Appendix

D-2

PALAEONTOLOGICAL REPORT

Palaeontological Impact Assessment for a Stormwater Management Plan for Portion 62 of the farm Ongegunde Vryheid No 746, St Francis Bay

Prepared for: **CEN IEM Unit**
36 River Road
Walmer
Port Elizabeth
6070

Compiled by: Robert Gess (PhD)
Rob Gess Consulting
(Research Associate of the Albany Museum)

Box 40
Bathurst
6166
robg@imaginet.co.za

July 2014

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Background

During flooding, in St Francis Bay, in September 2012 a number of natural depressions amongst the dunes located to the west of St Francis Drive filled up with accumulated groundwater and rainwater. Due to the resulting high water level, the pond in the south east corner of the dune field was breached, resulting in a mass of water flowing through the Santareme development in the vicinity of Diaz Road. This uncontrolled discharge of stormwater caused extensive damage to a number of properties as the water found its way to the sea.

CEN have been contracted to manage the excavation and development of a drainage system that will prevent the pans in the Santareme dunefield from flooding and overflowing. This will include development of a piped spillway system as well as enlargement of an existing culvert, which will carry overflow water passed housing developments, to the sea (Fig. 1).

Rob Gess Consulting were subcontracted by CEN to carry out a Palaeontological Impact Assessment of the area, and to make recommendations for heritage management.

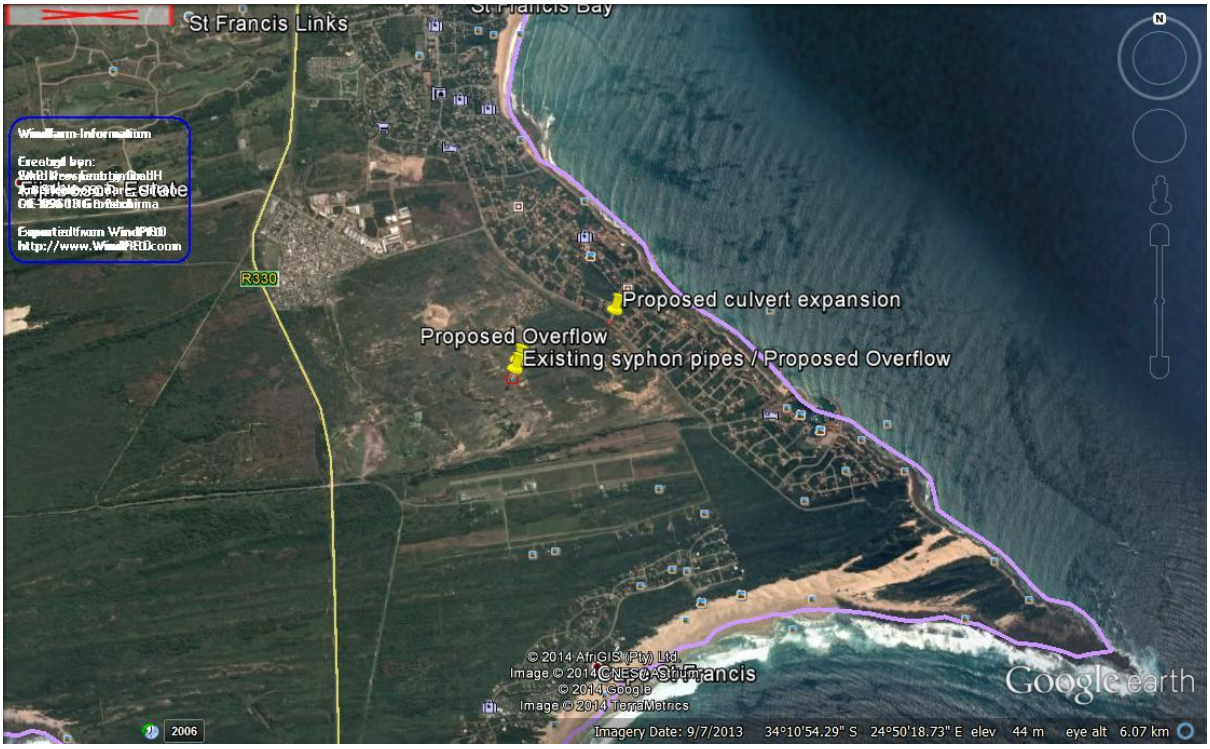

Figure 1: Satellite image of the Santareme dunefield (centre), showing position of proposed piped overflow system and proposed culvert expansion.

