as well as Late Cenozoic (Quaternary Period, comprising the Pleistocene and Holocene Epochs) mammalian fossils. Fossils from the Early Permian Tierberg Formation are poorly represented and occur mainly as sparsely distributed and generally not diverse assemblages of trace fossils (Anderson 1976; De Beer *et al*. 2002; Viljoen 2005; Johnson *et al.* 2006). These ichno-assemblages include arthropod trackways and associated resting impressions, fish swimming trails, horizontal epichnial furrows often attributed to gastropods, as well as a variety of different kinds of small burrows. Impressions of *Gondwanidium validum* and pieces of *Dadoxylon* have been discovered between Douglas and Belmont, south of Kimberley (McLaren 1976). Sponge spicules, fish scales and disarticulated microvertebrate remains from calcareous concretions have also been recorded (Zawada 1992, Bosch 1993). The Beaufort Group geological strata within the affected area are assigned to the *Dicynodon* Assemblage Zone (AZ) (**Fig. 5**). Therapsids from this biozone occur generally well-preserved in mudrock horizons and are usually found as dispersed and isolated specimens associated with an abundance of calcareous nodules (Kitching 1995) (**Fig. 6**). Molluscs, insects, plant (*Dadoxylon, Glossopteris*) and trace fossils (arthropod trails, worm burrows) are also occur in the biozone. Alluvial deposits of the nearby Modder River and its tributaries north of the footprint area, are associated with abundant Quaternary mammalian fossils (**Fig. 7**). The

river's fossil-bearing potential has been known for almost 150 years, with a frontlet and horn cores of *Pelorovis antiquus* recovered as far back as 1839 (Cooke 1955) and the remains of *Megalotragus priscus* discovered around the turn of the previous century (Broom 1909).

Field Assessment

The powerline footprint traverses existing road reserves, degraded farmland and areas formerly disturbed by the residential developments (**Fig. 8**). The associated distribution center footprints are located on degraded farmland, areas formerly disturbed by the residential developments and relatively undisturbed patches of open veld (**Fig. 9**).

Impact Statement and Recommendations

Harvard Connection to Outspan and Olivier loop-in (Cecilia loop-in)

The section primarily traverses existing road reserves, degraded farmland and areas formerly disturbed by the residential developments. A pedestrian survey revealed no evidence of palaeontologically sensitive outcrop, especially associated with high relief topography in the case of the Tierberg Formation and Adelaide Subgroup. It is also regarded as of low palaeontological significance with regards to dolerite contact zones as well as the overlying Quaternary component (**Table 1**). The reason for the latter is mainly due to a lack of suitable alluvial/fluvial deposits along the route. As far as the palaeontological heritage is concerned, the proposed development may proceed with no additional heritage assessments necessary, provided that excavations do not exceed areas larger than 1 m^2 and depths >1 m into fresh sedimentary bedrock. If so, such excavations , will need further monitoring by a professional palaeontologist as part of a follow-up Phase 1 Palaeontological Impact Assessment during the construction phase of the project.

Rooidam to Tevrede and Mimosa loop-in

The section primarily traverses existing road reserves, degraded farmland and areas formerly disturbed by the residential developments. The Rooidam, Tevrede and Mimosa distribution centre footprints are located on old or existing farmland. A pedestrian survey revealed no

evidence of palaeontologically sensitive outcrop, especially associated with high relief topography in the case of the Adelaide Subgroup. It is also regarded as of low palaeontological significance with regards to dolerite contact zones as well as the overlying Quaternary component. The reason for the latter is mainly due to a lack of suitable alluvial/fluvial deposits along the route. As far as the palaeontological heritage is concerned, the proposed development may proceed with no additional heritage assessments necessary, provided that excavations do not exceed areas larger than 1 m^2 and depths >1 m into fresh sedimentary bedrock. If so, such excavations , will need further monitoring by a professional palaeontologist as part of a follow-up Phase 1 Palaeontological Impact Assessment during the construction phase of the project.

Mimosa to Noordstad Connection loop

The section primarily traverses existing road reserves, degraded farmland, areas formerly disturbed by the residential developments as well as undisturbed open veld. A pedestrian survey revealed no evidence of palaeontologically sensitive outcrop, especially associated with high relief topography in the case of the Adelaide Subgroup. It is also regarded as of low palaeontological significance with regards to dolerite contact zones as well as the overlying Quaternary component. The reason for the latter is mainly due to a lack of suitable alluvial/fluvial deposits along the route. As far as the palaeontological heritage is concerned, the proposed development may proceed with no additional heritage assessments necessary, provided that excavations do not exceed areas larger than 1 m^2 and depths >1 m into fresh sedimentary bedrock. If so, such excavations will need further monitoring by a professional palaeontologist as part of a follow-up Phase 1 Palaeontological Impact Assessment during the construction phase of the project.

Hillandale loop-in (Alternative 1)

The section primarily traverses existing road reserves, degraded farmland and areas formerly disturbed by the residential developments. A pedestrian survey revealed no evidence of palaeontologically sensitive outcrop, especially associated with high relief topography in the case of the Adelaide Subgroup. It is also regarded as of low palaeontological significance with regards to dolerite contact zones as well as the overlying Quaternary component. The reason for the latter is mainly due to a lack of suitable alluvial/fluvial deposits along the route. As far as the palaeontological heritage is concerned, the proposed development may

proceed with no additional heritage assessments necessary, provided that excavations do not exceed areas larger than 1 m^2 and depths >1 m into fresh sedimentary bedrock. If so, such excavations will need further monitoring by a professional palaeontologist as part of a follow-up Phase 1 Palaeontological Impact Assessment during the construction phase of the project.

