ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED NUCLEAR POWER STATION (‘NUCLEAR - 1’) AND ASSOCIATED INFRASTRUCTURE

Heritage Impact Assessment

September 2012

Prepared by: Archaeology Contracts Office

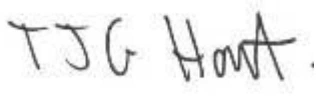
Prepared for: Arcus GIBB Pty Ltd

On behalf of: Eskom Holdings Ltd

03 September 2012

DECLARATION OF INDEPENDENCE

I, Timothy Hart, as duly authorised representative of the Archaeology Contracts Office of the University of Cape Town hereby confirm my independence as a specialist and declare that neither I nor the Archaeology Contracts Office of University of Cape Town have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Arcus GIBB was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for work performed, specifically in connection with the Environmental Impact Assessment for the proposed conventional Nuclear power station ('Nuclear 1'). I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it – as is described in my attached report.



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TITLE	**:**	Environmental Impact Assessment for the Proposed Nuclear power station ('Nuclear-1') and Associated Infrastructure Heritage Impact Assessment for the sites known as Thyspunt, Bantamsklip and Duynefontein
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EXECUTIVE SUMMARY

The Archaeology Contracts Office of the University of Cape Town was appointed by Arcus Gibb (Pty) Ltd on behalf of Eskom Holdings to undertake the heritage component of an environmental impact assessment of three proposed sites for a 4000 MW nuclear power station and associated infrastructure. Authorisation is sought for one of the three sites. The sites are situated in the Western and Eastern Cape, Dynefontein close to the existing nuclear power station (Western Cape), a second at Bantamsklip between Pearly Beach and Die Dam (Western Cape) and a third at Thyspunt between Cape St. Francis and Oyster Bay in the Eastern Cape. This study, which has involved extensive background and primary research followed by field assessment, has identified heritage sensitivities at all three sites.

All three sites contain significant heritage resources, being situated in areas which are known to be archaeologically and palaeontologically sensitive and in scenic areas with strong wilderness qualities. The findings of the study are summarised thus:

Duynefontein:

- Impacts to ephemeral Late Stone Age heritage will be minimal.
- Duynefontein is palaeontologically highly sensitive. Extensive mitigation will be required which, if done appropriately, will benefit palaeontological research.
- In cultural landscape terms the nuclear industrial presence is already established and accepted as a landmark by most Capetonians. Any additions to this will be additions to an already established identity.

Bantamsklip:

- By Western Cape standards the preservation and volume of archaeological sites is exceptional. Extensive mitigation will be required.
- The natural heritage landscapes of the place are excellent and make a contribution to sense of place in the region. Together with the archaeological material they represent a largely intact precolonial cultural landscape. Given the mass and bulk of the proposed activity, un-mitigatable cultural landscape impacts are expected.

Thyspunt:

- The archaeological and palaeontological heritage is diverse and prolific but pertinent to certain geographical areas – in particular the Oyster Bay Dune Field and within 300 m of the high water mark. The increase in the coastal set back zone from 60 m from the high water mark to 200 m has substantially reduced the impacts on archaeological sites. As a result of findings of extensive surveys, including a trial excavation program, it is possible to position the proposed nuclear power station in such a way that physical

impacts to heritage sites of an archaeological nature are minimised. Mitigation of any heritage material through sampling by controlled excavation, or creation of local exclusion areas is considered feasible with resources currently available. Some on site storage (a small museum) may be necessary.The wilderness qualities of this portion of the coast in contiguity with the archaeological heritage are exceptional and make a substantial contribution to the character of the region. Given the mass and bulk of the proposed activity, un-mitigatable cultural landscape impacts are expected.

ENVIRONMENTAL IMPACT ASSESSMENT FOR THREE PROPOSED NUCLEAR POWER STATION SITES ('NUCLEAR 1') and ASSOCIATED INFRASTRUCTURE

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ABBREVIATIONS

ACO	Archaeological Contracts Offi ce
amsl	Above mean sea level
DEAT	Department of Environmental Affairs and Tourism
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
HWC	Heritage Western Cape
Ka	kilo-annum (thousand years)
KRM	Klasies River Mouth
LSA	Late Stone Age
Ma	Million years
MSA	Middle Stone Age
MA	Mega-annum (a million years)
NHRA	National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NPS	Nuclear power station
PBMR	Pebble Bed Modular Reactor
SAHRA	South African Heritage Resources Agency

GLOSSARY

Archaeology: *Remains resulting from human activity, which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.*

Calcrete: *A soft sandy calcium carbonate rock related to limestone, which often forms in arid areas*.

Caenozoic: *The most recent of the three major geological times periods ongoing since 65 million years ago.*

Cultral heritage: *The legacy of heritage that has aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.*

Natural Heritage: *The legacy of natural objects and intangible attributes encompassing the countryside and natural environment, including flora and fauna, scientifically known as biodiversity, and geology and landforms*

Cultural landscape: *A distinct geographical area or property uniquely represent[ing] the combined work of nature and of people.*

Early Stone Age: *The archaeology of the Stone Age between 2 000 000 and 250 000 years ago***.**

Fossil: *Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.*

Heritage: *That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).*

Holocene: *The most recent geological time period which commenced 10 000 years ago.*

Late Stone Age: *The archaeology of the last 20 000 years associated with fully modern people.*

Middle Stone Age: *The archaeology of the Stone Age between 20-300 000 years ago associated with early modern humans.*

Midden: *A pile of debris, normally shellfish and bone that have accumulated as a result of human activity.*

National Estate: *The collective heritage assets of the Nation.*

Palaeontology: *The study of any fossilised remains or fossil traces of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or traces.*

Palaeosole: *An ancient land surface.*

Pleistocene: *A geological time period (of 3 million – 10 000 years ago).*

Pliocene: *A geological time period (of 5 million – 3 million years ago).*

Miocene: *A geological time period (of 23 million - 5 million years ago).*

SAHRA: *South African Heritage Resources Agency – the compliance authority charged with the protection of national heritage.*

Structure (historic:) *Any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith. Protected structures are those that are over 60 years old.*

Varswater Formation: *Sediments laid down under estuarine circumstances by the proto-Berg River during the Pliocene. Certain layers of this formation are highly fossiliferous.*

Velddrif Formation: *Shelly estuarine sands of the last interglacial (Pleistocene) that can be consolidated into calcrete.*

Wreck (protected): *A ship or an aeroplane or any part thereof that lies on land or in the sea within South Africa is protected if it is more than 60 years old.*

1 INTRODUCTION

The Archaeology Contracts Office (ACO) of the University of Cape Town (UCT) was appointed by ARCUS GIBB (Pty) Ltd (ARCUS GIBB) on behalf of the applicant, Eskom Holdings Limited (Eskom) to undertake the heritage component of an Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for the proposed construction of Nuclear-1 power station (NPS) and associated infrastructure fromone of the three proposed sites located in the Eastern and Western Cape Provinces. The Scoping Phase of this EIA process, in which the ACO participated, has resulted in the two sites in the Northern Cape (Brazil and Schuplfontein near Kleinzee) being excluded from further investigation.

One proposed site is situated close to the existing nuclear power station at Koeberg (Western Cape), a second at Bantamsklip between Pearly Beach and Die Dam (Western Cape) and a third at Thyspunt between Cape St. Francis and Oyster Bay in the Eastern Cape. This study (which has involved extensive background studies, primary research and fieldwork) has identified significant heritage sensitivities at all three sites.

The proposed activity is extremely complex in terms of not only the suitability requirements of the receiving environment, but also the engineering demands. Site safety and feasibility are paramount. The legislative requirements relative to an operation of this kind are complex. Not only does the proposed activity need to obtain authorisation in terms of the existing environmental legislation (National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) and associated EIA regulations) and various other licences, but it also has to satisfy the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999) (NNRA), which seeks to protect the safety of citizens in terms of nuclear activities. The geological stability of the receiving environment and local demographics are a primary concern in the site selection process, which started with the Nuclear Sites Investigation Program in the 1980s.

This revision of the report has been produced after a scope change was requested by Eskom. The field survey conducted in 2007 encountered physical restrictions in that vegetation in particularly the vegetated dunes was so dense that confident findings about the state of archaeological heritage could not be determined. To resolve this a further phase of work was commissioned by Eskom that involved excavating a systematic pattern of trial excavations in these areas. This programme has now been completed and the findings incorporated within this revision.

1.1 Background

"In many countries, including South Africa, economic growth and social needs are resulting in substantially greater energy demands, in spite of continued and accelerated energy efficiency advancements. As a result, electricity demand is growing faster than overall energy supply. The South African Government is currently targeting a six percent economic growth, which is equivalent to an average increase of four percent in electricity demand.

At present, only a few energy sources capable of providing a sustained power supply are available in sufficient quantities suitable for base load power stations. In South Africa, coal and nuclear power are used for base load electricity generation, while the open cycle gas turbines (using liquid fuel, such as diesel), two hydroelectric power stations on the Orange River, and pumped storage schemes, are used for peaking and emergency electricity generation. At present, identified renewable forms of energy, for example wind and solar, are inadequately developed to provide viable large scale power generation facilities capable of supplying a reliable base load and to be easily integrated into the existing power network in South Africa. In this context, nuclear power generation is likely to be able to provide a future, alternative mitigation strategy for greenhouse gas reductions, while providing the energy required (Arcus Gibb 2008)."

The three sites that have been identified for the proposed activity are presently under investigation as to their suitability in terms of the geological stability and engineering requirement of the project, economic, health and social requirements. Since nuclear power stations are reliant on a continuous source of cooling water, all three sites are situated on the coast in relatively sparsely populated areas. A decision has been made to use pressurised water reactors (PWR) however a vendor has not yet been appointed. The technology to be used will be "off the shelf" 3rd generation PWR technology. At this stage site layout information is preliminary and conceptual. Only once a decision has been made as to a vendor, will detailed layout plans will be developed. For the purposes of the EIA, a nuclear corridor has been assessed. This is a broadly defined land parcel large enough to contain a variety of designs and configurations of plant within it.

It is envisaged that a 4000 MW plant and associated infrastructure (high voltage yard, administration buildings and access roads) will eventually be constructed on each of the three sites along with expansion capacity for up to two more additional plants in future years. Each nuclear power station will require a footprint of roughly 30 - 60 hectares.

However this has to set within the owner controlled boundary and the emergency planning zones (EPZ). A 0 to 0.8 km Protective Action Zone (PAZ) and a 0.8 to 3 km Urgent Protective Action Zone (UPZ) are required by the EUR (Europene Utility Requirements) to be implemented around a nuclear facility for safety purposes. No new developments are allowed to be located within the PAZ and existing and planned developments situated within UPZ are required to be included in the facility's emergency evacuation plan. In the case of the existing plant at Duynefontein much of this land is used as a nature reserve.

The land parcels selected for the three sites are as follows:

The **Duynefontein** site is comprised of:

- Farm Witsand 2, 101.5741 hectares zoned Rural;
- Farm 1375, 37.0639 hectares zoned Rural;
- Klein Springfontein 33, 1399.4196 hectares zoned Rural;
- Klein Springfonfein 3, 54.1648 hectares zoned Rural; and
- Farm 34, 1257.3890 hectares zoned Rural.

The proposed nuclear corridor is situated on both sides of the existing Koeberg nuclear power station in the Koeberg Nature Reserve (Figure 1). The expansions, if required, will take place immediately to the north.

The **Bantamsklip** site is comprised of the following, with a possibility of future land acquisitions

- Remainder Hagel Kraal 318, 132.5744 hectares zoned Agricultural 1;
- Farm Buffel Jagt 310, 25.418 hectares zoned Agricultural 1;
- Portion 3 Buffel Jagt 309, 362.7053 hectares zoned Agricultural 1;
- Portion 19 Klein Hagel Kraal, 281.6164 hectares zoned Agricultural 1;
- Farm Buffel Jagt 311, unregistered zoned Agricultural 1;
- Portion 6 Klein Hagel Kraal, 85.6532 hectares zoned Agricultural 1; and
- Portion 1 of Hagel Kraal, 318 352.4593 hectares zoned Agricultural 1.;.

The proposed nuclear corridor is situated on the coast on the southern side of the R43 (Figure 2).

The **Thyspunt** site is comprised of the following, with a possibility of future land acquisitions

- Farm 741, 35.1921 hectares zoned Agricultural 1;

- Farm 824, 0.1023 hectares zoned Agricultural 1;
- Farm 325, 0.0058 hectares zoned Agricultural 1;
- Portion 7, Langefontein 736, 21.4133 hectares zoned Agricultural 1;
- Portion 6, Langefontein 736, 21.4133 hectares zoned Agricultural 1;
- Portion 8, Langefonfein 736, 21.4133 hectares zoned Agricultural 1;
- Portion 3, Langefontein 736, 21.4133 hectares zoned Agricultural 1;
- Portion 4, Langefontein 736, 21.4133 hectares zoned Agricultural 1;
- Portion 2, Langefontein 736, 21.4133 hectares zoned Agricultural 1;
- Portion 2, Welgelegen 735, 385.4066 hectares zoned Agricultural 1; and
- Portion 14, Welgelegen 735, 110.8876 hectares zoned Agricultural 1.

The proposed nuclear corridor is situated adjacent to the western shoreline of Thys Bay and along the rocky coastline as far as Tony's Bay (Figure 3).