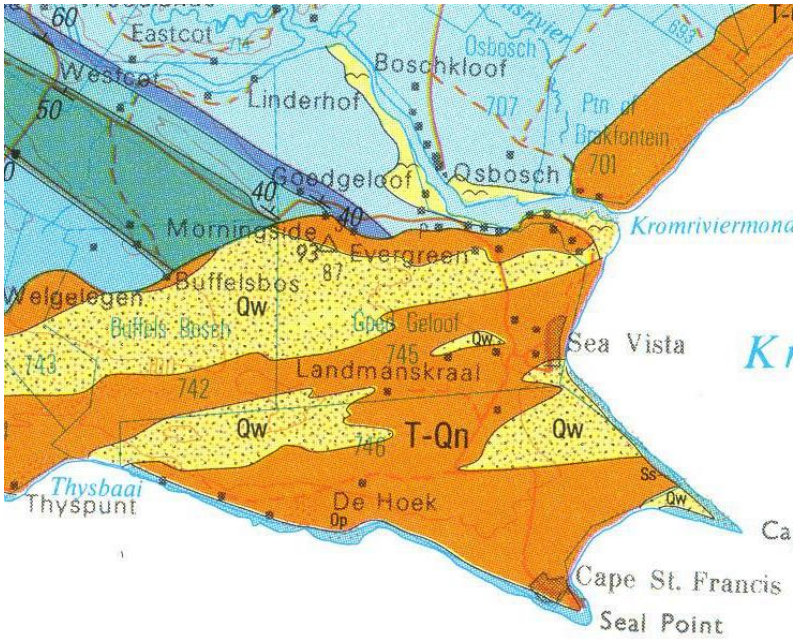

Figure 2: Geological map of Cape St. Francis and St. Francis Bay showing Cape Supergroup strata (shades of blue) masked by aeolian deposits (yellow and brown). Cape Supergroup deposits in diagonal order from centre left to centre top (shades of blue) are: Peninsular Formation, Cederberg Formation, Goudini Formation, Skurweberg Formation, Baviaanskloof Formation (Table Mountain Group) and Gydo Formation (Ceres Subgroup, Bokkeveld Group). Nanaga Formation (Tertiary to Quaternary T-Qn) is shown in brown. Geologically recent aeolian sands (Qw) are shown in yellow.

Geology and Palaeontology

The geology of Cape St Francis is largely masked by Tertiary and Quaternary to recent aeolian (wind blown sand) deposits. These are underlain by Cape Supergroup strata. More specifically, upper portions of the Table Mountain and lower portions of the Bokkeveld Group are represented. These rocks formed from sediments deposited in the Agulhas Sea, which had opened to the south of the current southern African landmass in response to early rifting between Africa and South America.

Cape Supergroup

The Table Mountain Group constitutes the first of three subdivisions of the Cape Supergroup. It consists of quartzitic sandstones derived from coarse sands deposited within the Agulhas Sea, and along its coastal plane. It was deposited during the Ordivician, Silurian and earliest Devonian Periods, approximately 500-400 million years ago.

The Bokkeveld Group, constituting the middle subdivision of the Cape Supergroup conformably overlies the Table Mountain Group. Bokkeveld strata consist largely of shales and thin interbedded sandstones derived from marine continental slope muds of early to mid Devonian (+/- 400 - 370 myo) age – which were deposited within the basin of the Agulhas Sea.