Hillandale loop-in (Alternative 2)

The section primarily traverses degraded farmland and undisturbed open veld. A pedestrian survey revealed no evidence of palaeontologically sensitive outcrop, especially associated with high relief topography in the case of the Adelaide Subgroup. It is also regarded as of low palaeontological significance with regards to dolerite contact zones as well as the overlying Quaternary component. The reason for the latter is mainly due to a lack of suitable alluvial/fluvial deposits along the route. As far as the palaeontological heritage is concerned, the proposed development may proceed with no additional heritage assessments necessary, provided that excavations do not exceed areas larger than 1 m^2 and depths >1 m into fresh sedimentary bedrock. If so, such excavations will need further monitoring by a professional palaeontologist as part of a follow-up Phase 1 Palaeontological Impact Assessment during the construction phase of the project.

Underground Section between Olivier and Mimosa

The section primarily traverses degraded farmland and undisturbed open veld. A pedestrian survey revealed no evidence of palaeontologically sensitive outcrop, especially associated with high relief topography in the case of the Adelaide Subgroup. It is also regarded as of low palaeontological significance with regards to the Quaternary component. This is mainly due to a lack of suitable alluvial/fluvial deposits along the route. As far as the palaeontological heritage is concerned, the proposed development may proceed with no additional heritage assessments necessary at this stage. However, excavations into fresh sedimentary bedrock will need further monitoring by a professional palaeontologist as part of a follow-up Phase 1 Palaeontological Impact Assessment during the construction phase of the project.

References

Anderson, A.M. 1976. Fish trails from the Early Permian of South Africa. *Palaeontology* 19: 397-409, pl. 54.

Broom, R. 1909. On a large extinct species of Bubbalus. *Annals of the South African Museum* 7:219 – 280.

Churchill, S.E., Brink, J.S., Berger, L.R. Hutchison, R.A., Rossouw L., *et. al*. 2000. Erfkroon: a new Florisian fossil locality from fluvial contexts in the western Free State, South Africa. *South.African Journal of Science* 96: 161 – 163.

Duncan, A.R. and Marsh, J.S. 2006. The Karoo Igneous Province. In: Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa, pp. 501 - 520. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

Johnson *et al*. 2006. Sedimentary rocks of the Karoo Supergroup. **In**: M.R. Johnson, *et. al*. (eds). *The Geology of South Africa*. Geological Society of South Africa.

Kitching, J.W. 1977. *The distribution of the Karoo Vertebrate fauna*. BPI Memoir 1. University of the Witwatersrand.

Kitching, J.W. 1995. Biostratigraphy of the Dicynodon AZ. **In**: B.S. Rubidge, *Biostratigraphy of the Beaufort Group*. Biostrat. Ser. S.Afr. Comm. Strat. 29 – 34.

Nolte, 1995. The geology of the Winburg area. Explanation to 2826 Winburg. *Geological Survey*, Pretoria 60 pp.

Rossouw, L. 2006. Florisian mammal fossils from erosional gullies along the Modder River at Mitasrust farm, central Free State, South Africa. *Navorsinge van die Nasionale Museum* 22(6): 145-162.

Theron, J.C 1966. 1:250000 scale Geological Map 2926 Bloemfontein. Compiled by Theron, J.C. from mapping by Spies, J.J, 1942, & Aerial photo interpretation by Fourie, G.P., Joubert, C.V., Le Roux, J.S., Theron, J.C. 1952-62 & students of the University of the Orange Free State 1956-61. Council for Geoscience. Pretoria.

Viljoen, J.H.A. 2005. Tierberg Formation. SA Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 8: 37-40.

DECLARATION OF INDEPENDENCE

I, Lloyd Rossouw, declare that I act as an independent specialist consultant. I do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work as stipulated in the terms of reference. I have no interest in secondary or downstream developments as a result of the authorization of this project.

16 / 08 / 2017

Tables & Figures

Table 1. Summary of potential impacts.

Area	**Potential Impact**	**Probability**
Ecca Group Tierfontein Formation (Early Permian)	Low-Moderate potential to destroy plant and trace fossils	Low
Adelaide Subgroup rocks (Late Permian)	High potential to destroy plant and large vertebrate fossil remains	Low (distribution center and aboveground powerline footprints) Moderate (Underground Section between Olivier and Mimosa)
Floodplain / overbank deposits	High potential to destroy Plio-Pleistocene fossil remains	Low
Pan margins & springs	High potential to destroy Pleistocene fossil remains	Low
Dolerite zone	No fossil potential	Low