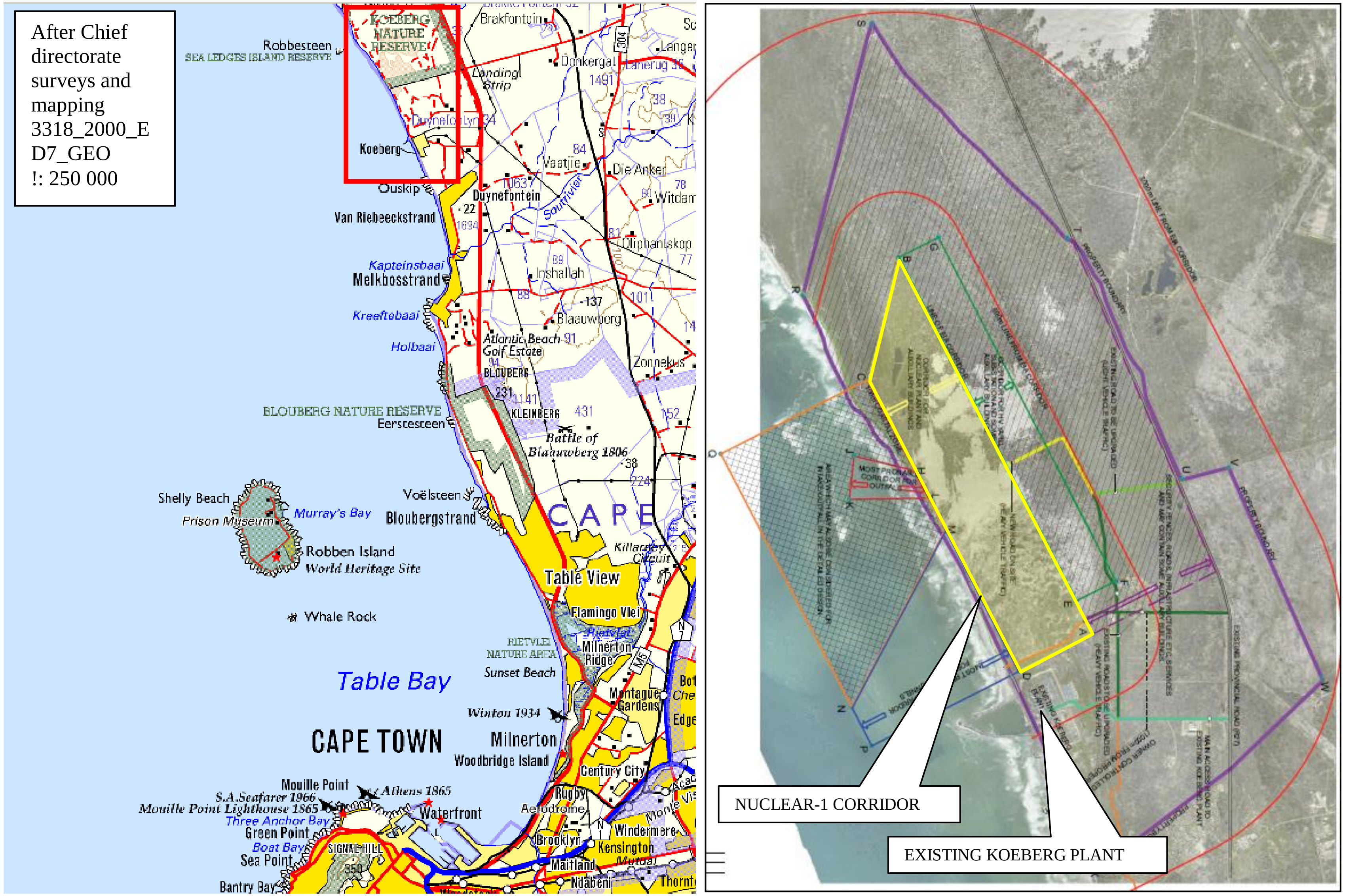

Figure 1. Location of the Duynefontein study area

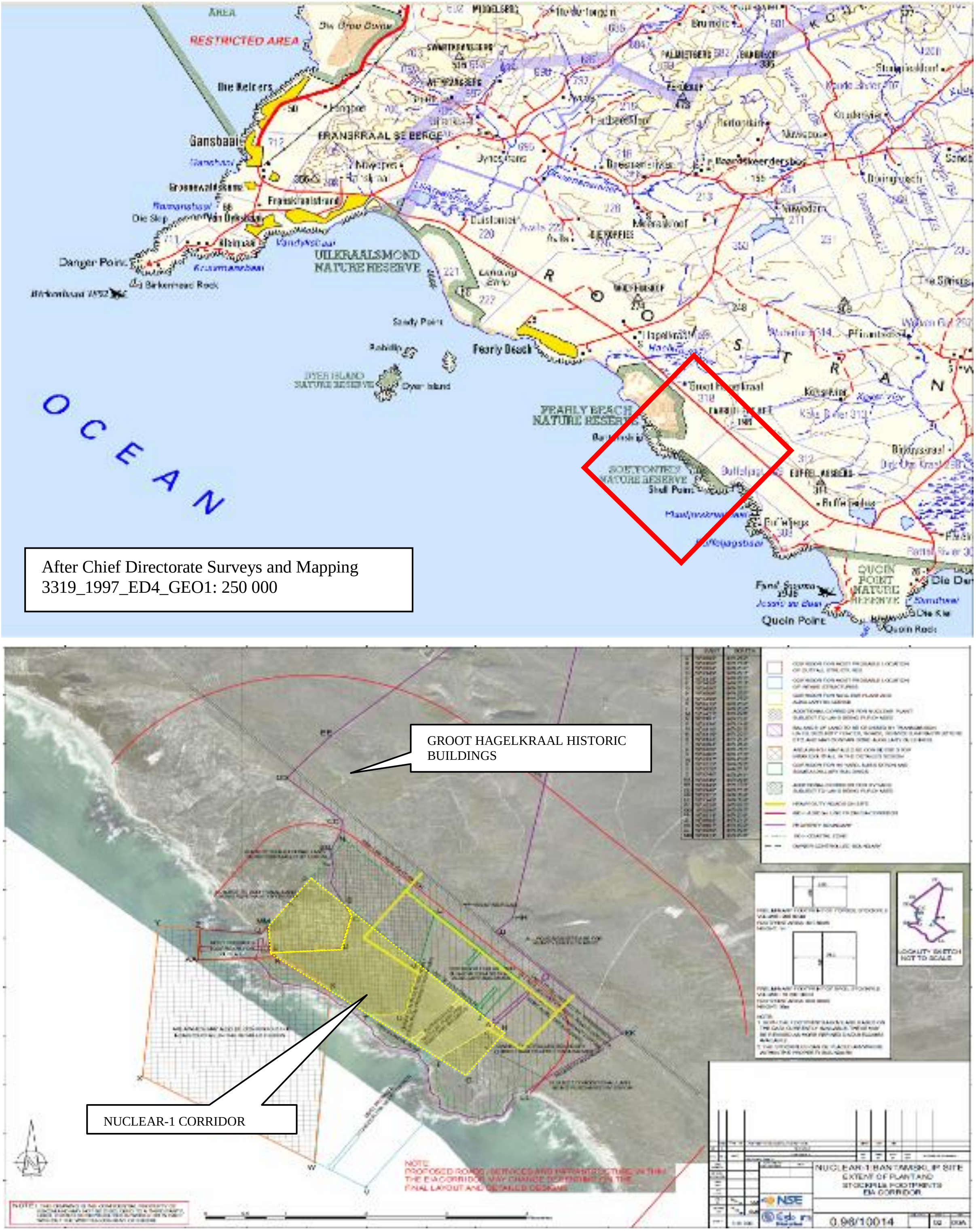

Figure 2 Location of the Bantamsklip study area

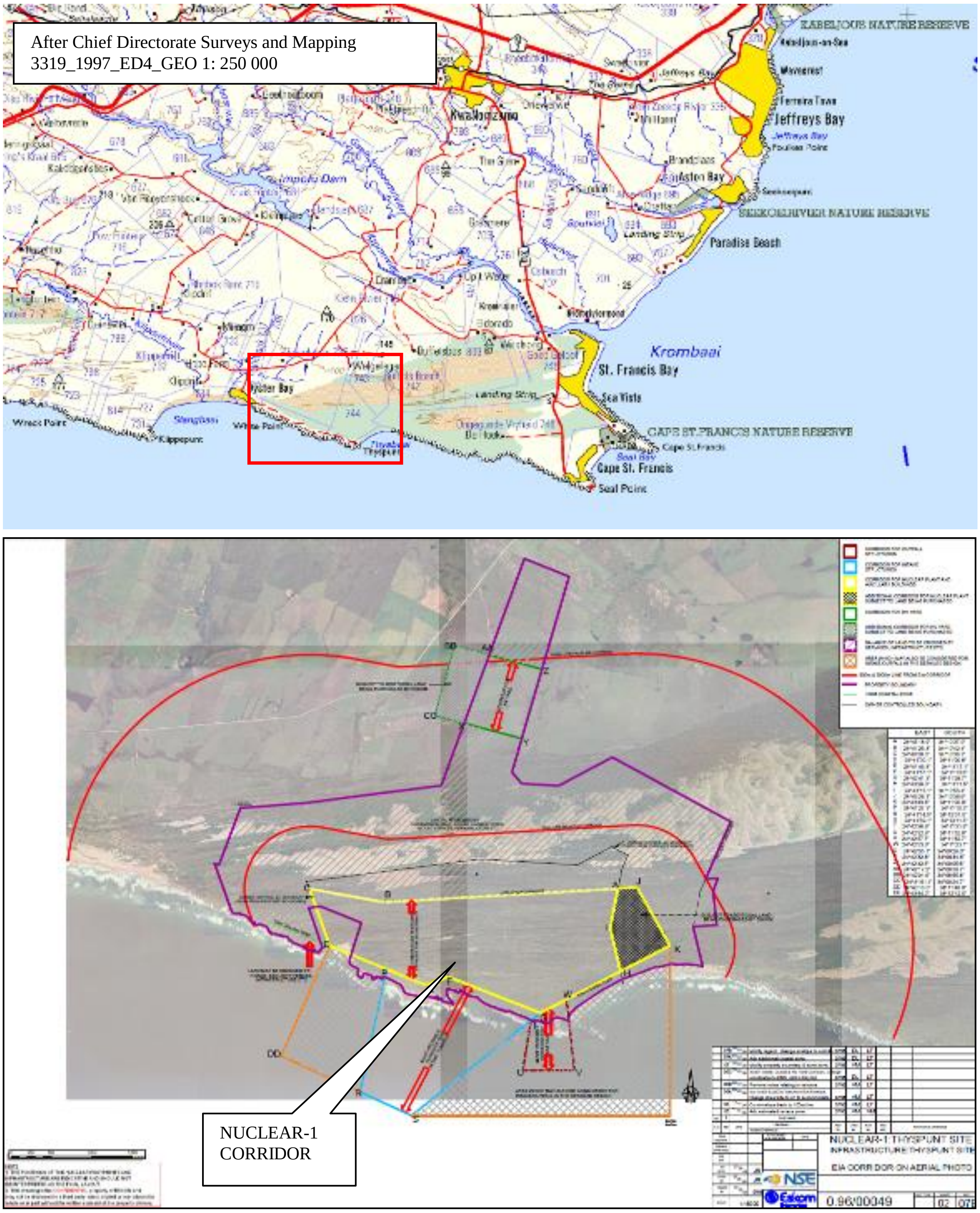

Figure 3. Location of the Thyspunt study area

1.2 Heritage impact assessment within the context of a nuclear power station proposal

Nuclear power stations may put a particular constraint on heritage management due to their unique requirements. Not only are the site selection and engineering requirements stringent, but the facility itself is engineered to strict design specifications, which cannot be deviated from without a lengthy process of testing and re-licensing. Function and safety dictate the layout and form of the nuclear structures. This means it is not possible to alter the design parameters such as form, architecture, bulk and height to suit aesthetic considerations or to be sympathetic to the surrounding landscape forms. The main structure will be an non-negotiable landscape fix with bulk and location demands that fly in the face of niceties such as urban edges, spatial planning guidelines and cultural landscape conservation. The nature of the industry demands places of relative solitude and large tracts of country and coastline. Inevitably these are wild places with high scenic and conservation values. Hence, their development brings an immediately taxing conundrum to disciplines such as heritage and biodiversity conservation.

1.3 Study Approach

Heritage, as defined by the National Heritage Rescources Act, 1999 (Act No. 25 of 1999) is a broad concept, which crosses the boundaries of many disciplines. Heritage resources change across the landscape which means that each area has its own unique set of heritage indicators which need to be identified and assessed. The approach to the work has been multi-disciplinary - studies within different heritage areas undertaken by relevant experts have been used to inform the findings of this report. These reflect the diversity of heritage issues that have been identified with respect to the three sites. Visual impact assessments for the three sites (which have relevance to landscape heritage) form a separate independent study within the EIA process. The various transmission lines that will integrate the nuclear power stations are the subject of three separate EIA processes. However, their cumulative impacts are briefly discussed in this report and copies of the Executive Summaries of the transmission line heritage impact assessment are included as appendices to the Revised Draft EIR for Nuclear-1

Of the three sites, Duynefontein (Farm 34) is the only one that has seen substantial development in the recent past – namely the existing Koeberg Nuclear Power Station and support structures. The other two sites, Bantamsklip and Thyspunt, are effectively untransformed "green field" sites which have seen minimal development in the recent past.

1.3.1 Heritage indicators

(a) Duynefontein (Koeberg)

Farm 34 contains the existing nuclear facility private nature reserve, which has become an accepted landmark in the mind of most Capetonians. When the bulk excavations were undertaken on site in the 1970s fossiliferous deposits were encountered in several of the geological strata that were affected. Furthermore, Pleistocene fossils and Early Stone Age artefacts were encountered. Archaeologists from the Iziko Musems of Cape Town then conducted a survey, noting the presence of Late Stone Age middens from the Holocene, as well as Pleistocene fossil bone accumulations at several localities within the nature reserve (Klein and Avery pers. comm.). Following these findings, Duynefontein has hosted major palaeontological research operations by international scientists.

Hence the following heritage indicators were identified at Duynefontein:

- The impact of the proposed activity on Caenozoic and Pleistocene palaeontogy;
- The impact of the proposed activity on Pleistocene archaeology and Holocene archaeology; and
- The impact of the proposed activity on historical landscape and features.

(b) Bantamsklip

The Bantamsklip site is made up of portions of uncultivated farmland. State land managed by CapeNature border the site on the east and west. The Overberg district coastline is considered to be a highly scenic area with strong wilderness qualities. It is also considered to be archaeologically rich (Aikman *et al.* 2005). However, the study area around the proposed nuclear site has not been subject to significant prior investigation. Given the known background heritage of the area, the following were identified as heritage indicators in need of assessment:

- Palaeontology;
- Pleistocene archaeology and Holocene archaeology, in particular the near - shore areas where many Late Stone Age middens are known to occur;
- The broader heritage landscape including significant natural areas as heritage; and
- The historic structures at Hagel Kraal farm yard.

(c) Thyspunt

The Thyspunt site has been subject to previous heritage-related studies, in particular by Dr Johan Binneman of Albany Museum, Grahamstown. He has published several papers and completed a PhD dissertation on the archaeology of the area. In addition, stakeholders in this area include a local Khoisan group (Gamtkwa community), which has expressed concern about the future of the heritage and their connection thereto as claimed descendents of the Khoisan people. Given the known background heritage of the area, the following were identified as heritage indicators in need of assessment:

- Holocene archaeology with particular reference to Late Stone Age shell middens representing past activities of Khoekhoen and earlier hunter gatherer communities;
- Pleistocene palaeontology and archaeology; and
- The natural and historic landscape qualities of the area.

1.3.2 Data sources

Sources of data have been derived from three main sources - extensive background reading and some primary archival research, specialist studies commissioned for this project and primary data collection in the field.

- Consultation with Dr Johan Binneman of Albany Museum, Grahamstown.
- Consultation with Prof Richard Klein of Stanford University, California.
- Communications with Dr Graham Avery, Iziko Museums of Cape Town.
- Communications with Sarah Winter and Harriet Clift (Overstrand Spatial Development).
- An extensive background literature review with respect to all three sites.
- Specialist palaeontological sub-studies by Dr John Almond reviewed internally by Mr John Pether (independent palaeontologists). This work is based on published sources and primary data held by the Council for Geo-science.
- The specialist palaeontological report for the Duynefontein PBMR site by John Pether.
- Specialist archival and historical internal sub-studies by ACO staff based on written records and primary research at the Cape Archives and Deeds Office.
- Physical heritage surveys conducted at all three sites, and the analysis of data collected.
- A recent extensive physical survey of the proposed Thyspunt nuclear corridor, authorised by SAHRA. This involved 2 months inspection and/or trail excavations at 113 localities on a grid system.