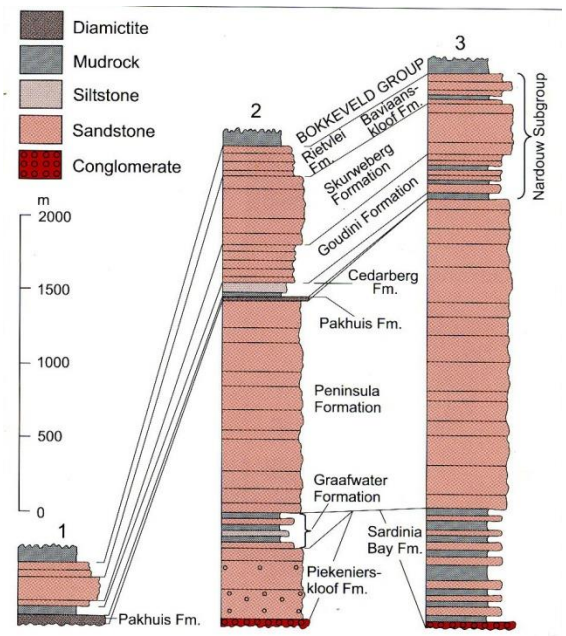

Figure 3: Stratigraphy of the Table Mountain Group, 3 represents the Eastern Cape (Johnson *et al*., 1999)

Very rare trace fossils have been recorded from the sandier units of the Table Mountain Group in the Western Cape.

More importantly, shale and mudstone interbeds within the Table Mountain Group are known to contain rare records of early Agulhas Sea life. Significantly the Soom and Disa shales, which comprise the Cederberg Formation provide an extremely valuable record of latest Ordivician life. The Soom shale exhibits soft tissue preservation, and has yielded specimens of primitive jawless fish, eurypterids, trilobites, orthocone nautiloids, brachiopods and molluscs. A brachiopod dominated invertebrate fauna has also been recorded from the somewhat sandier overlying Disa Formation. In addition to brachiopods this fauna includes trilobites, bryozoans, crinoids, tentaculitids and crustaceans. Due to poor outcrop, fossil faunas of this unit have not yet been uncovered in the Eastern Cape.

The Baviaanskloof Formation, uppermost unit of the Table Mountain Group has been recorded to contain concentrated lenses of invertebrate fossils which help to establish an earliest Devonian age for at least the upper portion of this Formation. They provide very early examples of the cold water marine Malvinokaffric invertebrate faunas that characterised the near polar Agulhas Sea during deposition of the Bokkeveld Group and its equivalents in south eastern South America. The Baviaanskloof Formation fossil record is dominated by brachiopods, but also includes the remains of trilobites, bivalves, gastropods, tentaculitids and ophiuroids. A variety of trace fossils are also known, as well as early land plants.

Lower Bokkeveld Group strata have yielded abundant fossil evidence of a range of early to mid Devonian deep water invertebrate faunas comprised of diverse brachiopods, molluscs, echinoderms and trilobites. In addition a few very localised but exciting fish fossils have been described. Plants and trace fossils are also known.

Although precise mapping of these units underneath the aeolian cover at Cape St Francis has not been possible it can be extrapolated that the Santareme dunefield is most likely to be underlain by strata of the Goudini and Skuweberg Formations.

Tertiary to Recent Aeolian Deposits

Cape Supergroup strata are disconformably masked by Tertiary to Quaternary and Recent aeolian deposits. Such aeolian deposits are known to, at times, contain deposits of large mammal bones and terrestrial molluscs. Aeolian deposits around the southern margin of South Africa reflect fluctuations in global sea level resultant from uptake of seawater during glacial and interglacial periods. Terrestrial vertebrate deposits therin reflect resultant shifts in ecosystem makeup between more coastal and more inland communities.

Nahoon Formation (Algoa Group)

Though not previously recorded from this locality, rocks attributable to the Nahoon Formation (Algoa Group) were observed protruding from beneath unconsolidated sands in the study area. The Nahoon Formation rocks observed consists of calcareous sandstone exhibiting root concretion structures. It was deposited on a wave cut platform incised into the underlying Cape Supergroup strata during the Cretaceous Period. The Nahoon Formation is believed to have been deposited during the regressions associated with the Wurm and Riss glacials during the Middle to Late Pleistocene. Dating of strata at Nahoon Point provided a date of approximately 30 000 years BP.

Nahoon Formation strata have preserved trace fossil footprints of humans, birds and possibly hyenas (at Nahoon Point). Middle Stone Age artifacts have also been recorded from a number of localities, as well as mammal bones (including a human femur) and terrestrial snails. Lateral equivalents elsewhere in South Africa have produced similar fossils and fossil footprints, including human footprints from near Langebaan.