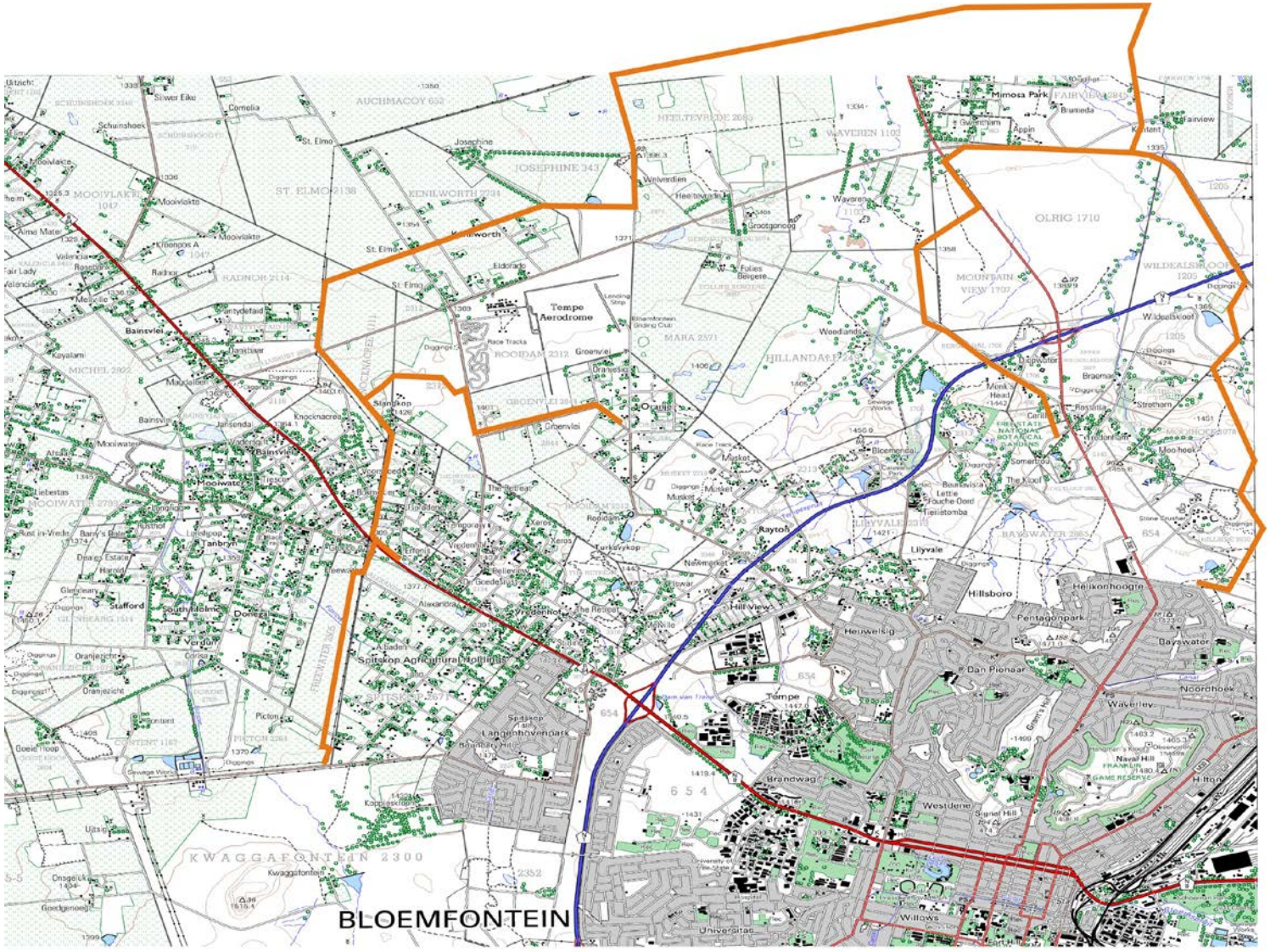

Figure 1. The proposed new 132 kV transmission line between the Harvard and Noordstad Substations, marked on portion of 1:50 000 scale topographic 2926 AA Bloemfontein.