1.3.3 Method

The study commenced with a desktop review of published sources to establish the existing state of heritage information. This was followed by desktop palaeontological assessments based on published sources as well as analysis of recent primary data held at the Council for Geo-science. For the Duynefontein site, the palaeontological report commissioned by this office for the PBMR heritage study (Hart & Pether, 2007) is directly relevant to the proposed nuclear power station sites.

The bulk of information has been derived from the physical survey of the three sites. The methods used in the field are briefly described below. The first surveys were carried out in June-August 2008, while trial excavations at Thyspunt were conducted in November – December 2011..

Duynefontein: Being relatively open country, the study area (the northern bulk of the Koeberg Nature Reserve) was searched by four team members. Large expanses of open land were covered with the use of light-weight agricultural motorcycles and an off-road vehicle so that maximum coverage could be economically achieved, while more thickly vegetated areas had to be searched on foot. Locations of heritage material were recorded, photographed and evaluated. A Garmin hand held GPS receiver was used to record positions of sites. Track logs were recorded should it become necessary to review landscape coverage. The duration of the study was six days.

Bantamsklip: The study area was physically searched by four team members making up two paired teams, each equipped with a Garmin GPS. The coastal area was intensively searched on foot, each person spaced themselves 50 – 100 m from the next depending on vegetation density. Numerous transects were walked on foot, all tracks and drill roads in the study area were driven using an off-road vehicle. The areas inland of the coastal dune cordon were searched with the use of a light agricultural motorcycle so that tracts of open land could be covered as economically as possible. Locations of heritage material were recorded, photographed and evaluated. A Garmin hand held GPS was used to record positions of sites and features. Follow-up visits were carried out to evaluate any further areas to be used for access roads, sand stockpiles or possible future land acquisitions. Track logs were recorded should it become necessary to review landscape coverage. The duration of the study was six and a half days.

Thyspunt: The study area was physically searched by four team members making up two paired teams, each equipped with a Garmin GPS. The coastal area was intensively searched on foot, each person spaced themselves 50 – 100 m from the next depending on vegetation density. Numerous transects were walked on foot, all tracks and drill roads in the study area were driven using an off-road vehicle. A Garmin hand held GPS was used to record positions of sites and features. Track logs were recorded to review landscape coverage. The duration of the study was five and a half days with an additional four days being used to assess proposed road alignments and additional land required for infrastructure, sand and rock stockpiles. When was this study done?

While the presence of archaeological material was relatively visible in the immediate coastal areas and open dune fields, the densely vegetated areas formed a knowledge gap. This was resolved by means of an additional phase of work carried out from 30 Octobor –to 15 December 2011 under an excavation permit issued by the SAHRA. This second study involved conducting trial excavations/ground surface examinations at 113 localities throughout the proposed nuclear corridor where ground surface visibility was poor. After discussions with SAHRA with respect to the restrictions encountered on site, it was decided that trial excavations would be dug at each point on a 200m grid superimposed over the proposed Nuclear-1 site – an area of some 700 hectares. This covered the proposed power station footprint and laydown areas. The purpose of the work was to check below surface sediments in densely vegetated areas where no previous archaeological material had been found. The work was accomplished using a 3-ton Caterpillar mini-excavator equipped with a narrow bucket and rubber tracks (to limit ground surface damage). Excavations were carried out to a depth of 2 m, sections logged then backfilled immediately. Once it became apparent that there was very little archaeological material in the vegetated dunes, SAHRA requested that the sampling level be reduced to one excavation per 400 m grid intersection. This allowed the team to exercise some latitude in terms of avoiding impacting indigenous thickets and wetland areas. The team reached every point on the 200m grid system on foot, with the result that the site has now been comprehensively searched, and the information gaps filled.

1.4 Assumptions and Limitations

Since this study forms part of an EIA process, other disciplines that bear a relationship to heritage issues such as planning issues, visual, socio-economic and tourism are covered in the overall EIA. It is expected and assumed that the heritage compliance organisations will consider the findings of the heritage study within the context of findings of the broader EIA.

Physical restrictions to the effectiveness of the field surveys have resulted in educated assumptions being made about the sensitivity, and possible degree of impact that could be experienced at each of the three proposed nuclear sites.

At Duynefontein it has been assumed that the palaeontological sequence described by Rogers (1982) and Pether (2007) will be equivalent in areas adjacent to the existing facility, and therefore directly relevant to this study. It has also been assumed that the Pleistocene palaeontological and archaeological deposits described by Klein *et al.* (1999) are not localised to the actual excavation site (Duinefontein 2) but are potentially more extensive. It is therefore believed that although the Duynefontein site contains the least number of archaeological sites, its degree of sensitivity and assessment of severity of any impacts must take account of a high probability of buried Pleistocene deposits.

At Bantamsklip it is assumed that the distribution of archaeological sites is an indicator of the general past settlement pattern of the area, which in turn is used as the basis for the statement of archaeological sensitivity. Experience has shown that shell middens can lie deeply buried under dune systems. It is expected that if any large scale excavations were to take place on the site, buried archaeological material will be unearthed.

At Thyspunt dense vegetation has negatively affected the effectiveness of the first field survey (2008) to the extent that assumptions have had to be made about the overall distribution of archaeological sites and sensitivity of the area based on the findings of earlier research and those parts of the study area that could be effectively assessed. It was for this reason that SAHRA was approached in 2011 for an excavation permit to allow trial excavations in areas where ground surface visibility was compromised during the initial survey. Trial excavations could not be conducted along the eastern portion of the eastern access road alignment due to very high local water tables and numerous temporary wetlands. Trial excavations were also not carried out in some indigenous thickets as this would result in unreasonable damage to vegetation.

Nonetheless, the study area is now comprehensively surveyed and very well understood.

At Duynefontein previous studies have revealed that much of the archaeological and palaeontological material in the area is deeply buried and not immediately apparent on surface inspection. Verification of the presence of this material will require an extensive trial excavation programme over the entire nuclear corridor (boreholes do not allow adequate visibility), which was not feasible in the scope of this study. In terms of later historical and archaeological material, ground surface visibility is good, permitting confidence in the findings with respect to Holocene archaeological material.

At Bantamsklip physical restrictions to the study relate to poor ground surface visibility in many parts of the site. Coastal fynbos is well established and growth is so dense in places as to be impenetrable. Land to be aquired to the west (not managed by Eskom) has become densely infested with alien vegetation. Overall visibility of on-surface heritage sites may be described as moderate. While the understanding of the general distribution pattern of heritage sites and features is considered by the team to be satisfactory, it is highly probable that many more sites exist than were recorded due to visibility restrictions.

Severe physical restrictions were encountered during the surveys at Thyspunt prior to the trial excavation of late 2011. Dense vegetation growth impeded surface visibility in all but the open dune areas. Even on the immediate shoreline, the density of plant growth around the numerous coastal springs significantly reduced ground surface visibility. The coastal dune thicket was often impenetrable, and the ground surface was obscured by leaf litter throughout. It is estimated that less that 20% of the study area could be effectively surveyed prior to 2011. Although a great many archaeological sites were recorded, the team was concerned that the distribution of sites over the landscape was a function of surface visibility rather than reflective of the true locations of archaeological and palaeontological material. This problem was resolved through trial excavations on areas of low visibility.

Separate EIA processes are currently being carried out with respect to transmission line integration projects for all three alternative power station sites.

1.5 Heritage legislation

The basis for all heritage impact assessment is the National Heritage Resources Act, 1999 (NHRA) (Act No. 25 of 1999). The NHRA prescribes the manner in which heritage must be assessed and managed. In the case of Environmental Impact Assessments in the Western Cape, the guidelines published by the Provincial Department of Environmental Affairs and Development Planning are directly based on the provisions of the NHRA (Winter and Baumann, 2005).

Loosely defined, *heritage is that which is inherited*. The NHRA has defined certain kinds of heritage as being worthy of protection, by either specific or general protection mechanisms. In South Africa the law is directed towards the protection of human made heritage, although places and objects of scientific importance are covered. The NHRA also protects intangible heritage such as traditional activities, oral histories and places where significant events happened. Generally protected heritage that must be considered in a heritage assessment includes:

- Cultural landscapes;
- Buildings and structures (greater than 60 years of age);
- Archaeological sites (greater than 100 years of age);
- Palaeontological sites and specimens;
- Shipwrecks and aircraft wrecks; and
- Graves and graveyards.

Section 38 of the NHRA requires that Heritage Impact Assessments (HIAs) are required for certain kinds of development such as rezoning of land greater than 10,000 m^2 in extent or exceeding three or more sub-divisions, or for any activity that will alter the character or landscape of a site greater than 5,000 m^2. "Standalone HIAs" are not required where an EIA is carried out as long as the EIA contains an adequate HIA component that fulfils Section 38 provisions.

Heritage Western Cape (HWC) is responsible for the management and protection of all provincial heritage sites (grade 2), generally protected heritage and structures (grade 3a-grade 3c) in the Western Cape Province. In the Eastern Cape, SAHRA shares the compliance role between the Eastern Cape office in East London and the Archaeology Unit at SAHRA, Cape Town. In terms of this particular project, HWC and SAHRA are important commenting authorities but are not responsible for decision-making as this study forms part of an EIA process for which the Department of Environment Affairs is the Competent Authority (in terms of section 38(10) of the NHRA).

2 DESCRIPTION OF AFFECTED ENVIRONMENT

All three sites are located on the coast and outside any physical urban edge, on land zoned rural or for agricultural purposes. Apart from Duynefontein (the site of the existing Koeberg Nuclear Power Station and associated infrastructure), Thyspunt and Bantamsklip are largely undeveloped. In general terms any development activity in undisturbed coastal land has a high chance of causing significant heritage impacts due to the likelihood of disturbing archaeological material, coastal palaeontology and affecting areas with wilderness qualities that are becoming increasingly scarce, given the proliferation of urban sprawl on the south and east coasts and coastal open cast mining along the west coast. The significant variation in climatic conditions between the west and south coasts has resulted in significant differences in human settlement patterns through pre-colonial to colonial period history from region to region. This in turn has resulted in varying kinds of heritage sensitivity across the three areas identified for the proposed activity.

2.1 Duynefontein

The proposed Duynefontein site is situated just outside the Cape Town urban edge on the Farm 34. Duynefontein is a West Coast farm that includes large tracts of coastal fynbos and an active dune field. Other than the coastal dunes, the topography is relatively flat. The existing power station (Figure 4) and infrastructure represent an industrial enclave in what is essentially a rural context. The two Koeberg reactor units and turbine hall, which have now been in place for more than two decades, are well known landmarks visible from Robben Island, Table Bay and Table Mountain. When Koeberg was under construction in the 1970s and 1980s, a significant portion of the farm was a major construction site accommodating temporary workshops, construction camps, concrete batch plants, etc. Furthermore, much of the excavated soils were accumulated in a soil stockpiling operation immediately north of the power station. Today these areas, which have been rehabilitated, form part of the Koeberg Nature Reserve, an amenity which is open to the public.

The proposed nuclear corridor at Duynefontein will absorb a moderate portion of the nature reserve to the north of the existing nuclear power station while the southern area up to the edge of the Duynefontein settlement may also be used for infrsastructure. The northern area contains in part rehabilitated spoils from the previous excavations, but also a substantial segment of the mobile dune system to the north. This area has never been developed before.

2.1.1 The regional heritage context

In recent years the West Coast has become famous for its fossil wealth. Just inland of Langebaan is the largest Miocene (5-6 million years old) fossil deposit in the world, parts of which are on display at the West Coast Fossil Park (Hendey 1982). This material was deposited in sandbar sediments at the mouth of the proto-Berg River (an ancient river and estuary that was the precursor to the Berg River), the course of which changed over the millennia in response to sea level changes. The excavation for the existing Koeberg Nuclear Power Station exposed fossiliferous formations of similar age reported on by Rogers (1980). Close to Hopefield, further inland, are the Pleistocene fossil beds at Elandsfontein (last million years) famous for the discovery of the early human species *Homo ergaster* (Saldanha man). On the edges of the Langebaan lagoon Dr Dave Roberts and Dr Lee Berger discovered the 200,000 year old footprints of an early modern human fossilized in calcrete sediments. At Hoedjiespunt, Professor John Parkington has excavated on the site of an ancient hyena lair where skull fragments and teeth of an early human were found, showing that parts of the individual were consumed by hyenas more than 300,000 years ago (Parkington 2006). Nearby, fossilized within the calcretes and aeoleanites are shell fish, animal bone and ashy hearths of people who lived in the area more than 100,000 years ago (Parkington, Poggenoel, Halkett and Hart 2004). Further south at Yzerfontein, Prof Richard Klein, Iziko Museums of Cape Town and the UCT ACO team has been conducting an ongoing project on a Middle Stone Age shell midden, one of the earliest known (Halkett et *al.* 2003).

(a) Palaeontological heritage

According to Pether (2007) the bedrock is weathered shale of the Tygerberg Formation (Malmesbury Group) and is ~600 Ma (Mega-annum - million years old), highly deformed and metamorphosed deep-sea turbidites. It has no intrinsic palaeontological potential. However, the softer zones in the bedrock were colonized by boring bivalves when the bedrock was last below seabed, producing *Gastrochaenolites* trace fossils (*Glossifungites* ichnofacies). These features exhibited no offsets due to shear forces in the bedrock, which was taken as reassurance that the area had been seismically quiescent since the Pliocene 2-5 Ma ago.

The bedrock is overlain by a fossiliferous marine gravel basal to a sequence dominated by bioturbated, slightly muddy, fine quartz sand, ~10 m thick, that has been dubbed the "Duynefontyn Member" of the Varswater Formation. A thin peaty sand caps the sequence. The "Duynefontyn Member" is richly fossiliferous and includes:

- Teeth, bones and scales of sharks, rays and bony fish;

- Fossil whale bone, dolphin and seal teeth;
- Marine birds, incl. the type specimens of a unique extinct penguin, *Nucleornis insolitus*;
- Terrestrial mammals, incl. bovid andhares;
- Terrestrial reptiles, snakes and tortoises; and
- Terrestrial plant pollen in the peaty sands.

The "Duynefontyn Member" is interpreted to be a regressive sequence of barrier beach coast succeeded by subtidal and intertidal facies of coastal tidal flats, which are overlain by freshwater, peaty marsh deposits of coastal *vleis*.

The peaty sands are erosively overlain by a basal gravelly sand unit with gastropod casts and shark teeth, the "Gastropod Bed". The latter is overlain by a mixed fine and coarse quartz sand unit, yellow-brown in colour and becoming paler upwards, which is regarded as an aeolianite. This is the Springfontyn Formation. Some terrestrial fossils from this formation are seemingly of middle-Pleistocene age.

