12. PALAEONTOLOGICAL ASSESSMENT

The palaeontology and the fossil potential within the study area and laterally adjacent to the existing Transmission lines between the Poseidon and Grassridge Substations was identified through a database survey. The study area is underlain by four major sedimentary sequences of varying ages, i.e. from 350 million year to recent. Each of these sedimentary rock units contain fossils of various types which have been collected over the years from a variety of localities underlain by these sediments. The sediments were deposited under widely differing environmental conditions and this is reflected in the fossil assemblages that are now found in the rocks (e.g. marine, estuarine and terrestrial).

Potential sites within the study area were identified through a comprehensive review of the literature pertaining to the various lithologies, as well as from fieldwork which has been ongoing in these areas for the past seven years.

12.1. Overview of the Main Geological Units and their Fossil Potential

The study area between the Poseidon and Grassridge Substations traverses four major sedimentary rock units that are found in the Eastern and Western Cape. From the oldest, at the base, the Cape and Karoo Supergroups are found in the northern two-thirds of the study area, while in the southern third the area is underlain by Uitenhage and Algoa Group rocks (see Figures 12.1 to 12.3). It is only in a relatively small area in the immediate vicinity of the Grassridge Substation that a thin veneer of recent sediments belonging to the Algoa Group (Bluewater Bay Formation) is present.

12.1.1. Cape Supergroup

The Palaeozoic (450 – 300 million years old) Cape Supergroup consists mainly of sandstones and shale (total thickness 9000 m) divided into three groups: the lower Table Mountain Group, overlain by the Bokkeveld Group, and finally the Witteberg Group. All three groups were deposited in an east-west striking basin and were latter subjected to a north-south compression tectonic event that produced the Cape Fold Belt. Prominent folding of these rocks is seen particularly in the Witteberg Group, as exposed within the mountainous Zuurberg area. The added temperature and pressure during the Cape Folding event had the effect of re-crystallising ("welding") the quartz grains in the sandstones together to produce particularly hard rocks. These resistant sediments are now seen as prominent parallel ridges with contorted bedding seen in many outcrops.

Figure 12.1

Figure 12.2

Figure 12.3

- *Fossil Potential:*

  The Witteberg Group has in the past yielded particularly fine fossil plants and fishes, e.g. at the Darlington Dam (previously known as Lake Mentz) and in the Grahamstown N2 by-pass road cuttings (Taylor and Hiller, 1993; Gess and Hiller, 1995). For the most part, the Cape Folding event effectively destroyed many fossils, and those that have been found are within those rocks which have not suffered a high degree of deformation.

12.1.2. Karoo Supergroup

Deposition of the thick pile of Karoo sediments took place in an intracratonic basin (on the African plate) and commenced with the Permo-Carboniferous glaciation which deposited the Dwyka Formation (tillite). This unit is followed, conformably, by the shallow marine shales and sandstones of the Ecca Group and then by the fluvial and lacustrine mudstones, shales and sandstones of the Beaufort Group. It is only the very lowest units of the Karoo sediments that have also been affected by the Cape Folding event. As a consequence, only the Dwyka, Ecca, and to a lesser degree the lower Beaufort rocks, are folded. Karoo Supergroup rocks outcrop within the study area north of the Zuurberg Mountains (Dwyka Formation, and Ecca and Beaufort Groups).

- *Fossil Potential:*
  - * *Dwyka Formation*: a glacial deposit (tillite) containing no fossils.
  - * *Ecca Group*: in this southern part of the basin, some fossil wood and fragmentary plant material is found. In addition, rare fish fossils have also been found (Jubb and Gardiner, 1975), as well as trace fossils in the form of burrows, feeding track and fish-fin drag marks at the interface of bedding planes.
  - * *Beaufort Group:* these predominantly terrestrial sediments have, throughout South Africa, yielded a large number of vertebrate fossils in the form of amphibians, early primitive reptiles (the captorhinids), mammal-like reptiles (therapsids), and fish. Minor freshwater invertebrates (molluscs) and plant fossils have also been recovered. For the most part, however, the fossils found in the Beaufort sediments are rare, particularly in the lowermost part of the succession, just above the Ecca-Beaufort contact.