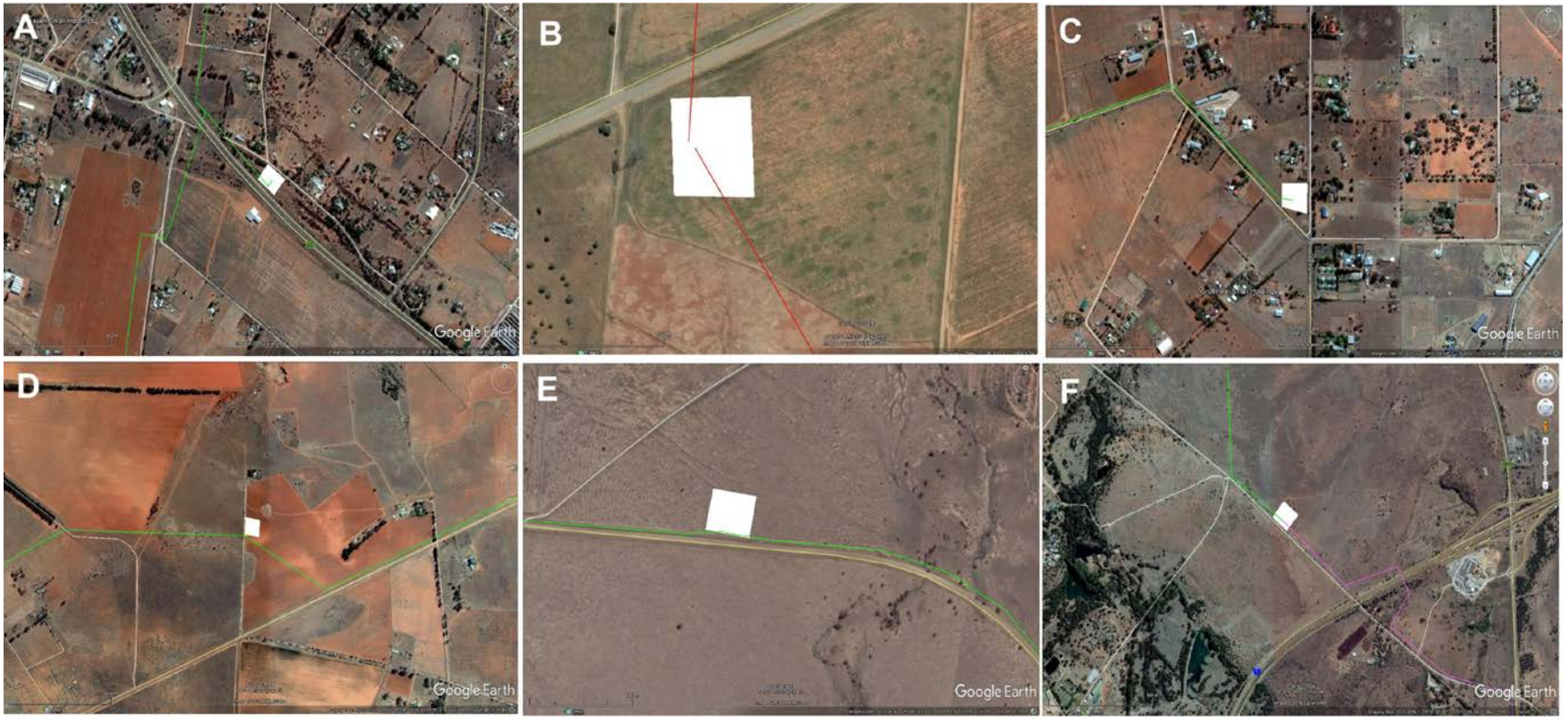

Figure 2. Aerial view of the (A) Outspan, (B) Rooidam, (C) Olivier, (D) Tevrede, (E) Mimosa and (F) Hillandale Distribution Centre footprints.