Unconsolidated aeolian deposits between Oyster Bay and Cape St. Francis have yielded large vertebrate fossils. These include an important site within the Oyster Bay dunefield, situated in reddish sands, suggestive of a more terrestrial setting at the time of deposition. Large mammal remains are associated with cultural remains referred to the Howisons Poort substage of the Middle Stone Age, suggesting an age of around 60 to 70 000 years ago. This coincides with the initiation of the Last Glacial which resulted in a drop in sea level.

Deposits of this age permit study of the roots of modern faunas that evolved in response to sea level changes and resultant environmental fluctuations. Though many taxa represented survived until modern times, others became extinct by end of the Pleistocene (approximately 12 000 to 10 000 years ago. These included a giant buffalo (*Synercus antiquus*), a giant wildebeest (*Megalotragus priscus*), large forms of plains zebra (*Equus capensis*) and a hartebeest-like antelope (*Damaliscus niro*).

The Oyster Bay site has yielded the remains of at least 18 vertebrate taxa, including those of the Giant Buffalo and the more recently extinct Blue Buck (*Hippotragus leucophaeus*). Antelope remains predominate although Cape Fur Seal, Dune Molerat, Plains Zebra, Bushpig, Hyaena and Hippopotamus are also represented. These remains appear to have been largely concentrated by Human subsistence activities, though reworking by Hyaenas is suggested by coprolites and occasional tooth marks on bones.

Reddish sands in this region are in turn blanketed by more recent (Holocene) mobile sands some of which, including those in the study area, have been stabilised within the 20th century.

Site visit

A site visit was carried out by Rob Gess Consulting on 10 June 2014, in association with other consultants. The area was found to mainly be covered in unconsolidated aeolian deposits that have been stabilised in the last 50 years.

At various points Nahoon Formation outcrops displaying calcretised root casts were found to underlie more recent aeolian deposits. At one point, close to the developmental corridor, resistant Table Mountain Group (Cape Supergroup) quartzitic sandstone, probably attributable to the Skurweberg Formation was found to protrude from the aeolianites and to cause a groundwater dam. No palaeontological material was recorded from this outcrop.

Figure 4: View towards the sea along the proposed developmental corridor within the Santareme Dunefield, showing recently vegetated unconsolidated aeolian sand cover.

Figure 5: Thick vegetation obscuring strata along the culvert to be expanded to carry stormwater drainage to the sea.

Figure 6: Resilient coarse quartzitic sandstone horizon of the Silurian Table Mountain Group (Cape Supergroup), presumably attributable to the Skurweberg Formation, protruding from more recent overlying strata.

Figure 7: Root concretions belonging to the Pleistocene Nahoon Formation (Algoa Group), underlying unconsolidated sand..

Conclusions and Recommendations

The area is characterised by recently vegetated dunes of unconsolidated sand.

Unconsolidated aeolian deposits are fairly shallowly underlain by calcretised Nahoon Formation (Algoa Group) deposits exhibiting root casts. These root casts had already been etched free of the less resistant sandstone matrix, presumably by wind scour, prior to burial.

These are in turn underlain by ancient deposits of the upper Table Mountain Group, with resistant strata, probably attributable to the Skurweberg Formation (Table Mountain Group, Cape Supergroup) protruding.

It may be reasonably conjectured that the deeply underlying Table Mountain Group strata will not be much affected by the development. Furthermore the author's prior research in this area suggests that softer, more fossiliferous layers are likely to have been weathered beyond palaeontological value to a depth greater than that to be impacted by the development.

The Nahoon Formation strata present may be impacted. Root concretions within this deposit are not considered palaeontologically important. There is a small possibility that mammal

bones may be present but these are generally not associated with layers showing abundant root concretions.

The greatest likelihood of fossil material being impacted would be in the form of large mammal bone deposits within the unconsolidated sands. There is a reasonable chance of this occurring. These are likely to be associated with archaeological material.

Discussion with the Archaeological team indicated that they would be recommending monitoring of excavations by an archaeologist. In this specific case, considering the overlap of palaeontological and archaeological heritage within such deposits, it can be recommended that the archaeological monitor should be tasked with looking out for bone deposits and should notify a palaeontologist and/or ECPHRA should any material come to light.

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