The section is capped by calcareous sands and calcrete, which should probably be relegated to the Langebaan Formation aeolianite. Middle Stone Age artefacts occur in the calcrete. Closer to the coast the Springfontyn Formation is truncated by the sea-level highstand of the Last Interglacial 128-119 ka (ka: kilo-annum, thousand years ago), when shelly beach sands were deposited.

(b) Pre-colonial heritage

In 1973, Richard Klein discovered the palaeontological site known as *Duynefontein 2* – fragments of fossil animal bone which had been un-earthed during geotechnical trial excavations for South Africa's first nuclear power station (see Figures 6 and 7). The site *Duynefontein 2* was excavated annually between 1998 and 2003. It produced a wealth of Pleistocene fauna (about 300,000 years old) and resulted in numerous publications of the findings in international journals, establishing the name "Duynefontein"[1] as a place of world class scientific discovery (Klein et *al.* 1999, Cruz-Uribe *et al.* 2003). Klein closed the excavations once he had obtained a substantial sample of animal bone representing the diversity of species believed to be in the area during the mid-late Pleistocene. Scientists hope that this area will one day yield very rare human remains – the age and geological context are considered promising. Despite the ongoing work by Klein and others, it is not clear exactly how extensive the Duynefontein palaeontological resource is. The fact that the fossil material has been

[1] Spelling used referring to the archaeological site published as "Duynefontein 2" as opposed to place name 'Duynefontein".

excavated at only a single locality at Duynefontein is likely to be a function of the fortuitous geotechnical excavation where the material was initially identified. It remains unknown how much more lies buried under the dune of the Witsand formation, although according to Avery (pers. comm.) pockets of fossil bone have been observed from time to time in the dune field when sand movement allows (Figure 5).

The coastal regions of the Western Cape were occupied in pre-colonial times by people who exploited marine resources for their livelihood. Human occupation of the coast is archaeologically reflected in the thousands of shell midden sites and rock shelter deposits that mostly date after the last 6,000 years. About 2,000 years ago the economic order changed with appearance of Khoekhoen herder groups in the Western Cape. Herder sites, such as at those at Kasteelberg (Sadr *et al.* 2003), show occupation between 1,800 and 1,600 years ago. European explorers had contact with many of the Khoekhoen groups along the coast. These people included the CochoqQua, whose territory stretched from Saldanha Bay to Vredenburg, and the ChariGuriQua or GuriQua who occupied the lower Berg River area, St. Helena Bay and points around Piketberg.

Shell middens have been observed locally at Blouberg Beach, Atlantic Beach and within the Koeberg Nature Reserve. The implications of this are that shell midden material could be encountered in the form of surface archaeological sites, or as buried lenses anywhere within the study area. Late Stone Age sites (the heritage of the Khoekhoen and San peoples of Southern Africa) were relatively numerous along the Western Cape coast and can be observed close to any area of rocky shoreline where shell fish and other marine resources could be exploited (Parkington, 2006). These kinds of sites, which are mostly less than 5,000 years old, and characterised by piles of shellfish, stone artefacts and from time to time pottery, have been observed in the Koeberg Nature Reserve (although no comprehensive survey has been completed).

Unfortunately, outside of any area that is either isolated or protected, shell middens have suffered from disturbance caused by people, construction activities, property development and off-road vehicles to the extent that a once common (but finite) heritage resource has become alarmingly threatened. While compliance authorities are aware that heritage resources of this type are increasingly endangered, there is as yet no overall regional strategic conservation goal in place that would direct any strategic action within the heritage community. Nevertheless, intact shell middens have become highly valued heritage resources. Heritage authorities (HWC, SAHRA) have responded to this situation by identifying several middens for Provincial Heritage Site nomination.

(c) Colonial period heritage

The landscape inland and to the north of Duynefontein is dominated by agricultural land, which has its origin in early Dutch East India company grants and quitrents[2] (the Farm Duynefontein 34 being one of them). Some of the original farm boundaries can still be identified within the contemporary cadastral layout (Hart, Clift and Schietecatte in prep.). Although along the southern portion of the West Coast many of the early farms have become sub-divided and broken up by developments such as Atlantis Industrial Township, Brickfields, Western Province Shooting range and various sand mining operations. A number of notable farm names and associated structures have survived - Groot Olifantskop (Keert de Koe), Vaatjie, Brakkefontein and Donkergat are but a few that have been recently identified as containing early fabric. Within this area, research into the heritage of early colonial settlement is limited with only site identification surveys being completed to date.

The earliest colonial period history pertaining to the Duynefontein study area is reflected in primary archival documentation. Reference is made to a Hermanus Dempers as 'inhabitant and owner of the 'Opstal' on the loan place named 'Duynefontein' (CA CO 3985 ref, 117, CO 3887 ref 79).

Dempers became the owner of the then extensive property in 1799, but it is unclear who the first grantee was. It is indicated in a complaint letter lodged by Dempers (dated 26 Sept 1811) that 'tenants' were cutting wood that belonged to him. These tenants were apparently awarded certain land rights in 1731, and paid rent to the Cape Government. The struggle over marginal land is demonstrated in the competing livelihoods at Duynefontein. Dempers was a brickmaker and as such was "always in great want of bushes and other small wood and for that reason never cut away any wood in the vicinity of his house, but always saved it in order to let it grow to greater perfection." The 'illegal' cutting of wood "even about his house" exposed his "cultivated ground to be blown away." He laments that "to his greatest sorrow in what manner some persons make ill use of the privileges which they have obtained" and begs the authorities to protect him against the "attempts of those who are striving to injure him" (CA CO 3985 ref, 117, CO 3887 ref 79).

When the property was surveyed in 1834 for the quitrent grant, there is no indication of houses or any built structures. There is, however, a 'Kraal Ordannantie', which features on the diagram as well as the later 1890 SW Cape survey map.

The colonial period history of Duynefontein is interesting; however it does not reveal any particular significance in terms of associations with events, or important historical

[2] A quitrent is a grant of land given for 15 years for which an annual rent is paid. Quitrent tenure was introduced to South Africa in 1732.

personalities. The early surveyor's diagrams have been superimposed over modern plans of the farm in an effort to locate the historic kraal. The kraal location appears to be outside of the study area. Neither the site of Demper's house, nor of his tenants, is known. It is possible that ephemeral evidence of their presence may lie under the dune sands somewhere on the property.

2.1.2 Duynefontein Heritage survey - findings

The physical survey of the Duynefontein study area conducted for this project revealed that the heritage significance of the site is varied. No colonial period heritage sites were found while heritage sites relating to the Late Stone Age are few. The heritage significance of the Duynefontein option relates to its Miocene palaeontological and Pleistocene archaeological and palaeontological deposits.

The findings of the physical survey are thus:

- **Miocene Fossil Material:** The fossil material that will be exposed in the excavations for Duynefontein nuclear power station and in all likelihood subsequent expansion phases, will be similar to that described by Rogers (1980, 1982), as observed during the latter phases of construction of the extant plant during 1978. It is predicted that the main excavations for the installation will expose the bedrock, at 10-14 m bmsl, underneath a vertical section of 24-28 m of sediment. The highly fossiliferous "member" of the Varswater formation, which lies just above the Malmesbury shales in the local geological sequence, will inevitably be encountered during bulk excavations for the proposed activity. Due to the fact that deep excavations south of the diamond areas of the West Coast are limited to that which was carried out for the first Koeberg installation and the phosphate mine at Langebaanweg, the extent of the Miocene fossil resources are relatively unknown. It can be anticipated that pockets of Miocene fossiliferous material are common from Milnerton to Langebaan.
- **Pleistocene fossil material:** Occurrences of Pleistocene fossil bone are to be found in the study area in almost any area where shifting dune sands have exposed the underlying nodular ferricrete horizon (ancient land surface). In particular there are two notable sites known to archaeologists – Duynefontein 1, a possible Pleistocene Hyena den with a very large exposure of associated fossil fauna, and Duynefontein 2, a known and important Pleistocene palaeontological site with archaeological material. Duynefontein 2 has produced results of Importance. Both sites lie directly under the footprint of the proposed nuclear power station corridor. It is predicted that the fossil occurrences are far larger and deeper than what has already been archaeologically exposed. One of the greatest difficulties experienced in terms

of the assessment of archaeological and palaeontological heritage is the fact that most of the significant material is buried. It is known that at the site of Duynefontein 2 there are at least three buried horizons (ancient land surfaces) (Klein, 1999 & Uribe *et al.* 2003), each of which represent different ages in the Pleistocene and Holocene prehistory of the region. Klein and his team found the fossilized remains of ancient Pleistocene fauna on a 300 000 year old land surface along with traces of human activity. The animals included many species not seen in the Cape today as well as several extinct species such as the giant buffalo, giant pigs, extinct species of elephant, hippopotamus and the Cape horse. The main fossil horizon lay roughly 1m below the surface of the present day wind-blown sands. Nodular calcretes had developed over the fossil horizon making excavation very difficult at times. Deep soundings by Klein and his team revealed the presence of an even older deeper horizon; however ground waters at a depth of 2 m prevented its detailed excavation. Klein (pers. comm.) is of the opinion that archaeological and palaeontological deposits such as those found at Duynefontein 2 have the potential to exist anywhere within the Eskom held property and beyond. However, the difficulty is that there are no known methods of establishing where they are without extensive trial excavations. Klein did not terminate the excavation at Duynefontein 2 because the fossils had run out, but because he had achieved what he believed was an adequate sample for his research purposes. The proposed activity will directly threaten the entire sequence of fossiliferous deposits where any deep construction work is envisaged. The difficulty in defining appropriate mitigation measures is that the extent of the resource is unknown. If it is localised to the footprint of the development area of the proposed nuclear power station or any of the expansion phases thereof, the destruction of the palaeontological material will be complete and the impact will be severe (without mitigation). If the resource is large as Klein has suggested (extending beyond the proposed power station footprint), the resource will be partially impacted.

- **Late Stone Age:** Ten possible middens were encountered (some sites without artefactual material may in part be gull drop sites). These are relatively ephemeral single occupation scatters. Interestingly the shell fish species on them consists primarily of white mussel shell (*Donax serra).* This reflects the marine resources that can be obtained from the mainly sandy beach that borders on the property. Artefactual material associated with these sites is limited to informal quartzite flakes and chunks. The sites can generally be graded as being of moderate local significance, which means that mitigation in the face of possible destruction caused by development is warranted and achievable.
- **Cultural landscape:** The heritage survey of the study area did not reveal any aspects of the cultural landscape and associated person-made structures that are

of any particular significance, or protected by the NHRA. The layering of the landscape reflects a multitude of pre-colonial layers. The early colonial farming element is invisible, being dominated by the 20th century landscape of industry and nature conservation. Before the existing power station was built, the study area was a rural landscape of sandy and mainly un-cultivated land and prior to the construction of the R27, very remote. Although through the efforts of the Koeberg Nature Reserve staff, the property has retained its wilderness qualities in places, the nuclear power station is an exceptionally powerful visual intrusion, which together with its support structures and access road has completely transformed the place into a peculiar combination of an industrial and rural ambience. The introduction of a further industrial element will strengthen the industrial character of the place, but given the already established bulk of the existing facility, it is anticipated that the sense of change that will take place to the landscape will be acceptable since Duynefontein is an accepted and established landmark.

2.1.3 Statement of significance

The heritage significance of Duynefontein is dominated by its internationally recognised palaeontological wealth. The Late Stone Age archaeology of the site is comparatively insignificant and poses a minor risk. The proposed activity is a threat to the significant palaeontological heritage resource. Palaeontologists, given the right circumstances, welcome the opportunity to study strata and sequences that they very seldom have the opportunity to view. Provided that there is an opportunity to carry out the appropriate scientific studies with the appropriate funding in an appropriate time frame, with a suitable commitment from all parties, a situation of potentially high negative impact can be transformed into a scientific benefit.

Figure 4 (above) View over the study area towards the existing Koeberg power station

Figure 5 (left) Fossilised metapodial of a medium bovid found close to Duynefontein 1 archaeological site

Figure 6 (bottom left) Duynefontein 2 archaeological/palaeontological site in 2008.

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Figure 7 (bottom right) Duynefontein 2 archaeological/palaeontological site in 2000.

2.2 Bantamsklip

Bantamsklip is located on the southern coast of the Western Cape Province between the small towns of Pearly Beach and Die Dam. Situated about 9 km east of Pearly Beach, the context is rural. The general area is a holiday destination on account of its scenic qualities, mild climate and "unspoiled" coastline. The study area itself has exceptional wilderness qualities and is a natural heritage site on account of its floral diversity, in particular the unique limestone formations which are home to specialised plant communities making the region a significant biodiversity hotspot. The farm Groot Hagelkraal is a registered Private Nature Reserve and a Natural Heritage Site. Properties to the immediate east and west of the site are state owner and managed by CapeNature, but not are gazetted nature reserves.

The study area (the broad area of land that will contain the nuclear infrastructure) lies on the seaward side of the farm Groot Hagelkraal. Most of this land is owned by Eskom and managed as a natural area. The R43 from Pearly Beach to Die Dam divides the farm into an inland and coastal portion. The inland portion lies partially on the coastal plain, however the northerly-most portion extends into a series of limestone massifs, an ancient *facies* of the surrounding Peninsula Formation. These limestone formations contain a multitude of rock shelters, caves and overhangs, some of which contain archaeological sites. Currently there is one cluster of standing structures on the entire property – namely the Hagelkraal farmhouse and outbuildings, all of which are conservation-worthy vernacular structures. The farm is run by a wild flower enterprise, which is friendly to the aesthetics of the area. The proposed development area lies on the southern side of the R43 adjacent to the rocky point known as Bantamsklip. There are no buildings on this portion of land apart from a ruined farm boundary wall and a concrete water tank.

The coastal portion of the study area incorporates two rocky points, framing a mostly rocky shoreline. While this shoreline is highly active, small embayments and longitudinal gullies result in the exposure of largish expanses of tranquil water and rock pools in the intertidal zone. The shoreline is flanked by a series of parallel vegetated dunes. These are stable and densely vegetated with coastal fynbos. The dune system extends inland for 300 – 400 m, after which the landscape opens up onto a coastal plain. Towards the eastern edge of the site fossil dunes (aeolianites and calcretes) are exposed on the surface. Where the soil depths are shallow these are sparsely vegetated. There are no buildings or ruins on the coastal portion of the property. Several informal tracks traverse the landscape and the near shore area.

These are used mainly by fishermen. Abalone poaching is taking place on the property – this is evident by modern middens of shucked[3] shells hidden under large bushes or nestled between dunes.