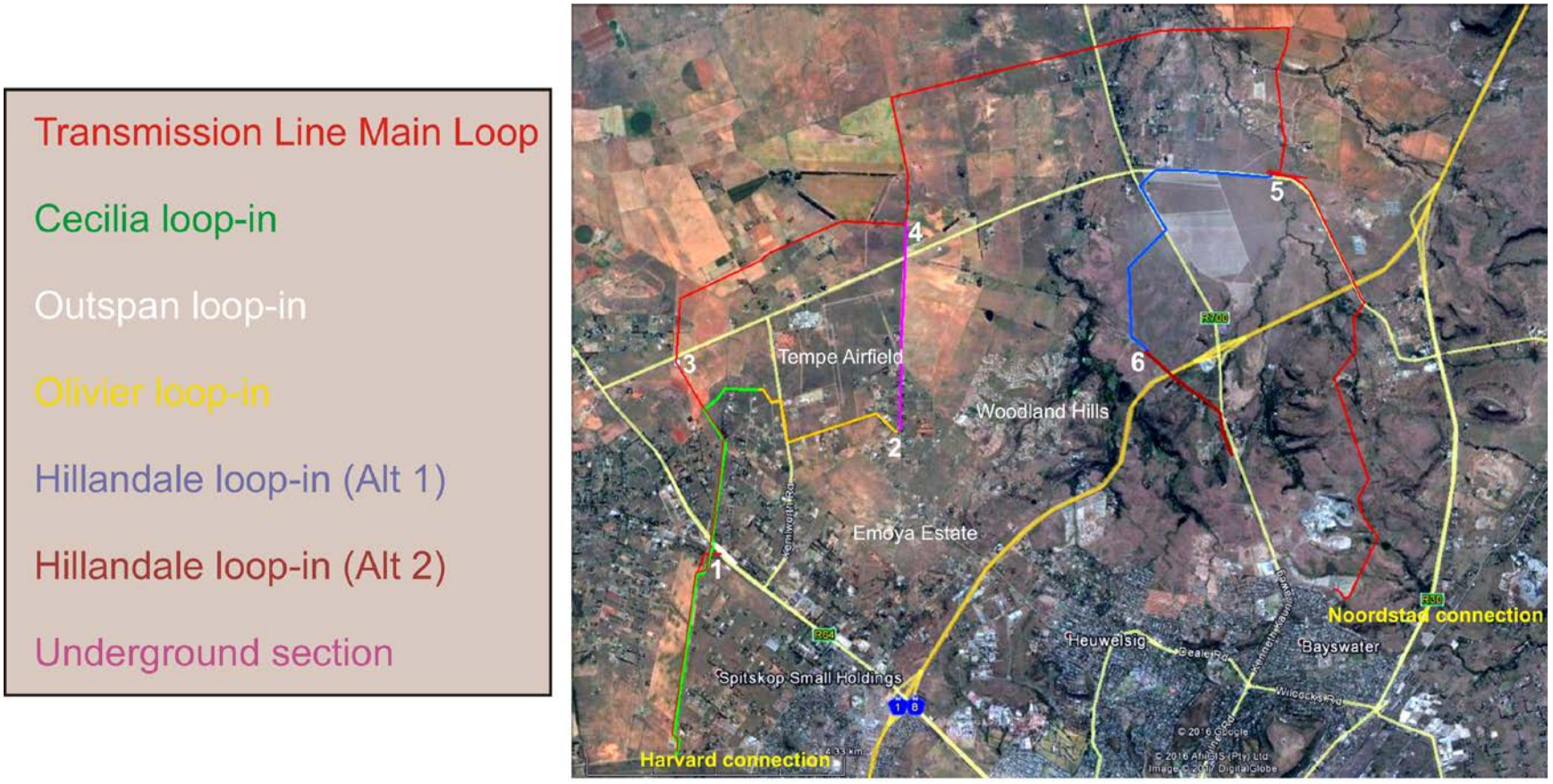

Figure 3. Aerial view of the proposed overhead powerline sections and alternatives. The distribution centre localities are numbered 1 Outspan, 2 Olivier, 3 Rooidam, 4 Tevrede, 5 Mimosa and 6 Hillandale.

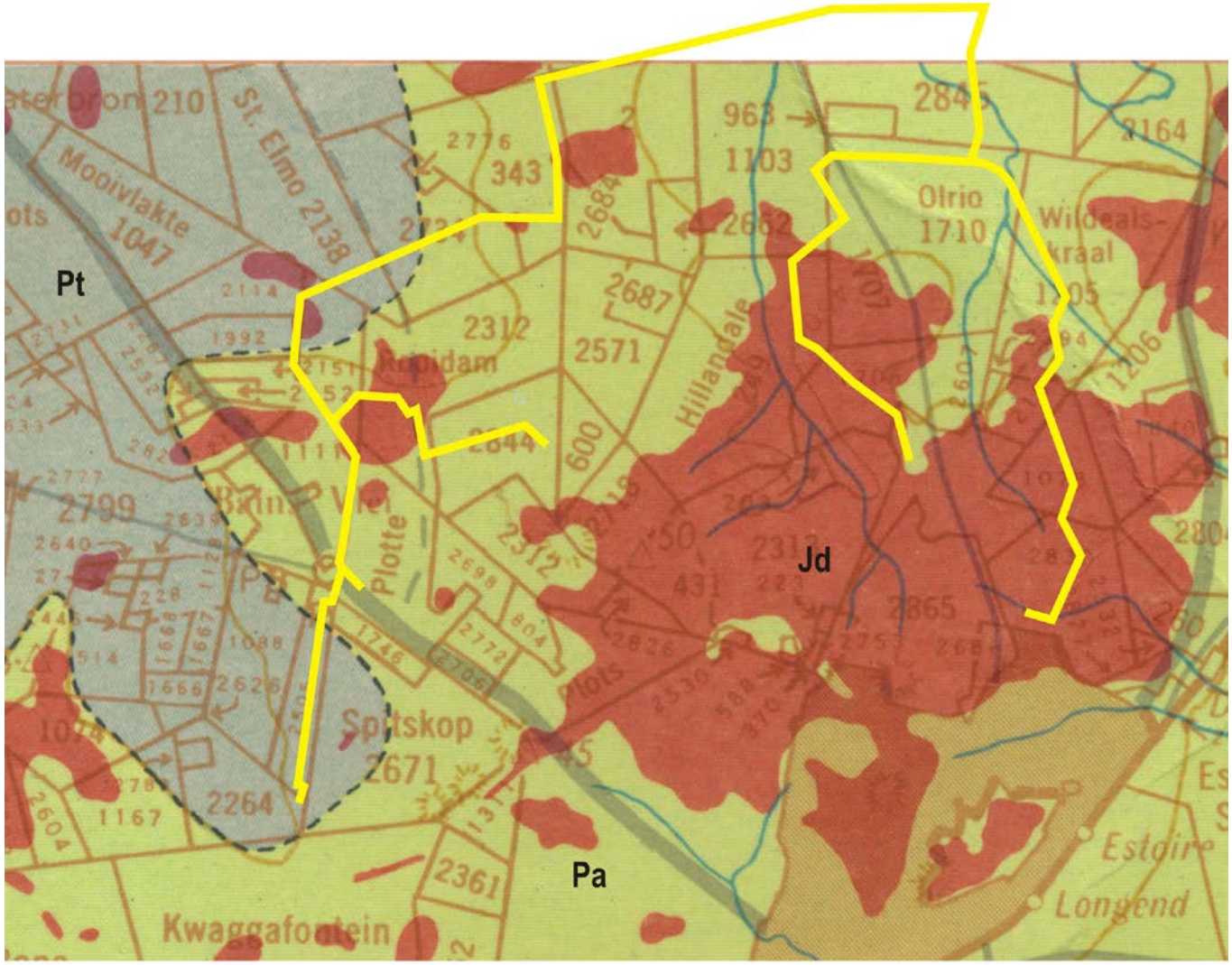

Figure 4. Portion of the 1:250 000 scale geological map Bloemfontein 2926. The route (yellow line) is situated within Karoo Supergroup rocks of the Early Permian Ecca Group (*Pt*) and overlying Adelaide Subgroup (*Pa*) The sedimentary rocks are intruded by resistant Jurassic dolerites (*Jd*).

