

# PHASE 1 ASSESSMENT OF A PROPOSED MINING AREA ON THE FARM VELDDRIF 110

Prepared for

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Prepared by

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## PREAMBLE

This report is in two parts, the first dealing with an assessment of the archaeological material on the proposed mining area, and the second with the palaeontological deposits.

## PART 2

### **1. ASSESSMENT OF THE PALAEOONTOLOGICAL DEPOSITS ON THE PROPOSED MINING AREA ON THE FARM VELDDRIF 110**

DUNCAN MILLER

#### **1.1 INTRODUCTION**

This part of the report deals with the palaeoenvironmental, and palaeontological, potential of the proposed lime quarry to exploit the shelly grit deposit on the St Helena Bay coast north of Velldrif. It is based on a number of informal visits by the author over the past ten years to inspect the existing exposures of shelly grit, and on a formal visit conducted on 17 July 1994 as part of the Phase I evaluation of the proposed mining development. This visit was commissioned by the developers, Lime Sales Limited, and took place with Mr Timothy Hart (Department of Archaeology, UCT) and Mr Martin Tyler (Geologist, Lime Sales Limited).

#### **1.2 LOCATION AND EXTENT OF THE SHELLY FOSSIL BAR COMPLEX**

A fossil shoreline/offshore bar complex exists on the eastern shores of St Helena Bay, between the villages of Laaiplek and Dwarskersbos, north of the mouth of the Berg River. A preliminary description by A.J. Tankard (1976) concluded that there are two major elements, an inner bar best exposed just west of the town of Velldrif, and an outer bar exposed in various places from the Laaiplek rubbish dump north towards Dwarskersbos. In reality the deposit is more complex. In the vicinity of the proposed mining area the inner bar is well developed, the outer bar bifurcates with an erosional channel separating the two limbs, and there is a former inlet channel cutting both limbs of the outer bar. Various parts of these deposits have been quarried in the past to form the present exposures, but most of the former and ongoing quarrying activity is focussed on the landward side of the outer bar, which forms the major deposit. The proposed mining concession includes the most substantial part of this complex, namely the two limbs of the outer bar where the deposit of shelly grit is best developed and ranges up to 3m thick. The areas excluded are the southern-most portion of the complex as well as the inner bar where the developer's testing has shown that the deposit is less than 1m thick (M. Tyler pers. comm.). Seaward of the proposed concession area is a series of prograded beach deposits of uncertain age.

#### **1.3 AGE AND ORIGIN**

The shelly grit deposits of the inner and outer bars have not been dated directly, and nor has the series of prograded beaches. The shelly grit deposits on the bars are assumed generally to be late Pleistocene (ie. about 125 000 years old) on the basis of the presence of only one extinct sub-species of mollusc and the fact that the deposits lie only a few metres above modern mean sea level. Neither of these are particularly reliable criteria for dating such deposits, which may be either older or younger (Miller in press). In all probability the deposits are composites and contain material of potentially significantly different ages. On the west coast, with its characteristically low sedimentation rates and tectonic stability, it is common for Holocene beach deposits (ñ 5000 years old) to lie up against much earlier Pleistocene deposits (Miller et al. 1993).

The shelly bars formed at a time of considerably higher mean sea level when large areas

of the Berg River estuary were flooded and formed a marine embayment, somewhat similar to the present Langebaan Lagoon. The shelly deposits in question accumulated in the shallow mouth of this bay, although scattered shell deposits of different faunal composition are present up to 15 km inland (Tankard 1975, 1976). The bars are preserved because they form part of an actively prograding shoreline, one of only two known on the west coast at present (Rogers 1980, 1987; Miller et al. 1993).

#### **1.4 STRATIGRAPHY AND SEDIMENTOLOGY**

The geological description of the deposit as it appears in the Environmental Management Program document prepared by Lime Sales Limited (Tyler 1993:2-3) is a good summary of the general stratigraphic relationships visible in extant quarried sections. These deposits have received some scientific attention (Tankard 1975, 1976; Miller et al. 1993; Dingle & Honigstein in press) but they are very poorly documented and there have been no detailed stratigraphic or sedimentological studies. We know from field observations that in places the shell deposits are up to 3 m thick; that there is vertical and lateral variation in sedimentology and molluscan species distribution; that large sandy pockets exist which appear to be devoid of shell; and that the degree of comminution varies throughout the deposit. Lateral facies change is to be expected in large-scale sedimentary features such as these and the inhomogeneity of the deposit is clear even on cursory inspection.