In essence the area may be described as a sparsely-inhabited coastal wilderness with a high diversity of flora. It is an aesthetically attractive place with a strong sense of country and solitude. The archaeological sites on the property are numerous and thanks to the lack of development and relatively closed access, in a good state of preservation. Such areas are becoming increasingly threatened along the south coast as even outside the physical urban edges of Pearly Beach residential buildings are proliferating in what used to be wilderness areas between Bantamsklip and Buffelsjagsbaai.

2.2.1 The regional heritage context

The Bantamsklip area has not been subject to previous heritage studies or much archaeological research, although adjacent areas have been researched by archaeologists of the South African Museum (now Iziko Museums of Cape Town), which was very active on the south coast in the 1970s and early 1980s. Studies into colonial period settlement and heritage are few, with existing information focussing mainly on the early mission stations of Genadendal and Elim. However, the recent Overstrand Spatial Development Framework has incorporated a heritage overview for planning purposes. The work conducted by Aikman, Baumann, Winter and Clift (2005) is a first attempt at characterising the broad heritage aspects of the region.

(a) Pre-colonial Heritage

The first formal research into the prehistory of the Overstrand region was that published by Professor John Goodwin (1946). This research did not involve any excavations of archaeological sites on the southern coast, but was based upon a series of observations of *viswywers* (tidal fish traps) that had been built by prehistoric people - possibly the same people responsible for the accumulation of shell middens that contained numerous fish bones and fragments of pottery. Goodwin stressed the need for the archaeological investigation of sites that could provide evidence linking the contents of shell middens and the *visvywers*.

It was not until the 1970's that research by archaeologists of the South African Museum provided further insight into the prehistory of the southern cape to the west of Cape Agulhas. Excavations by Frank R. Schweitzer (1979) at Die Kelders coastal cave near Gansbaai produced early evidence (1 600 years ago) for the introduction of pottery

[3] A shucked shell is one that has been opened to remove the edible meat.

technology and domestic stock into the Cape as well as a MSA (Middle Stone Age) occupation over 40,000 years old.

The significant pottery finds led Schweitzer (1970, 1979) to conclude that the cave occupants were in contact with herders – Khoekhoen pastoralists who made their appearance in the Western Cape (along with the skill of making pottery and herding domestic animals) roughly 2,000 years ago. He thought this view was substantiated by the change in seasonal use of the cave that seemed to be reflected through time. The earlier layers seemed to have accumulated in winter months, while the more recent layers showed longer occupation extending into spring and possibly even summer (Schweitzer, 1979). This prolonged occupation was thought to be facilitated by an increased reliance on domestic animals for food.

More recent excavations validated much of Schweitzer's work (Marean, 2000). The researchers were able to make use of more modern technologies and dating techniques to conduct excavations at a far finer degree of resolution. These excavations extended deep into the MSA layers. They were able to establish that the MSA levels were deposited over a short space of time (15,000 – 20,000 years) but that they were nonetheless a good deal more complex than had been thought by Schweitzer (Avery *et al.*, 1997). They also found that stone tools made on fine-grained materials, similar to *Howiesons Poort* (a key marker phase of the MSA) artefacts at the top of the MSA levels dated to between 80,000 and 60,000 years ago.

The recent work at Die Kelders significantly increased the number of early human remains excavated at the site, most of these being teeth of sub-adults (Grine, 2000). Analyses of the teeth, in particular, revealed that these individuals, while displaying some traits that were similar to modern Africans, were not conclusively modern (Marean, 2000).

Inland of Gansbaai on the farm Byeneskranskop are limestone outcrops (very similar to those at Groot Hagelkraal), which contain numerous caves and shelters that attracted pre-colonial occupation. First excavated in 1974 (Schweitzer & Wilson, 1982), the main archaeological cave site at Byeneskranskop is near the top of a hill, 60 m above sea level and 19 m x 15 m at its greatest extent. The site records a relatively complete sequence of occupation over almost 13,000 years. The importance of sequences such Die Kelders and Byneskranskop is that they help researchers to understand the relative ages and cultural affiliations of the many open sites in the region.

Research in the Pearly Beach area has mainly been conducted by Graham Avery of Iziko Museums of Cape Town. Several open station shell middens in the Pearly Beach area were surveyed and excavated by him in an attempt to derive a systematic, regional understanding of the subsistence strategies of pre-colonial south coast populations

(Avery, 1974). Sites here were found to extend from locations just behind the beach dunes to up to two kilometres inland. Sites generally cluster near the rocky stretches of the coast where shellfish are abundant, while no sites were found along the sandy beaches. Avery (1974) makes the suggestion that occupation sites may be linked to the occurrence of milkwood thickets, which provided shelter for people. According to Avery, the shell middens can be divided into three varieties, each characterised by different predominant species of shellfish that occur at different depths within the intertidal zone. He hypothesised that these differences suggest the employment of different procurement and processing strategies. The relative dominance of various shellfish species in the middens could relate to the timing of harvesting or the ways and places the shellfish were prepared and eaten (Avery, 1974). Avery (1976) identifies a number of types of stone features at the Pearly Bay sites. These are: hearths with evidence for burning, hearth-like structures with no ash or charcoal, groups of large stones associated with burials and roughly semicircular features that were possible anchorages for huts or windbreaks. In recent years similar features have been associated with shell middens throughout the south and west coasts.

Avery (1976) drew the conclusion that these coastal sites reveal that the ancestors of both the Khoekhoen herders and hunter gatherer groups accumulated them as part of a cyclic or seasonal system that used both inland and coastal resources. It is now broadly accepted by archaeologists that shortly after 2,000 years ago, a new economic system was introduced to Southern Africa - namely certain groups of people adopted transhumance pastoralism (in this case with herds of fat-tailed sheep and later cattle) instead of primarily relying on hunting and gathering, which was universally practiced in South Africa before this time. The origin of early stock keeping in Africa is still unknown.

The only documented work that has ever taken place at Hagelkraal involves a skeleton, which was excavated from dunes. It was surrounded by an ephemeral shell scatter and several large boulders. The associated cultural material suggested a Late Stone Age interment[4] (Voigt, 1972). The areas surrounding the Hagelkraal vlei and the nearby limestone ridges contain a significant concentration of sites (Avery, 1974). Archaeologist Mr David Halkett (pers. comm.) recalls participating in archaeological trial excavation in a cave on the property in the early 1980's. A human skeleton was revealed, however lung distress caused by cave dust forced the group to close the site.

A study, which took place in an area with similar landforms to Bantamsklip, is worth consideration. In 1984 an area just to the west of Struisbaai was the focus of a study by archaeologists from the South African Museum and the UCT (Hall 1984). They were interested in the way in which prehistoric people were using the different kinds of environments represented in this area. The focus of this research was an area very similar in morphology to the site currently under investigation in this report in that it involved a shoreline, coastal dunes and flat coastal plains. An exhaustive survey of this area showed that the majority of archaeological sites were located directly on the shoreline, or on the edge of the inland dune field where large dunes overlook the coastal plain. The coastal plain itself was relatively devoid of archaeological material and was clearly not a popular area for Stone Age communities. The study showed that the dune field had been favoured for occupation over the last 4,000-6,000 years by both earlier hunting and gathering people and possibly pastoralists later on. Further research undertaken by the ACO team throughout the Southern, Western and Northern Cape has confirmed that prominent coastal dune systems were important settlement areas during the late Holocene (up to 5,000 years ago). Prehistoric people were selecting deflation bays and inland edges of the dune fields for encampments as these provided good locations from which to exploit the seasonal water and good grazing found on the coastal plain, or the marine resources of the nearby shore. It is therefore predicted that pre-colonial settlement patterns at both Bantamsklip and Thyspunt are likely to be similar.

(b) The colonial period

Aikman *et al.* (2004) comment that Khoekhoen herders were the dominant groups of people in the Overstrand region when the Dutch East India Company started extending its interests beyond the Cape Peninsula in 17th century. A powerful herding community which occupied the Caledon plains, the Chainoqua, traded regularly with VOC outposts – the demand from the VOC for cattle for re-victualing ships was insatiable. Although the Overstrand areas were considered to be among remotest of the fledgling colony, the pervasiveness of the colonial settlement endured. The first Europeans used small sailing craft to access the coast, eventually followed by overland wagon trails (one of which is preserved in the study area). Eventually nomadic European stock farmers and professional hunters moved into the area – they were the forerunners of permanent colonial settlement.

In the 18th century the Dutch East India Company began to "formalise" the process of granting farms in the area. Stock posts were granted east of Hermanus by the 1730s while the first hunting licences were granted in the Baardskeerdersbos area by 1706. By the mid 18th century it can be safely assumed that European settlers had made their presence known in the Pearly Beach – Buffeljags area. The Khoekhoen Herders who had grazed their sheep, cattle and goats on the coastal plains for more than 1,000 years did not fare well in what was a hopelessly unequal contest with the Europeans. They lost their traditional grazing lands and succumbed to foreign illnesses brought in by the

[4] The act of burial

colonists. By the 19th century the remnant populations of these once powerful communities, devastated by smallpox and the breakdown of their traditional political structures found themselves confined to mission stations or "employed" on the colonist's farms.

The towns of Pearly Beach and Gansbaai were established in the 19th century. These small towns had their origin in informal gathering places where *trekboers* converged at the coast at freshwater springs to fish and get relief form the dry interior. Aikman *et al.* (2005) report that it was only after relaxation of Dutch laws about boat ownership that the small fishing villages began to develop at places such as Gansbaai. "The Uilenkraals, the Hagelkraal and the Buffeljags Rivers drew early inland stock farmers to the coast annually. This pattern continued through the 19th century and apart from a few fishermen's cottages there were few permanent dwellings along this coast until the end of the 19th century and beginning of the 20th century. Given the large number of ships to have been wrecked here this would have made it very inhospitable for survivors. Apart from some isolated groves of milkwood trees at Stanford cove, Franskraal and at Pearly Beach, it is an almost treeless landscape with coastal dunes and low scrub vegetation offering little shelter. The most famous wreck was that of the Birkenhead in 1852 off Danger Point. A lighthouse was built there in 1895. The first permanent settlement in this district would appear to have been at Gansbaai although there were already a few houses at nearby De Kelders. The fishing entrepreneur Walter MacFarlane employed 17 fishermen in Gansbaai in 1903. This became the nucleus of the fishing industry, which was to develop over the following 100 years. A harbour was constructed as well as fish meal factories, ice making and freezing facilities and canning and fish processing works". (Aikman *et al.*, 2005:239).

(c) Groot Hagelkraal

The farm Groot Hagelkraal (Farm 316, diagram 546/1831) was granted to Gideon Johannes Joubert (Daniel's son) in perpetual quitrent on the 6th of June 1831 (Sw. Q. 6-27). Groot Hagelkraal was subdivided in 1917 and Portion 1 was included in the farm Groenkloof (see below). The remainder of the farm was consolidated into the farm Hagelkraal in 1949. From the coastline inland, it is described as down pasture, heathy sandy flats and sour mountain ground. In Portion 1 next to the Cape Road the position of a hut is indicated.

A piece of land (unnamed) (Farm 315, diagram 921/1837) was granted to Johannes François du Toit in perpetual quitrent on 30 November 1837 (Sw. Q. 12-15). It was subdivided in 1917. Portion 1 was included in Groenkloof (see below). Another portion was included into the farm Hagelkraal in 1949. The Hagelkraal River runs through Portion 1; Portion 2 contains a rocky hill with heath and reed, from this hill tributaries run to a river standing in summer. Close to the river runs the road to Elim.

Buffel Jagt (Farm 309, diagram 561/1831) was granted to Petrus Jacobus Joubert in perpetual quitrent on the 6th of June 1831 (Sw. Q. 6-43). The farm was subdivided in 1889 and in 1949, Portion 1 of was incorporated into the farm Hagelkraal. The Cape Road runs along the boundary of the farm. No structures are indicated, only marshy ground where cattle may be watered by digging a dam.

The current farm Kleyn Hagelkraal (Farm 321, diagram 121/1947) is a consolidation of the original farm with the same name, three portions of the farm Groenkloof and Farm 320 along the high-water mark of the Indian Ocean on 30 April 1948.

The original farm Kleyn Hagelkraal (Farm 319, diagram 572/1931) was granted in 1831 (Sw. Q. 7-2) to Gideon Joubert (Daniel's son) in perpetual quitrent. The Hagelkraals River runs through it and it had three plots of formally cultivated land along the Cape Road and near a spring. The original survey diagram did not indicate any buildings.

The farm Groenkloof (Farm 317, diagram 53/1917) was made up in 1917 of two portions: Portion 1 of Farm 315 and Portion 1 of the farm Groot Hagelkraal (see above).

Farm 320 (diagram 922/1837) along the high-water mark of the Indian Ocean was granted to Jacobus François du Toit (Andries' son) on the 20th of November 1837 on perpetual quitrent (Sw. Q. 12-16).

Hence, the land parcel that is the subject of the study had its origins in a series of 19th century land grants. Important heritage information is that the Cape Road crossed the study area from east to west, and that a residence/hut/dwelling of some form was present of the property when it was first granted. The existing farm complex could easily have had its origins shortly after the formal granting of the land.

2.2.2 Tidal fishtraps

Since tidal fishtraps have been identified at both the Thyspunt and Bantamsklip study areas, a note on these features is relevant to this study. Following on the suggestions of Goodwin (1946), Avery (1975) put forward the notion that many coastal shell middens sites may be linked to the stone-built fish traps that are common around the shoreline of the South Coast. These traps have also been noted along the coast at Humansdorp, Gouritz River mouth, Cape Agulhas and Bredasdorp (Goodwin, 1946).

Fishing by means of the construction of tidal "dams" is used throughout the world – the materials from which the traps are built varies from place to place, however the basic principle is the same, namely the creation of tidal dams that result in the confinement of fish to an area where they can be easily collected or speared. The method is still used in Northern Kwa-Zulu Natal (reed weirs and dams). Similar traps were used in the great intertidal zones of European rivers in the first millennium AD (L. Schietecatte pers. comm). Stone tidal fish traps have been recorded along the southern Cape coast, Cape Peninsula and recently at the mouth of the Berg River on the West Coast. No traps have been located along the north-west coast. Avery (1974) has observed that tidal fish traps in the southern Cape were used in areas with specific characteristics: i.e. places where the gradient gave rise to large intertidal zones where there were ample moveable boulders and rocks, where shallow sheltered conditions allowed people to create gullies and dams.

Avery's research provided solid evidence that the traps were successfully used and maintained by communities at Elim into the 20th century. Although Avery's work is well researched and detailed, he was never able to answer the question of how long fish traps were in use in the Southern Cape. He hypothesized that the traps had their origin in pre-colonial times being used by Khoekhoen herding communities, who harvested the traps at favourable times of the year on their seasonal herding cycles. While this is a plausible hypothesis, in reality the age of use of fish traps and their association with pre-colonial herding peoples has not been thoroughly investigated. Hine (2007) has re-examined the issue and found compelling historical evidence tthat most of the tidal fish traps existing today were built by colonial farmers in the 19th century and maintained by their descendants well into the 20th century. What remains unknown is whether the tradition of tidal fish traps has historical continuity back to pre-colonial times. At present, the balance of evidence suggests this is not the case.