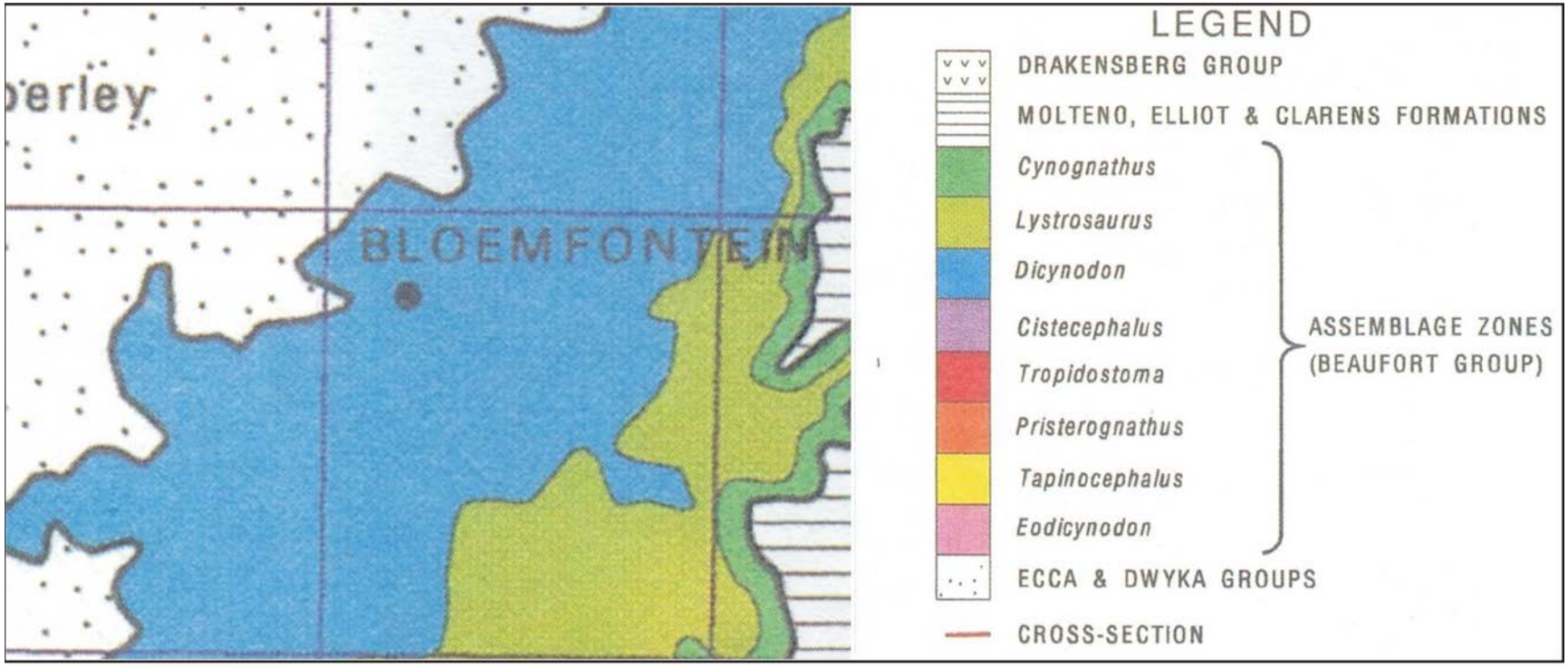

Figure 5. Distribution of vertebrate biozones of the Beaufort Group around Bloemfontein (after Rubidge 1995).