#### **1.5 SCALE AND IMPACT OF PROPOSED MINING**

The thickest sections of the deposit have been targeted for mining. It is difficult to estimate the proportion of the total deposit that this represents because the outlying sections are not exposed, but it is a significant percentage. Two areas are to be mined, a southern area with an estimated tonnage of 1 080 000 metric tons and a northern one of 210 000 metric tons. The life of the mining operation is expected to be some 19 years, with a planned production rate of about 20 000 tons per annum (Tyler 1993:3). During this time the best developed sections of the fossil bar complex will be mined out in its entirety.

Mining is planned to start in the southwestern corner of the concession and progress in an easterly and then northerly direction, removing blocks approximately 200 by 20 metres. This will create a longitudinal N/S face of about 200 m and a short transverse E/W face of about 20 m in each excavation. The entire shelly layer in each of these blocks will be removed for processing (see Tyler 1993 for details).

#### **1.6 PALAEOENVIRONMENTAL, PALAEOONTOLOGICAL, AND GEOLOGICAL SIGNIFICANCE**

The southern west coast of South Africa is mantled with Quaternary deposits, most of them poorly consolidated, and some of them fossiliferous. Although many of these deposits are of commercial significance and are exploited for fertilizer, lime, and building materials, the palaeoenvironmental study of this area is in its infancy. The number of scientific reports dealing even indirectly with the late Quaternary sediments is very small, and our understanding of the existing fossiliferous deposits of St Helena Bay is still rudimentary (Dingle and Honigstein in press; Kilburn & Tankard 1975; Miller in press; Miller, Yates, Parkington & Vogel 1993; Rogers 1980, 1982, 1987; Tankard 1975, 1976; Tankard & Rogers 1978). There are no detailed palaeoenvironmental studies of the St Helena coastline and we have very little knowledge of the geological history of the area.

The Velddrif fossil bar complex is the largest known of its kind on the west coast and is situated in a key geomorphological position. Up to now the sheer size of the sedimentary feature has precluded systematic investigation, and there has been no immediate threat to the bulk of the deposit. The fossil bar complex has been sampled very cursorily for macropalaeontological and micropalaeontological investigation (Tankard 1975, 1976; Dingle & Honigstein in press). A systematic sampling program has not yet been carried out for either palaeontological or sedimentological study. Both of these would be highly desirable because the fossil bar complex is the key to the sediment dynamics and geological history of the former St Helena embayment. This knowledge is not just of academic interest. The shell deposits are of commercial value and knowledge of their sedimentology and origins, and of the sedimentary dynamics of such an embayment, has obvious implications for exploration and locating other economic deposits (eg. lime, salt, and phosphate) as well as for understanding the regional history of sea-level fluctuations and the geomorphological history of the Berg River estuary area as a whole.

A detailed palaeoenvironmental reconstruction of the Pleistocene history of St Helena Bay is becoming increasingly important. The current spurt in coastal development in the area is going to obliterate or obscure much of the evidence of former sea level change. The variation in sedimentology and in species composition of the complex fossil bar deposits is an important record, to be studied in detail before we can attempt a thorough reconstruction of the local and regional Pleistocene history.

### **1.7 RECOMMENDATIONS FOR FUTURE DEVELOPMENT**

In my opinion the fossil bar complex north of Laaiplex is the single most important deposit on the southern west coast for an understanding of the local dynamics of late Quaternary high stands of the sea. It has not been studied in detail yet because the resources were not available to sample such a large deposit systematically. The prospect of large-scale mining of this deposit represents a threat to the core of this deposit and is simultaneously a potentially very fruitful opportunity. Not all parts of this deposit are equivalent and the variation within it is part of the information that must be recorded. If the mining happens without a thorough sampling programme very important and irreplaceable palaeoenvironmental and palaeontological information will be lost.

I recommend that any further mining or quarrying development of the Velddrif deposit be required to build a sampling programme into its plans, to mitigate the loss of sedimentological and palaeontological information during the mining process. The details of this plan should be negotiated in collaboration with the relevant scientists of the South African Museum. Estimates of the costs of this enterprise are detailed in the Appendix.

### **1.8 CONCLUSIONS**

In my opinion measures such as those outlined above should be mandatory for any development that will destroy geological, palaeontological, or archaeological deposits of significant scientific worth. In the case of the Velddrif fossil bar deposit the proposed mining will remove a large proportion of the most well developed part of the sedimentological unit. It is crucial for the palaeoenvironmental study of St Helena Bay and the Berg River estuary area as well as regional sea-level studies that representative samples of this deposit should be preserved for future research if at all possible.

### **1.9 REFERENCES**

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## APPENDIX

### RECOMMENDATIONS FOR THE ESTABLISHMENT OF THE PROPOSED ARCHIVE

The following recommendations have been formulated in consultation with Dr Roger Smith (Head, Earth Science Division, South African Museum) and Dr Graham Avery (Head, Archaeology Division, South African Museum).