2.2.3 Bantamsklip heritage survey – findings

(a) Palaeontology

The findings of the study by palaeontologist John Almond, which is contained in Appendix 2, is summarised below. Bantamsklip and Thyspunt share similar geology and palaeontology.

The study area is located on top of a wave-cut platform incised into tough quartzitic bedrock of the Peninsula Formation (lower Table Mountain Group). Apart from the rocky coastline itself, where a modern gravel and boulder beach as well as coarse beach sands are found, the platform is mantled with a thin (11m or less) veneer of less well consolidated late Caenozoic sediments of the Bredasdorp Group. Logs of borehole cores through the Caenozoic cover beneath the site location are given in a report on the subsurface geology by De Beer (2001). The site has been cored more recently (C. De Beer, P. Siegfried, pers. comm., 2008) but borehole logs were not available at the time of writing.

The bedrock platforms beneath both south coast sites are built of Table Mountain Group sediments of Early Palaeozoic age. These are moderately too highly deformed and unlikely to yield well-preserved fossil material; at most, sparse trace fossil assemblages are expected. A thin cover of Late Caenozoic / Neogene coastal sediments belonging to the Bredasdorp Group (Bantamsklip) or Algoa Group (Thyspunt) is also present. The palaeontological sensitivity of these younger sediments ranges from low to high. The Neogene units are poorly- to well-consolidated and mainly consist of sparsely fossiliferous aeolianites (wind-blown sands) of Quaternary age (<1.8 Ma), with occasional subsurface calcrete horizons. A limited range of terrestrial fossils, such as snail shells, rare vertebrate bones, teeth (perhaps associated with hyaena dens) and even trackways, as well as organic-rich peats or mudrocks might be encountered subsurface within these aeolianites, especially along palaeosol horizons.

The overall palaeontological sensitivity of the Bantamsklip site is moderate to low compared to the Duynefontein site**.**

(b) Pre-colonial archaeological material

The survey revealed that the study area and neighbouring portions of land to the west are rich in a broad suite of archaeological material ranging from Middle Stone Age scatters to numerous Late Stone Age shell middens. Two occurrences of tidal stone fish traps were also observed. Colonial period heritage is limited to the Groot Hagelkraal farm buildings and an historic boundary wall, which spans the proposed nuclear corridor.

A detailed log of archaeological occurrences is presented in Appendix 1.

Middle Stone Age material was noted broadly scattered on all exposed fossil dune and calcrete surfaces within the study area. This is particularly prevalent on the eastern side of the site. The material which takes the form of widespread conflated scatters of quartzite flakes and cores, sometimes cemented into the surface of the aeolianite, is highly disturbed by years of deflation and erosion. It is expected that the material will also exist on buried palaeosoles under the vegetated sand bodies. While particularly high concentrations were mapped, no discreet archaeological sites were identified – the concentrations being attributed to natural processes. No fossil bone was noted in association with any of the material, however dispersed shell fish were present. This is probably Late Stone Age material that resulted from subsequent occupation of the fossil dunes. The possibility must be considered that there may be in-situ material contained within the fossil dune body, however ascertaining this would require trial excavation, which was outside the scope of this study.

Late Stone Age shell middens are prolific within 400 m of the coastline (see Appendix 1), with the highest concentration being within 200 m of the shore. During the study some 115 occurrences were observed. This number is only an indicator of density as much material is likely to be buried within dune bodies or obscured by thick coastal fynbos. Along the shoreline itself, the material is so profuse that the sites form an almost continuous ribbon of material. Away from the shoreline, distinct middens may be observed. All observations of Late Stone Age middens took place within the near-shore area and the vegetated dune cordon (Figure 10) of secondary and tertiary parallel dunes. No middens were identified on the flat coastal plain areas inland of the dune complex. Late Stone Age sites were observed in caves and rock shelters in the limestone complex inland of the study area, however this portion of farm lies outside the proposed footprint of the power station.

Middens close to the shoreline (see Figure 9) are characterized by concentrations of *Haliotis midae* shells (not to be confused with shells left by perlemoen poachers evident in the area). Other shellfish that are present are numerous *Turbo sarmaticus* (Alikreukel), *Choromytilus meridionalis* (black mussel), *Haliotis midae*, *Oxystele spp.*, *Burnupena spp.* and various limpets – in particular *S. argenvillei*, *C. longcosta and S. granatina*. On all the sites recorded the artefactual assemblage was relatively informal, being dominated by quartzite chunks and flakes and flat boulders used as grinding surfaces. Exotic raw materials such as silcretes are unusually scarce. Fragments of Cape Coastal Pottery were found associated with a minority of middens, indicating that some of this occupation is less than 2,000 years of age. Other cultural items such as ostrich eggshell beads were remarkably scarce. Unlike much of the South Coast, the immediate coastal sites have not been impacted to a major extent by the coastal tracks and various other *ad hoc* roads onto the beach. Although some sites had been exposed in the coastal tracks, generally the preservation of the sites is good, many are stratified and of solid research value. Of interest is that the Bantamsklip middens are all very similar to each other in terms of their content.

Judging by the dominance of *Haliotis midae* on the immediate coastal sites, these localities are interpreted as “de-shucking stations” where prehistoric people were processing the meat out of the shell to decrease the weight and bulk of their catch before taking it to another destination – possibly shelters in the lime stones at Byneskranskop and Hagelkraal.

The kind of material observed is consistent with the archaeological assemblages thought by many archaeologists to be associated with settlement in the Cape after 2 000 years ago, however recent unpublished work undertaken by the ACO has shown that informal artefact assemblages tend to reflect the last 3 000 years of coastal human settlement, especially on the coast and are necessarily exclusively associated with the advent of pastoralism. In short, indications are that the coastline was utilised by ancestors of

Khoekhoen herders and San hunter gatherers from about 3 000 years ago to the historic period.

(c) Colonial period heritage

Colonial period heritage within or close to the proposed nuclear corridor is fairly limited. Within the nuclear corridor is an extensive stone wall constructed from blocks of calcrete (see Figure 8). The age of this feature is unknown, however it is anticipated that it was built in the 19th century as a field or farm boundary before the advent of barbed wire fencing.

Remains of two stone wall fish traps were identified close to the study area in shallow gullies in the intertidal zone. These are not particularly well preserved examples.

The farm houses and barns at Hagelkraal (outside of the proposed nuclear corridor) are significant heritage buildings and are certainly worth recording on the provincial heritage register (Figures 10, 11). The buildings, which are all made from limestone blocks, have vernacular qualities. The long cottage, of which a portion is ruined, is potentially the oldest house in the complex and dates to possibly the early days of the farm in the late 18th to early 19th century. The main farmhouse is likely to be mid 19th century – it has been recently renovated but still retains Victorian elements and an early Victorian (or even Georgian) beamed ceiling. The barn is of similar age and construction. The entire complex is remarkably intact, being picturesquely set on a limestone outcrop among a thicket of ancient milkwood trees. Sherds of 19th century ceramics were noted in the yard, indicating a possibility of colonial period archaeological potential.

(d) Cultural landscape

The cultural landscape qualities (setting) of the area are essentially that of a wilderness area – the dominant human cultural element is essentially pre-colonial. The colonial past is represented by a single historic farmstead set against a spectacular backdrop of milkwoods and distant limestone massifs. The Old Cape Wagon road, which runs roughly parallel to and just south of the R43, is discernable on aerial photographs but very overgrown and difficult to indentify in the field. Perhaps the greatest heritage value of the area is that it is one of the last remaining stretches of the south coast that has not been subject to excessive development, resulting in good preservation of the pre-colonial and colonial past. The wilderness qualities of the place enhance the significance of the archaeological sites, as the both the sites and their physical context remain intact. Bantamsklip is an important biodiversity area – its natural heritage qualities are predominant over any person-made elements of the landscape. It is because of the unspoiled beauty of the place that the R43 is considered to be a scenic route in terms of the Overstrand Spatial Development Framework.

2.2.4 Statement of significance

The heritage significance of the Bantamklip site may be summarised as follows:

- The study area is significant in terms of Late Stone Age pre-colonial archaeology, in particular the large quantity of shell middens. Many of the middens are very well preserved and are in themselves archives of information about the identity and behaviour of pre-colonial people, as well as the environment in which they lived.
- While shell middens are relatively common, undisturbed middens are becoming increasingly rare. The relatively large number of well preserved middens is considered to be significant.
- The Late Stone Age heritage of the area is directly linked to the heritage of South Africans who are alive today. It is automatically protected by section 35 of the NHRA.
- The Middle Stone Age material identified on the fossil dunes does not carry high significance as the material is disturbed and common. However, it must be taken as an indicator that *in-situ* material may exist within the dune bodies. *In-situ* material would be considered to be significant.
- The Hagelkraal farm buildings are good examples of vernacular regional style and can be considered to be of high local significance.
- The cultural landscape significance of the place relates mainly to its superb natural heritage, setting and contribution to the wilderness qualities of the region.

Figure 8 (above left) Historic limestone boundary wall, Bantamsklip.

Figure 9 (above right) *Halyotis spp.* midden at Bantamsklip.

Figure 10 (below) View looking eastwards over the Bantamsklip study area. The immediate fore-dune contains concentrations of shell middens forming an almost continuous ribbon along the coast.

Figure 12 (above) Vernacular cottage at Groot Hagelkraal farm complex This is a typical Cape *"langhuis"* built from south coast limestone. The end portion is in a ruined state.

Figure 13 (below) Farm house at Groot Hagelkraal farm complex. Although recently renovated, the building contains mid-late 19th century fabric.

2.3 Thyspunt

Thyspunt is located on the south coast of the Eastern Cape between the holiday towns of Cape St. Francis and Oyster Bay. Like Bantamsklip, the area is rural in character. Economic activities in the immediate area are mainly dairy farming, however there is a sigtnificant fishery industry at St. Francis. Oyster Bay is a small upmarket holiday/retirement community. Infrastructure in the town is limited and the population is highly seasonal. St. Francis is a developed upmarket community supporting a relatively small permanent population of mostly retired people. During the summer holiday season the population increases dramatically – the area is well set up for tourism being replete with hotels, restaurants and B&B facilities. Outdoor activities are clearly important as themed adventures, diving and surfing, big game fishing and golfing facilities are available. The area is cherished for its scenic beauty – dramatic dunes and beachscapes, natural heritage and mild climate. Accelerated property development activities have had a devastating impact on the functioning of the large headland-bypass dune system, which is a significant natural feature of the area. The interruption of the natural feeding and flow of aeoloian sands has resulted in vegetation changes and the cessation of sand deposition at St. Francis Bay Beach, which is now severly eroded (La Cock and Burkinshaw 1996). Eskom's land holding in the area has in part put a brake on seemingly un-controlled westwards expanding property development.

The Thyspunt site, which is a natural heritage site, includes a number of landforms that have played a role in the distribution and quantity of heritage sites. The most inland portion of the site (a long panhandle of land) consists of cultivated meadows that are used for dairy farming. Between the agricultural lands and the coast is an extensive dune field, a very large stretch (15 km) of which is active shifting sand. Towards the coast the dunes are stable and vegetated with a mixture of dense coastal thicket and coastal fynbos. Wetlands are found in many of the dune bays, while amongst the active dunes pools of fresh water accumulate on ancient land surfaces exposed in the deeper blowouts. The vegetated dune peaks reach a maximum height of 10 m amsl – the gradient towards the shoreline consisting of a series of substantial parallel undulations. The coastline is characterised by mostly an active rocky shoreline, apart from a stretch of beach at Thysbaai on the eastern coastal portion of the site. Springs flow into the sea at the interface of the dune complex and bedrock and freshwater pools and wetlands along the shoreline are numerous. The immediate shoreline vegetation is lush and often swampy under foot. There are two small sheltered bays (at White Point and Tony's Bay). Tony's Bay contains an extensive stone fish trap complex. Wildlife noted in the study area includes small and medium bovids, bush pigs, small carnivores and numerous avian species. Like Bantamsklip the shoreline would have provided prehistoric communities with ample marine resources.

The human made environment at Thysbaai is limited to the existing Eskom workshop, conservation office and accommodation facility and several small cottages (shacks). Eskom has “inherited” various informal arrangements set up by previous landowners of the property. The cottages are used by various families for holidays and fishing trips. Notable among these is the St. Andrews shack, which is used by the school (St Andrews, Grahamstown) for outdoor education, recreation and may be hired by persons associated with the school. The “shack” apparently is a source of cherished memories for generations of past pupils and teachers since the 1960’s (See Appendix 4). Access to the cottages is via a sandy track (suitable for vehicles with off-road capability) from Oyster Bay, although access can also be gained from the Cape St. Francis side of the property. The only other built features within the study area are various small “dams” at springs close to the shore from which residents collect fresh water, various storage tanks and a single abandoned 19^{th} century house on the edge of the agricultural land in the inland portion.

2.3.1 Regional heritage context

A deeds survey has revealed that farms were first granted in this area by the British colonial government in the 1820’s, while it would appear that large portions have remained “Crown” or government land until recently.

Virtually no published information is available with respect to the colonial period history of Oyster Bay and Cape St. Francis. However, it is known that the Kromme River was historically navigable for light steamers and small sailing craft. The history of the place relates to its beginnings as a small informal port. During the 19^{th} century the coastal shipping trade played an important economic role, as it was the only way available to move large quantities of goods at relatively high speed. The 19^{th} century light house at Seal Point, Cape St. Francis is the only proclaimed heritage site in the immediate area. A search of web-based material has revealed that Leighton Hulett and members of the Hulett family were the first people to develop the area when they established a holiday home in what was a wilderness area in 1954. According to La Cock and Burkinshaw (1999) the area was largely undeveloped in 1960, apart from a few holiday cottages. In 1967 the first canals were excavated and by 1970 there were about 161 holiday houses in the area. Hence most of the built environment is of very recent construction.

Unfortunately the lack of published information, or systematic built heritage surveys in the Eastern Cape has somewhat restricted the regional historical synopsis presented in this report. However, the regional pre-colonial heritage has been studied in some detail and is very well published.

(a) Palaeontology

Unlike Duynefontein the Palaeontological significance has never been formally appraised until a study was commissioned to evaluate its potential. This is commented on in the findings of the heritage survey (Section 2.3.2(a) of this report)

(b) Pre-colonial heritage

The south coast was one of the first areas recognised by professional archaeologists as being important for the study of South African prehistory. South coast sites and places have lent their names to many stone tool industries, including the Mossel Bay Industry from the Cape St. Blaize site and the Robberg from Nelson Bay Cave. Already, Goodwin (1946: 105-106) is prompted to state, "The southern Cape, from Port Elizabeth to Swellendam, is by far the most important archaeological area in Southern Africa…This is the southern wall of the continent, against which culture after culture has made its last stand before inevitably disappearing under the next wave of peoples." He continues "Here South Africa has evidence of value to the world of prehistory and it is essential that it should be protected so far as it is humanly possible." (Goodwin 1946: 116). Regrettably, this has not been the case.