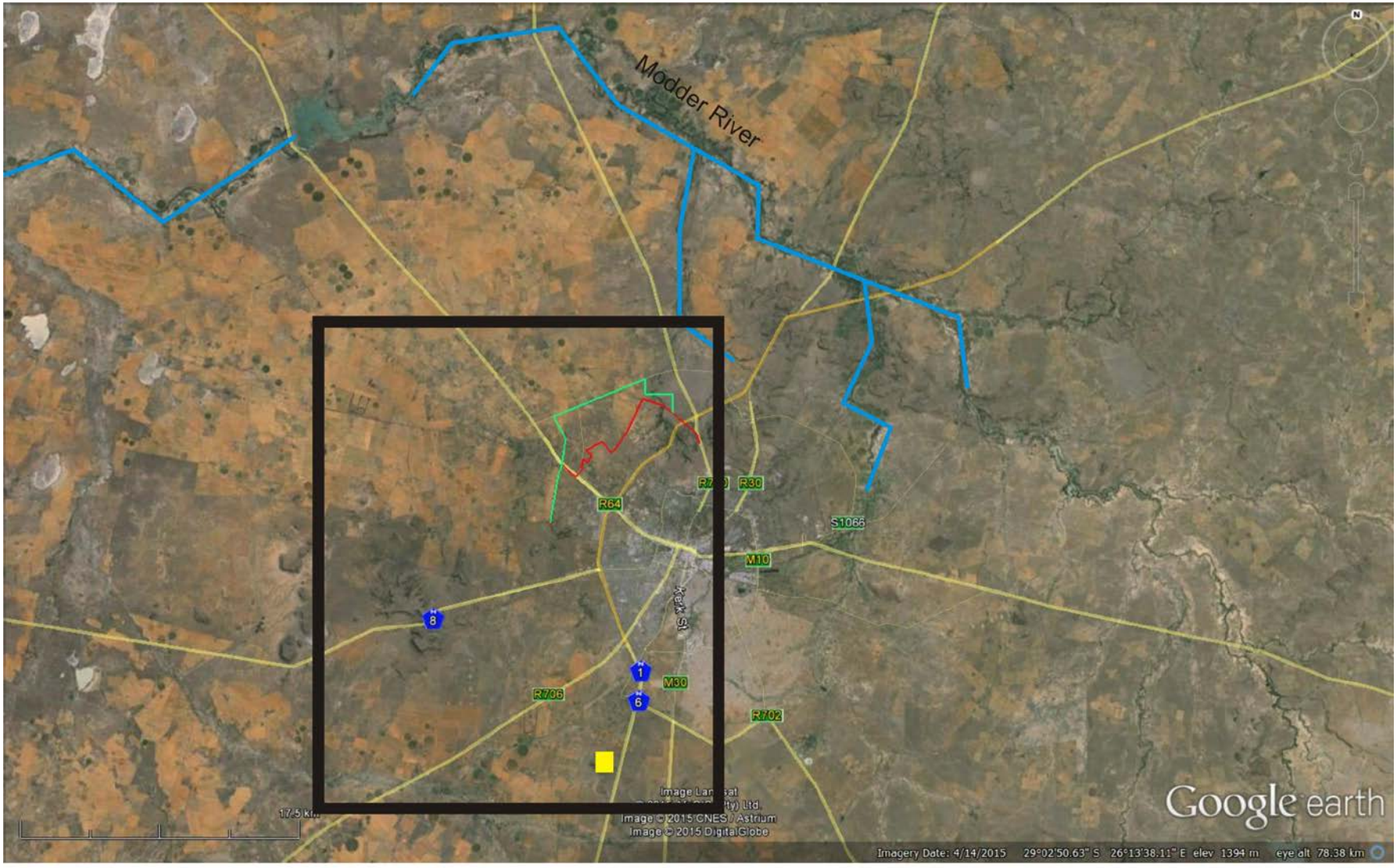

Figure 6. Position of a therapsid fossil exposure (yellow square) situated within the 2926 AA map sheet area and located south of the proposed development footprint.