    The Beaufort Group is subdivided into eight biozones (Rubidge, 1995) on the basis of the vertebrate fossil assemblages found in each zone. The Poseidon-Grassridge corridor study area traverses the lower five biozones (from youngest to oldest at base). These are indicated in Figure 12.3.

- *Cistecephalus Zone*, the northern-most portion of the study area, extending approximately 10 km below the Poseidon Substation.
- *Tropidostoma Zone,* a further approximate 10 km extending to the dolerite dyke breaching the landscape.
- *Pristerognathus Zone*, in the vicinity of the Great Fish River.
- *Tapinocephalus Zone*, a narrow zone of approximately 5 km.
- *Eodicynodont Zone* – This lowermost zone has not been established with confidence in this area as yet. If present, it would constitute a very thin layer having a limited north-south surface exposure of no more than 200 m in the vicinity of where the existing 220 kV Transmission line crosses the R32.

A comprehensive list and description of the vertebrate fossils that may potentially occur in the five biozones across which the study area extends can be found in Rubidge (1995). It must be emphasised that for the most part, fossil bone (often a blue-black colour) in these lower biozones of the Beaufort Group in the Karoo Supergroup is rare.

12.1.3. Uitenhage Group

The lower Cretaceous Uitenhage Group is the best preserved, and reaches its maximum thickness in the Algoa basin. The outcrops are generally poor with large areas being covered by dense thorn scrub and Tertiary to Recent sediments of the Algoa Group. Good exposures are confined to the valleys of the Swartkops, Coega, Sundays and Bushmans Rivers. Three formations are recognised within the Uitenhage Group (oldest at base):

- Sundays River Formation – Estuarine and shallow marine sandstones, sandy limestones and shales.
- Kirkwood Formation – Fluvial sandstones, siltstones and mudstones.
- Enon Formation – Fluvial conglomerates, grits and coarse sandstones (high energy environment).

These sediments have been deposited in a series of half-graben fault blocks with the bounding faults having an approximate east-west strike, consistent with the southerly-directed tensional stresses that marked the break up of Gondwana during lower Cretaceous times (approximately 135 million years ago). This postulated east-west fault occurs in the vicinity of Buffelskuil in the Zuurberg area.

It is only in the southern most third of the study area between the Poseidon and Grassridge Substations that rocks of the Uitenhage Group outcrop are encountered.

- *Fossil Potential:*
  * *Enon Formation:* the base occurs as a thin strip at the foothills of the Zuurberg. Only rare fossil wood and possibly worn dinosaur bone is typically found.
  * *Kirkwood Formation* sediments are best exposed in cliff faces along the Sundays River and rarer in gully erosion channels close to stream beds. There is an abundance of fossil plant material, mainly fossil wood, in the form of loose boulders and some logs in excess of 6 m in length. To a lesser degree, fossil leaf impressions occur in places in finer sandstones and mudstones. Perhaps more importantly, one finds isolated vertebrate bone and teeth fragments which are derived from various type and sizes of reptiles like dinosaurs, crocodiles and lizards, and on the rare occasion, mammals. These vertebrate fossils are considered to be rare (De Klerk *et al*., 2000).
  * *Sundays River Formation* mudstones and sandy limestones are of estuarine to marine origin. Invertebrate estuarine and marine fossils are characteristic of this unit although some vertebrate bone has been recovered, e.g. from plesiosaurs, and some minor dinosaur bone material.

Fossils of Kirkwood and Sundays River Formation have been reviewed by McLachlan and McMillan (1976). Estuarine and shallow marine invertebrates like bivalves, gastropods and ammonites occur in sandstone and claystone, e.g. Coega and Swartkops brickfields. Others occur in hard calcareous coquinoid sandstones, and are difficult to extract. Some delicate thin-shelled specimens have been recovered from the mudstones. Trace fossils in the form of small burrows of the Planolites type occur in the finer lithologies, and a delicate ophiuroid (or brittle star) may be indicative of the quiet water conditions during deposition.