Recent studies have fulfilled Goodwin's assertion about the heritage significance of the Southern Cape. The Southern and Eastern Cape Coast has seen human occupation since the Early Stone Age. Klein (1974) has suggested that the human presence in the Southern Cape dates back as long as 700,000 years ago. Sites such as Blombos at Still Bay and Klasies River Mouth near Humansdorp (west of the study area) have been rigorously scientifically excavated and have revealed the earliest evidence known to human-kind about the behaviour of early modern humans and the evolution of abstract thought or symbolic behaviour. Sites that have the potential to provide this kind of evidence are limited to a mere handful in the old world, and as such have extraordinary value.

The archaeological site "Klasies River Mouth" (KRM) is perhaps the most significant archaeological site close the study area. It was first reported to archaeologists at the South African Museum in 1955. The massive sequence of deposits contained within this coastal cave has been subject to study by local and international teams of archaeologists since the 1960s. Excavations were conducted in the 1960s by Singer and Wymer (1982), who described four phases of Middle Stone Age occupation, including a Howiesons Poort level between phases II and III and two Late Stone Age phases.

Smaller but more thorough excavations have since been undertaken by Hillary Deacon during the 1970s and 1980s (Deacon 1995, Deacon and Deacon 1999). These revealed more detail about the dating of the site and the palaeoenvironmental conditions. Both excavations yielded fragmentary human remains associated with MSA deposits. These fragments, dated to around 90,000 years ago with some as old as 120,000 years, probably don't reflect intentional burials and it has even been suggested that they were the result of cannibalism (Deacon 1995, Deacon and Deacon 1999). The human specimens would appear to be morphologically modern and aspects of modern behaviour and cognition are attested to by Deacon and his post-graduate students. The early humans created middens in selected areas for waste disposal. Deacon (1995) suggests that cannibalism is always associated with symbolic behaviour. If cannibalism is evidenced by the fragmentary nature of the KRM remains, they may indicate modern cognitive abilities. The Howiesons Poort levels have been argued to show modern thought too (Wurz 1997; Wurz 2000): the choice of artefact type and material, which was imported from as far as 20 km away, is thought to be stylistic. However, no evidence for fishing and an apparent reliance on docile, young or aged prey animals that were fairly easy to hunt would indicate that food procurement strategies were not fully developed (Klein & Uribe 1996), indicating that fully modern levels of technological sophistication had still not been reached. Klasies River Mouth is thus one of a small suite of internationally significant archaeological sites (limited to southern Africa) that are pivotal to our understanding of the emergence of modern human behaviour.

At Thyspunt and Cape St. Francis a number of studies have been completed on the numerous Late Stone Age sites and shell middens of the Holocene period.

Feast (1974) excavated a burial from dunes in the Cape St. Francis area some 150 m from the shore. The burial was accompanied by a shell necklace and a grindstone was placed above his/her cranium. There were also were several pieces of ochre and some stone flakes and chips near the cranium. The burial has been dated to the mid-Holocene, approximately 5,000 years ago (de Villiers 1974).

Further excavations at Cape St. Francis revealed a human buried with a dog (Chappel 1969). The dog bones have been dated to 1,150 years ago (Mitchell, 2002). As dogs may have accompanied herders, these finds suggest the presence of Khoekhoen pastoralists in this area.

Cairns (1975) excavated several circular stone platforms in this area as well as a human burial. The stone platforms are most likely to be hearths, possibly used to cook shellfish meat. These platforms have been identified at a number of other sites along the south coast at Slang River (Goodwin, 1946), Noetzie (Orton & Halkett in prep.) and Pearly Beach (Avery, 1976).

Deflation horizons at Oyster Bay have yielded the first known occurrence of an open-air Howiesons Poort assemblage (Carrion *et al.*, 2000). These stone artefacts have been proven to be contemporaneous with hyena coprolites from the same horizons, allowing for palynological examinations of the environmental conditions during the early Last Glacial. The studies showed that the landscape during the Last Glacial period accommodated complex patchworks of vegetation and was generally cooler, with the climate closer to inland conditions (Carrion *et al.*, 2000).

Johan Binneman of Albany Museum, Grahamstown, has conducted by far the most detailed archaeological work in the area. He has completed surveys of the Cape St. Francis Dunefield, visited and sampled sites at Thyspunt on a number of occasions since the early 1980s and completed a preliminary survey commissioned by Eskom. Binneman (1996) has identified a suite of sites in the area that contain artefactual material characteristic of the full range of archaeological sites that are known to have occurred over the last 7,000 -10,000 years. In addition his studies revealed the presence of a never before described artefact tradition (the Kabeljous industry), which occurred in this area during the mid-late Holocene. Within the study area he described microlith rich sites characteristic of the mid-Holocene (5 000 - 6 000 years ago), the late Holocene, as well as ceramic rich sites which may be attributed to the Khoekhoen herders of the last 2 000 years. Significantly Binneman also identified numerous ESA and MSA artefacts including Howiesons Poort scatters on paleosoles exposed in the Thyspunt Dune Field. Some of these are associated with fossil hyena droppings (coprolites) as well as fossilised bones of extinct mammals such as the Giant Buffalo (*Pelorovis antiquus*). In his PhD dissertation Binneman remarked on the extraordinary variety and richness of the suite of archaeological sites in the area. He comments that most of the sites lie within 300 m of the coast. Nilssen (2006) who recently did mitigation work at the St. Francis Links Golf Estate located numerous shell middens several kilometres from the ocean. Many of these were buried or obscured by sand and vegetation – a factor that must be considered in the evaluation of heritage significance in this study.

(c) Colonial period heritage

Like other parts of the South Coast during the Late Stone Age, the introduction of pastoralism roughly 2,000 years ago was a significant event that broke the ancient tradition of hunting and gathering that had been the method of human subsistence for thousands of years. Before colonisation of the Eastern Cape by the British in the early 19th century, Khoekhoen herders formed powerful transhumant communities (herding cattle and sheep) throughout the coastal plain and from time to time into the Great Karoo (Hart, 1987). They enjoyed dominance as far as the Great Fish River, where they shared a loose border with farming communities to the East. European farmers (Trekboere) were the vanguard of formal colonisation and accelerated granting of land by the British

Colonial Government. Land that was viewed as a shared resource by the Khoekhoen was no longer available to them.

Research conducted as part for this study has shown that the area known as Thyspunt was made up of farm Thyspunt (Farm 744) and the Farm 741 both in the Humansdorp District. Farm 741 has always been unregistered state land and as such there is no title deed for it. Farm 744 on the other hand is made up of portions of the farms Welgeleë, Buffels Bosch and Langefontein. All three farms were originally granted in 1816 or 1817, in other words, early in British colonial rule. The farms have been extensively subdivided but ownership of the portions largely remained within the same group of families.

Farm Welgeleë (Farm 743) comprises Lot A of farm Welgelegen (Farm 735) and Portion C, Portion 15 and remainder of Portion D of the farm Buffels Bosch. The farm Welgelegen was first granted in 1817 in perpetual quitrent to Hendrik van de Watt; portion A was divided of in 1886 when H.J. Potgieter and 4 others sold it to Hendrik Frederick Peter Sinn. The original title deed diagram indicated one fresh water spring, no built structures and described the land partly as grazing land, partly as sand and thicket.

Farm Buffels Bosch was initially granted on quitrent in 1816 to Wessel Hendrik Moolman. It was regranted in 1890 under the Act "The Land Beacons Amendment and Extensions Act" (Act 9 of 1879) to Herman Jacobus Potgieter and 15 others, who all held shares in the farm. The oldest title deed diagram only shows the swamp and two roads but no structures or springs. The diagram of 1886 shows a network of new roads, at the convergence of which four buildings are indicated next to two springs. Furthermore three dams and the swamp (probably the water bodies to the north of the dune field) are indicated. Portions 3 and 4 were divided off the original farm in 1891. Portion 9 was divided off Portion 4 in 1957.

Farm Langefontein (Farm 736) was only named as such when it became part of the Humansdorp District. It was originally Erf 467 in Oyster Bay. It was granted in quitrent in 1817 to Hendrik van der Watt. Portion 1 was divided off in 1963 when Tzitzikama Estate (Pty) Ltd sold it to Anthony Auret. The Surveyor General diagrams show the run-off of a spring to the ocean across the farm and a road along the coastline from the one end of the farm to the other.

Hence the colonial period heritage of the site is unremarkable and no doubt typical of a great many others in the area. The existing farm buildings at Welgelegen (apparently all fairly modern) probably relate to the site of the early 19th century structures indicated on diagrams. A single small historic cottage on the inland portion of the study area was probably a *Bywoners* cottage

2.3.2 Findings of the heritage survey - Thyspunt

(a) Palaeontology

The palaeontological potential of Thyspunt is in many ways similar to Bantamsklip in terms of geological context. However, the dune field complex at Thyspunt is large and deep, which means that there is a very high potential for Pleistocene palaeontology and archaeology to exist below the dune bodies.

- The proposed nuclear corridor at Thyspunt is situated on top of a low-lying coastal platform that has been carved by wave action into resistant, quartzite-dominated sediments of the Nardouw Subgroup (upper Table Mountain Group / TMG). The TMG platform surface mostly lies between 4 to 8 m amsl, rising to a maximum of 10 m amsl, and is mantled with a thin veneer of late Caenozoic coastal sediments of the Algoa Group. Various formations within the Algoa group are potentially moderately fossiliferous.
- Of greater concern is the more recent Pleistocene palaeontology and archaeology that is exposed from time to time in the active dune system. Carrion *et al.* (2000) report finding fossil remains within the active dune system. He comments on quantities of fossil bone found lying on palaeosols associated with hyena coprolites and suggests that hyena activity during the Pleistocene may have been responsible. Also identified were extinct mammal species (*Pelorovis antiquus* – giant buffalo) that suggests that the fossil material dates to within the Pleistocene. Binneman (pers. comm.) commented on the high frequency of Middle Stone Age material within the deflated areas in the dunes, some of which he considered to be relatively undisturbed. Since Binneman had made most of his observations in the 1980s the vegetation has encroached (based on aerial photographs) over areas where he had made many of his observations and has become impenetrable in these areas. However, the significance of Binneman's findings is considered in the overall impacts that will result from the proposed activity.

In summary, Thyspunt is likely to produce significant Pleistocene fossils and archaeology. Unlike Duynefontein, the potential to produce Miocene fossils is very low.

(b) Pre-colonial archaeology

Taking into account the earlier findings by Binneman (1996, 2001) and the findings of this study the pre-colonial heritage in the study area is extraordinarily prolific, particularly within 300m of the high water mark and the open dune fields. Along the coast archaeological material was found almost everywhere where ground surface visibility allowed. It stands to reason that the total number of archaeological sites that exists on the affected properties is undoubtebly more than the number of occurrences that were found during the surveys. Shifting dunes and oscillating vegetations patterns have obscured many sites that were identified years ago. Interestingly the vegetated dunes that lie between the coast and the headland bypass dune system are almost entirely devoid of archaeological material. It was noted that despite the high rainfalls that took place in the area in 2011, drainage of this area was very good as the water table was not encountered in any trial excavations including those in the bottom of the dune slacks.

Given the comprehensive amount of work that has taken place to date, good information about the distribution of archaeological sites may be deduced. The area within 300 m of the rocky shoreline was densely occupied, and probably contains more than seventy percent of the archaeological sites in the entire study area. The shoreline offered pre-colonial people abundant resources. There are sheltered bays and pools where shellfish could be easily collected as well as ample opportunity for fishing. This, combined with numerous fresh water springs along the shoreline would have made this locality an ideal settlement localityfor pre-colonial people. It is quite likely that there is a drop off in the frequency of pre-colonial sites adjacent to the the beach at Thysbaai as beaches were not nearly as attractive to pre-colonial people as resource rich rocky shorelines. A recent survey of land adjacent to Thysbaai beach, although very restricted by dense vegetation growth, indicated a drop off in the frequency of archaeological site in this area, opening up a possible less sensitive option within the proposed nuclear corridor. The distribution of sites at Thyspunt is indicated in Appendix 1.

- Middle Stone Age material was noted broadly scattered on almost all exposed palaeosols within the active dune system. While much of the material was dispersed, at least one site (an artefact manufacturing area) appeared to have well preserved spatial patterning. Although bone fragments are numerous, much of this is recent and out of context. Due to shifting vegetation patterns and dune movement the Middle Stone Age *Howiesons Poort* material was not relocated. The evidence collected by ourselves and other authors suggests that the ancient Pleistocene land surfaces that evidently lie preserved under the dune system are highly sensitive. Due to the dynamic state of the dunes, surveys should ideally be repeated over a number of years before a comprehensive picture can be determined.
- Late Stone Age shell middens are numerous within 300 m of the coastline and in the active dunes, with the highest concentrations being situated on the shoreline close to shallow bays in rocky shores and springs. During the study some 150 occurrences were observed, with many more being noted outside the proposed nuclear corridor. This number is only an indicator of density as some material is likely to be buried within dune bodies. Along the shoreline itself,

the material is so profuse that the sites form an almost continuous ribbon of material (Figure 13). It is notable that many middens take on the form of large vegetated mounds (Figure 16), which can be seen from a distance due to the fact that specific kinds of coastal vegetation grow on them. The majority of the middens are very well preserved as access to the coast is restricted and only accessible by off-road vehicle. Within the well drained vegetated dune areas, which make up a large portion of the site between the coast and the headland bypass dune system, archaeological sites are sporadic and ephemeral. They are more numerous towards the east where there are wetlands and standing water (St Francis Links Golf Course) and eastern areas of the site. The overall distribution of archaeological sites correlates very well with the immediate presence of springs and sources of standing water. Hence the spatial distribution of Late Stone Age archaeological material is highly focused around areas of optimal resources (see Appendix 1 for distribution maps).