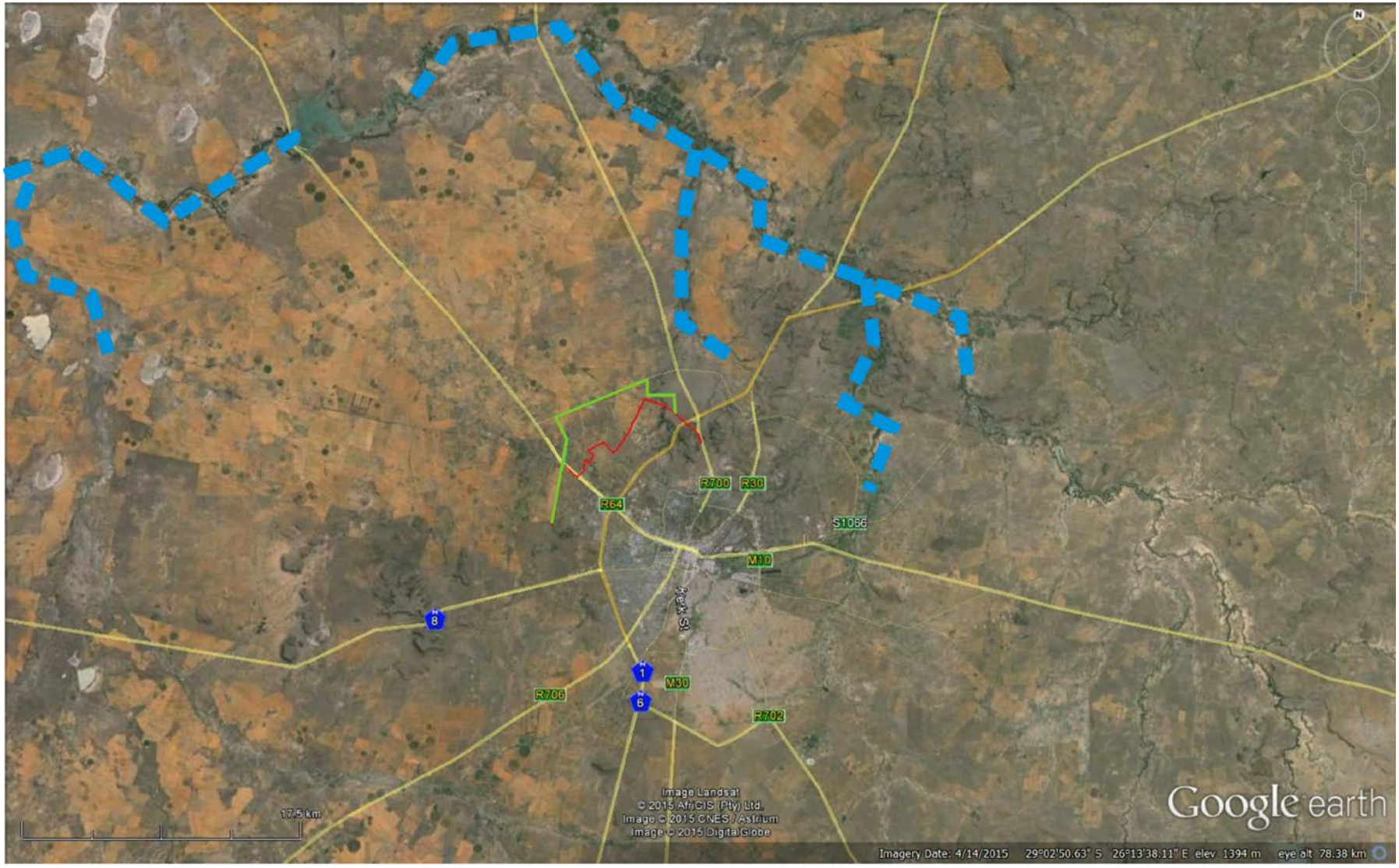

Figure 7. Position of fossil-bearing and archaeologically significant overbank sediments of the Modder River and its tributaries between Maselspoort and the Krugersdrift Dam in relation to the location of the proposed power line route.

Figure 8. The powerline footprint primarily traverses existing road reserves, degraded farmland and areas formerly disturbed by the residential developments.

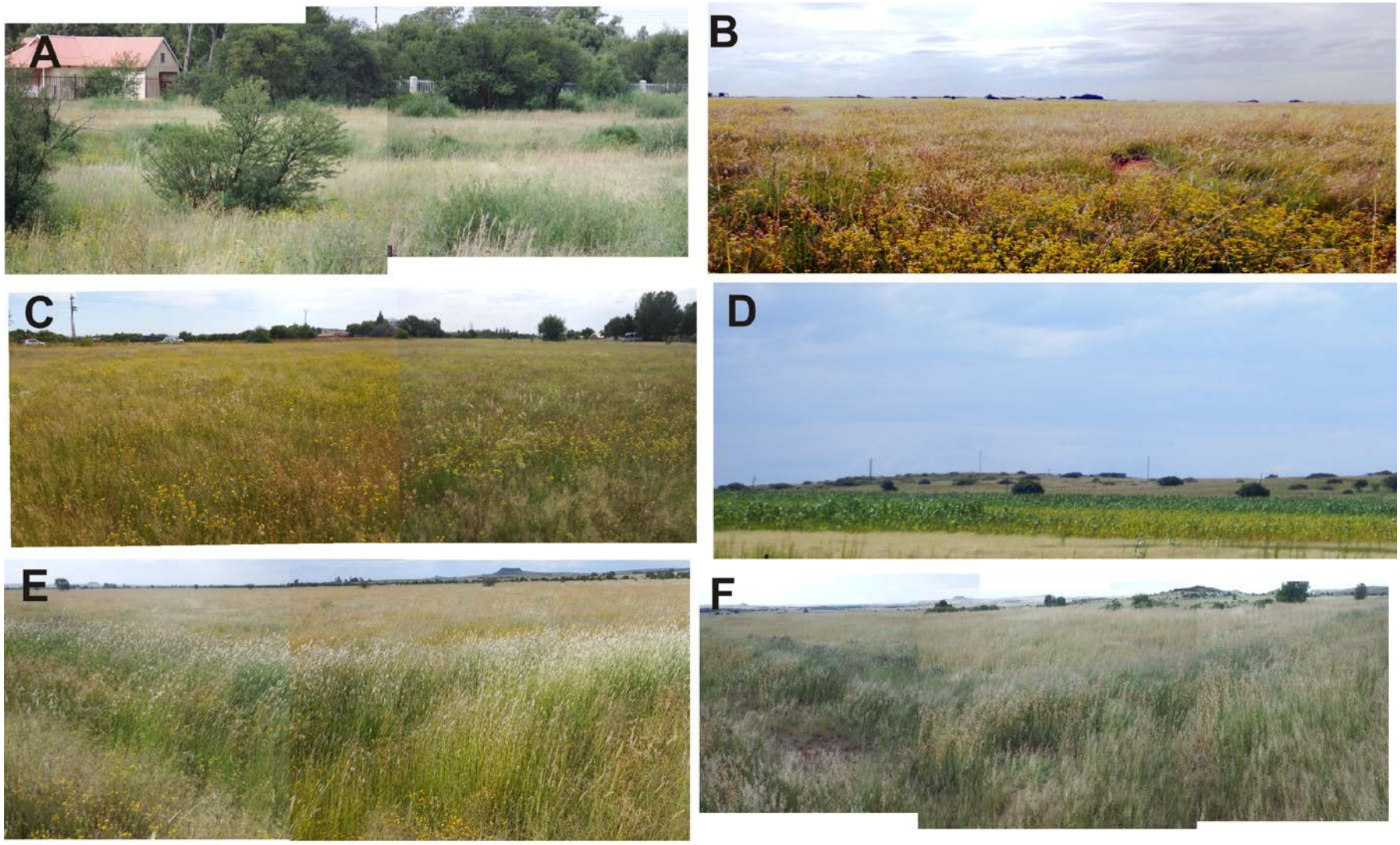

Figure 9. The distribution center footprints are located on degraded farmland, areas formerly disturbed by the residential developments and relatively undisturbed patches of open veld. A) Outspan, looking north; B) Roodam, looking northwest; C) Olivier, looking southwest; D) Tevrede looking north; E) Mimosa, looking norteast and F) Hillandale, looking northeast.