12.1.4. Algoa Group

The younger Neogene Algoa Group sediments are represented by a veneer of marine and marine related (aeolian) formations, are characterised by calcareous clastic sediments and are classified, according to origin, as marine, aeolian and fluvial (Le Roux, 1989).

a) *Marine deposits*, being either beach, nearshore, estuarine or lagoonal deposits associated with transgressive/regressive shorelines, are now subdivided on the grounds of distinct lithological and palaeontological characteristics, as well as age differences into the:

Palaeogene	-	Bathurst Formation (oldest)
Neogene	-	Alexandria Formation
Quaternary	-	Salnova Formations (youngest)

b) *Coastal aeolian deposits* are represented by the:

Late Pliocene to Early Pleistocene	-	Nanaga Formation
Middle to Late Pleistocene	-	Nahoon Formation
Holocene	-	Schelm Hoek Formation

c) *Fluvial deposits* are subdivided into the:

Martindale, Kinkelbos, Bluewater Bay

Kudus Kloof and Sunland Formations.

Table 12.1: Classification of Cenozoic Deposits along the South-East Cape Coast

Age		ALGOA GROUP		
		Marine	**Aeolian**	**Fluvial**
Quaternary	Holocene	Salnove Fm	Schlem Hoek Fm	Sunland Fm
	Pleistocene		Nahoon Fm	
Tertiary	Pliocene	Alexandra Fm	Nanaga Fm	Kudus Kloof Fm Bluewater Bay and Kinkelbos Fm's
	Miocene			
	Oligocene			
	Eocene	Bathurst Fm		Martindale Fm
	Palaeocene			

These sediments were deposited during a series of transgressive/regressive cycles dating from late Paleocene to Holocene (65 million years ago to Recent).

- *Fossil Potential:*

  In the vicinity of the Grassridge Substation the area (within a 2 km radius) is underlain by a thin veneer of the 1,4 – 2 million year old fluvial sediments of the Bluewater Bay Formation. Occasional freshwater shells (Unio and other species) and fragments of terrestrial shells occur, however, these are well known and really of little consequence.

  Directly below this is the 1,8 – 15 million year old Alexandria Formation (shallow marine) is exposed within 3 km and 8 km north of the Grassridge Substation. The Alexandria Formation usually contains an abundance of marine invertebrate fossils in the

form of shelly material derived from bivalves and gastropods. A 2 m thick oyster bed occurs in a road cutting approximately 1 km from the Grassridge Substation, indicating that marine conditions occurred at the time of deposition some 200 m above sea level today. The Alexandria Formation is important palaeontologically as it has to-date yielded more than 170 species of molluscs, four species of brachiopods, at least four species of Echinoderms and a few species of crustacia, some coelenterates as well as some Bryozoa. Vertebrate remains include teeth from sharks and fish, as well as fish vertebrae and coprolites have also been recovered.

12.2. Potential Impact on Palaeontological Sites as a Result of the Construction of the Proposed Transmission Line

The area in which fossils are most likely to be found is that of the Algoa Group. Potential impacts on palaeontological sites as a result of the construction of a new Transmission line will be both positive and negative.

A positive impact is that sites previously not known of or identified will be discovered (before or during construction activities), primarily through excavation activities associated with construction activities. Fossil remains can be collected, and these sites can then be recorded/reported, which will enlarge site records and provide insights for future research.

It is, however, possible that fossil remains uncovered at a palaeontological site may be lost or rendered unrecognisable due to excessive disturbance. This is considered as a negative impact associated with construction activities.

12.3. Recommendations

The following is required to be considered and incorporated into a management plan prior to construction activities being initiated:

1. Construction managers should be informed regarding the possible palaeontological sites which may be encountered during construction, and the procedures to follow in the event of sites being encountered.
2. Managers should inform all construction workers not to make any collections of remains, and not to disturb any identified sites, as far as possible.

3. If potential palaeontological sites are found, the occurrence should be reported to a qualified palaeontologist for investigation. Generally fossils can be removed quickly and would, therefore, not delay or hinder construction operations.