1. Mining should be approved subject to the provision that an archive of appropriately documented and representative palaeontological and sedimentological material be established, in collaboration with the South African Museum. On site this would involve systematic diagrammatic stratigraphic recording of all exposures in conjunction with a systematic photographic record, making resin peels of representative facies and sedimentary structures, bulk sampling of representative sections, and preliminary sorting and sub-sampling to create the archive collection. In the museum the archive collections will be labelled permanently, sorted, boxed, catalogued, entered in a data base, and shelved.
2. Lime Sales Limited should guarantee in writing the provision of arranged access by academic specialists (sedimentologists, palaeontologists, and palaeoenvironmentalists) to monitor the exposure of fresh sections and to sample them, and effective liaison or regular reporting of mining progress to the South African Museum so that these visits can be planned appropriately.
3. All recording, sampling, preliminary sorting, and storage of palaeontological and sedimentological samples should take place systematically, planned in collaboration with Head of the Earth Science Division, South African Museum (currently Dr Roger Smith), or his designated deputy (currently Mr John Pether).
4. Lime Sales Limited will be responsible for providing the financial resources to cover the costs of such a sampling programme and for the costs of the establishment, but not the maintenance or subsequent analysis or scientific study, of the sample archive. The recommended sum to be made available for this purpose is a maximum of R200 000 per annum plus an annual inflation-linked escalation factor, for each year of the sampling programme. This will be the maximum financial liability of the mine and any additional costs will be borne by the S.A. Museum, unless the mine agrees otherwise in negotiation.
5. It is recognised that both the S.A. Museum and Lime Sales Limited would have an interest in keeping the sampling and archiving of material to the absolute minimum. There will be an annual reassessment of the sampling strategy, and adjustment of both the sampling programme and the budget if necessary. If the programme is scaled-down, suspended, or terminated by the S.A. Museum there will be a proportional reduction in the mining company's financial obligation for the years affected by such change.
6. Lime Sales Limited should designate a suitable employee, preferably with a geological qualification, to be trained by S.A. Museum personnel to carry out the necessary intermittent stratigraphic recording, photography, peeling, bulk sampling, and preliminary sorting on site, and thereby avoid the additional expense of having these essential curatorial activities carried out by S.A. Museum staff on a contract basis.
7. Lime Sales Limited should make provision on site for the undercover storage of 100 kg bulk samples (up to 100 samples per annum) for up to two years. Suitable space should also be provided for preliminary sorting and labelling before transportation of the archive samples to the S.A. Museum.
8. For the purposes of the establishment of this archive the South African Museum will provide their scientific consultants' time and expertise free of charge except for field trip costs incurred, will charge the minimum possible for the costs of curation of the collection,

will provide the housing for the collection on an ongoing basis with no additional charge, and will assume responsibility for the subsequent research and publication costs.

9. All records explicitly taken as supporting documentation for the sample archive (photographic negatives, section drawings, box counts, peels, etc) will be housed at the South African Museum. The ownership of the samples, these records, and the publication rights are to be transferred to the S.A. Museum. A fixed period embargo on the publication of research results may be negotiated by Lime Sales Limited with the S.A. Museum.

10. In event of mining exposing unexpected palaeontological or archaeological material not covered by the planned sampling programme, the S.A. Museum should be notified immediately and mining in that area suspended until scientists from or designated by the museum, have had reasonable opportunity to investigate the find. Arrangements for any removal should be made in consultation with the S.A. Museum and National Monuments Council. Such material includes a stratified archaeological horizon such as a midden, a concentration of stone artefacts, terrestrial vertebrate fossils, marine mammal fossils such as whale bones, or human burials in the overburden.

## BUDGET

This proposed budget has been drawn up in consultation with Dr Roger Smith (Head, Earth Science Division, South African Museum) and Dr Graham Avery (Head, Archaeology Division, South African Museum). These costs represent the real expenditures necessary to create the proposed sample archive and do not include the costs of maintaining or analysing the material in this archive. These projected annual costs have been calculated assuming the annual exposure of 20 new face lengths (each 200µm plus 20µm), 1 resin peel per face length, 5 bulk samples per face length, and the availability of a Lime Sales Limited employee to carry out (under supervision) the recording, sampling, and preliminary sorting.

Projected annual costs (not including escalation factor)

Photography (20 spools + processing)	R15000
Resin peels (20 peels)	R5000
Museum storage bay (for 20 peels)	R1000
Sample storage materials (for 100 samples)	R1000
Sample storage bays (4 bays)	R4000
Site visits (4 visits at government rates)	R6000
In-house sample and data management	R2000
TOTAL	R20000