- Middens are characterised by an eclectic mix of shell species. While at Bantamsklip *Haliotis midae* (perlemoen) would seem to have formed the meat bulk of resources, this was not the case at Thyspunt. Very few *Haliotis spp.* shells were seen at all. The staple appears to have been *Turbo sarmaticus* (Alikreukel), which was noted on virtually all sites together with a diversity of limpets *Scutellastra longcosta, Cymbula oculus* as well as large numbers of *Scutellastra cochlear. Perna perna* (brown mussel) was also noted on most sites. Of particular interest was the presence of *Oyxstele tigrina* dominated middens, which is interpreted by Binneman (1996) as being attributable to quick expedient coastal forays that were the style of subsistence during the pastoralist period. While this shellfish is commonly available in the Western Cape it is very seldom present on middens in large quantities. This points to some form of cultural preference at Thyspunt. On all the sites recorded the artefactual assemblage was relatively informal, being dominated by quartzite chunks and flakes and flat boulders used as grinding surfaces. Exotic raw materials such as silcretes and fine grained quartzites are also present. However, formal artefact quantities are low. Binneman (1996) has reported recording microlith dominant assemblages on sites within the dune system but not on the immediate coast. Fragments of Cape Coastal Pottery (Figure 14) are common, much more so than at Bantamsklip. Also noted in at least one instance was the presence of large backed artefacts that fit the description of the Kabeljous Industry first described by Binneman.
- Late Stone Age middens were also recorded in the active dune fields between 700 m and 2 km inland. Although these sites are quite far from the shoreline, they are surprisingly numerous. They are generally discreet, well preserved and exhibit good within-site spatial patterning including hearths and stone platforms in some instances (Figure 15). Pottery of the Cape Coastal variety is common, some of it elaborately decorated. Bone is in evidence throughout the

dune field, although not all of it is archaeological. The dune field sites are remarkably intact considering the dynamic environment in which they exist. Judging by the range of artefacts on them, they have not been picked over by tourists and souvenir hunters. If access control was not in place and the dunes were easier to access, the sites would be in far poorer condition.

- The vegetated dune system between the coast (300m inland) and the Oyster Bay dune field is largely devoid of archaelogical material. Indications are that there is a strong correlation between particularly Late Stone Age sites and the presence of sources of fresh water. Sites are prolific adjacent to the coastal springs and in the Oyster Bay dune field where pools of fresh water are to be found on an almost permanent basis. Sites may also be observed towards St Francis, where the Sand River and the many temporary and permanent wetland systems exerted a strong influence on human settlement patterns. Conversely, the vegetated dunes are very well drained: sources of surface water are limited, which is a likely reason why archaeological sites occur sporadically in the vegetated dunes, which makes up the bulk of the proposed nuclear footprint (see Appendix 1 for site distribution map, walk paths and trial excavations).
- The colonial period heritage of the study area is limited. An abandoned farm house (figures 19-21) situated on farm 735 portion 2 is the only structure on the property that could be securely identified as being greater than 60 years of age and thus protected by the general protections of the NHRA. The house dates to the late 19^{th} to early 20^{th} century. Joinery and wood work is in place but deteriorating through abandonment. It is possible that this cottage is one of the earlier Welgelegen farm buildings. Its demolition may be necessitated by the construction of the HV Yard.
- A well preserved complex of historical fish traps (Figure 17) is situated in the shallow bay below the St. Andrews cottage. Long thought to have been built by pre-colonial pastoralists, new research (Hine, 2007) indicates that they were either built or inherited by colonists who used them to provide a cheap source of protein for themselves and their staff.
- The St. Andrews Shack (see Appendix 4) is associated with a long tradition of use by this famous Eastern Cape School (Figure 19). It is a place cherished by many people and has been integral to their education. There are distinct traditions associated with the shack such as the maintenance of the diary by all visitors. The St. Andrews Shack is a place of tradition and may therefore be conservable and gradable as “living heritage” as defined in the NHRA. Demolition of this structure is not supported.
- According to the National Shipwreck Register (SAHRA) three ships were wrecked in Thysbaai during the 19^{th} century. These are likely to have been driven up onto the rocks or beach.

C. Cultural landscape

The cultural landscape qualities of the study area refer to its natural heritage and high biodiversity in union with the person-made landscape in the distinct geographical area defined by Cape St. Francis (east), Oyster Bay (west) and the outer (north) perimeter of the dune system. The landscape, together with the archaeological sites it contains may be viewed as a single wholistic entity, which retains the spatial patterning of human use of the landscape in a largely intact natural coastal environment that has not changed significanctly since prehistoric times. A rare aspect of the area is the active dune field – a headland bypass system almost 15 km in length, which together with the wide range of archaeological and palaeontological resources on it, place it among a few surviving landforms of this kind and size around the country. This dune field, together with the coastal thicket vegetation and rich shoreline with its natural springs represents a uniquely intact environment in which KhoeKhoen pastoralists and San hunter-gatherers existed. The Gamtkwa Khoisan Council (stakeholder meeting, Hankey 2010) regards the completeness of this natural and human environment as a wholistic entity of extraordinary heritage value to all Khoisan descendents. It is to be noted that there is more than one group claiming that it represents the Gamtkwa (of which the Gamtkwa Khoisan Council is one), and that the approaches of these competing groups to conservation of the Khoekhoen heritage differs remarkably – one group supports responsible excavation and housing of acrefacts in a museum, whilst the other is opposed to any form of disturbance.

2.3.3 Statement of significance

The heritage significance of the Thyspunt site may be summarised thus:

(a) The study area is highly significant in terms of Late Stone Age pre-colonial archaeology, in particular the large quantity and variety and size of shell middens. Many of the middens are very well preserved (among the best ever seen by the author) and are in themselves archives of information about the identity and behaviour of pre-colonial people, as well as the environment in which they lived.

(b) While shell middens are relatively common, undisturbed middens are becoming increasingly rare. The large number of well preserved middens is considered to be significant.

(c) The Late Stone Age heritage of the area is directly linked to the heritage of South Africans who are alive today. Particularly relevant is the fact that a high proportion of the middens are less than 2,000 years old, are pottery rich and associated with a time when Khoekhoen herders were the dominant force in the area. Concern has been expressed by a local “first nation” community (the Gamtkwa) with respect to the future of archaeological material, which is regarded to be the heritage of the Khoisan people and their descendants. All pre-colonial material is automatically protected by section 35 of the NHRA.

(d) The Middle Stone Age and Early Stone Age material identified on the fossil dunes is potentially important in scientific terms, especially if it is preserved in an *in-situ* context on palaeosols deep under shifting dunes in association with fossil bone. The potential exists for incredibly rare human remains of early humans to exist in associated contexts.

(e) While not of any architectural merit, the St. Andrews Shack is associated with living heritage and tradition. It has significance in terms of the concept of living heritage as defined by the NHRA.

(f) The abandoned farm cottage at Welgelegen (Pennysands), which lies within an area demarked for the construction of a high voltage yard, is of moderate heritage significance due to its poor condition and low architectural merit. It does not contain any unique elements.

(g) The cultural landscape significance of the place relates mainly to its superb natural heritage, pre-colonial heritage, setting and contribution to the wilderness qualities of the region. In terms of the UNESCO definition of a "cultural landscape" – a distinct area containing the combined works of nature and people - Thyspunt and environs is a uniquely intact pre-colonial cultural landscape that contains the intact evidence of how pre-colonial people used the landscape – a complete settlement pattern.

Figure 13 (above) Coastal midden at White point, Thyspunt

Figure 14 (above right) Decorated ceramic from a Dune Field site, Thyspunt

Figure 15 (right) Stone feature on dune midden at Thyspunt

Figure 16 A large shell midden at Thyspunt vegetated with low shrubs and grasses. Coastal middens are often distinguishable by the low vegetation cover.

Figure 17 (above) Tidal fish traps at Tony's Bay, Thyspunt

Figure 18 (left) The St. Andrews cottage shack built from old packing cases, has been used as a "getaway" by people associated with the school.

Figure 19 (below left) This cottage close to Welgelegen is the only generally protected building in the study area

Figure 20 (bottom left) The lath and beam ceiling in the abandoned cottage remains intact.

Figure 21 (bottom right) Victorian window frame at the abandoned cottage.

3 IMPACT IDENTIFICATION AND ASSESSMENT

3.1 Ways in which heritage can be impacted

The fact that certain kinds of heritage are finite means that any form of impact assessment automatically invokes the maximum scores in terms of the criteria of replaceability, reversibility and duration. The identification of heritage can be extremely difficult in that it is often obscured under the ground surface, (particularly in archaeology and palaeontology) and a great many variables are always unknown. This means that heritage specialists rely on experience and sometimes educated intuition to reach their conclusions. Scientifically quantifying heritage impacts is equally problematic due to the fact that the resource being assessed is qualitatively and quantitatively unpredictable (in terms of methods that are available today).

Tangible heritage such as protected structures, archaeological sites and palaeontological material is finite. Once it is damaged or destroyed, that state endures forever. It can never be replaced or reversed. It is possible to mimic or reconstruct certain kinds of heritage such as buildings and individual objects, and to an extent it may be possible to reinstate a cultural landscape but with loss of authenticity. The main sources of impact to heritage fall into two broad categories – a) the destruction of the physical heritage object itself and b) the destruction or change of its context.

It is not expected that the final choice of technology will influence the outcome of impacts. The nature and mechanisms of impact will be similar – extensive excavation, landscape modification and disturbance.

3.1.1 Construction phase impacts

Destruction of tangible heritage (structures, archaeological sites, fossils) almost always takes place during the construction process of development activities rather than during the operational phases as the main source of impact to heritage is due to the disturbance of undisturbed ground or landscape and/or demolition of structures and places protected by the NHRA and/or valued by a community. Invariably the impacts are irreversible, irreplaceable and of permanent duration as heritage resources are finite – unlike plants and animals, heritage resources are unable to reproduce.

Archaeological sites (including shipwrecks), Pleistocene palaeontology and graves are highly fragile and context sensitive, which means that their value is very easily destroyed when the landscape in which they are situated is disturbed by bulk excavation, installation of services and roads. Mitigation can be achieved through scientific recording, sampling or excavation. However, these are also destructive processes. In general, full rectification of heritage impacts is not normally possible in the case of archaeology unless the archaeological sites can be conserved in their entirety. The best that can be achieved is the sampling of the archaeological material so that a representative sample of the find is conserved in perpetuity. The process is slow, exacting and expensive. The end result is always the loss of the archaeological site as a permanent heritage resource; the gain is the rescue of knowledge provided that the archaeological sampling is done in according to suitable standards. Archaeologists prefer to conserve where ever possible in the interests of sustainable heritage management.

Palaeontological material is destroyed by bulk earthmoving, cutting and mining operations. However, palaeontological resources tend to be extensive (depending on the resource) and are rather more resistent to impact than archaeological material for the simple reason is that there is more of it. Because palaeontological material is often very deeply buried, scientists often rely on human intervention in the land surface to collect data. Aside from natural exposures, open cast mines, quarries and deep road cuttings often present the only opportunities for palaeontologists to examine deep sediments, which under normal circumstances they may not have access to. In short, provided that palaeontolgists can use the opportunity arising from major construction works to adequately sample and record profiles and exposed material as part of the environmental management process, a potential negative impact can be transformed into a positive opportunity to increase the levels of knowledge about a locality and the species of fauna and flora that were present in the past.

Cultural landscapes are highly sensitive to accumulative impacts and large scale development activities that change the character and public memory of a place. In terms of the NHRA a cultural landscape may also include a natural landscape of high rarity value and scientific significance. Certainly the construction of a large facility such as a nuclear power station is likely to result in profound changes to the overall sense of place of a locality, if not a region. On a smaller scale comparatively minor factors such as ill-conceived and distasteful signage, “overpowering” entrance gates to sites or security fences adjacent to natural areas and scenic drives will constitute a bothersome aesthetic irritation than can cause serious cumulative damage to the qualities of a “place”. It may be argued that it is possible to a degree to rectify damage to a cultural landscape through demolition of intrusive elements, but this seldom happens – the impacts to all intents and purposes are permanent. Given the nature and scale of the proposed activity that will involve massive intrusive permanent bulk in what are considered significant natural heritage areas, mitigation of the impact on the cultural landscape is not feasible, although careful environmental planning may assist in lessening the effects of infrastructure “sprawl”.

Construction will result in the generation of several million m^3 of sand and rock (spoil) from the excavation to bedrock required for the nuclear island. Possible alternatives for the disposal of this material are marine disposal by piping (the proposed alternative) or land-based disposal (investigated as an alternative during early planning but no longer favoured).

3.1.2 Operational phase impacts

During the operational phase of the plant, it is expected that impacts will be largely neutral, provided that the applicant manages the heritage resources on the affected properties adequately. Any future infrastructure expansion should be regarded to be new construction and will be subject to its own EIA and/or HIA, so cannot be regarded to be included in normal operational activities.When certain operational decisions are made in response to the needs of the facility (road construction, construction of peripheral buildings, pipelines etc) further more minor EIA processes may be triggered.

3.1.3 Decommissioning phase impacts

Heritage impacts can occur during the decommissioning phases of large operations. The process of rehabilitation will involve surface disturbance and earthmoving operations. The effect of this, like during the construction phase, will be the destruction of context in which archaeological heritage is situated, the demolition of buildings that are greater thanthan 60 years old. In terms of the current protections of the NHRA, the Nuclear Infrastructure could be greater than 60 years old once demolition and rehabilitation is required. This would invoke the general protection of the NHRA in its present form.

3.2 Site-specific impacts

3.2.1 Duynefontein Site

Impacts at the Duynefontein site will take place primarily during the construction phase or during any expansion phase that involves bulk earthworks. Changes to landscape qualities of the place will occur and persist until such time that the facility is fully decommissioned and demolished.

During construction the following impacts are expected to occur:

- The landscape qualities of the place will change, the wilderness qualities of the Nature Reserve will diminish as the industrial ambience (which will accumulate substantialy given the presence of the existing facility) will become a dominant factor.
- Bulk excavation will destroy early to mid-Pleistocene palaeontological resources that are expected to exist throughout the nuclear corridor. Although little is known of the extent of these deposits, they are potentially highly important as they could contain very early human fossil material.
- Bulk excavation will disturb and destroy mid-late Pleistocene archaeology and palaeontology as manifested at the sites DUYNEFONTEIN1 and DUYNEFONTEIN2. While the DUYNEFONTEIN2 deposits have been dated and studied, little information is available with respect to their total extent.
- Dune levelling, bush clearing and bulk excavation will destroy some ephemeral Late Stone Age archaeological sites that exist within the dune system.
- Late Stone Age human burials may be destroyed in any place where earthmoving takes place.

During the decommissioning phase the following impacts may occur:

- Destruction of structures more than 60 years of age; and
- Earthmoving on un-modified landscapes may impact physical heritage.

3.2.2 Cumulative impacts

The addition of additional nuclear power stations will add to the prominence of the existing structure. However, since this is already an established landmark, the cumulative effect is somewhat moderated.

Given that very little is known about the full extent of either the Miocene or Pleistocene palaeontology or archaeology at Duynefontein, it is not possible to quantify the cumulative impacts, other than to state that the Nuclear-1 footprint, together with the subsequent expansion phase footprints represents a substantial transformation of the environment with commensurate impacts on a finite resource.

3.2.3 Access roads

The threat of destruction of heritage caused by access roads is relatively low, provided that the roads do not cut deeply into the surrounding landscape. At Duynefontein, surface archaeology is a relatively minor concern, while the fossil horizons are mostly buried and are unlikely to be impacted by road construction.

Table 1 Summary of Impacts for the Duynefontein Site

Impact		Intensity	Extent	Duration	Irreplacable resources	Consequence	Prob.	SIGNIFICANCE
Destruction of Miocene palaeontolgy	Unmitigated	High	Low	High	Low	Medium	Medium	**Medium**
	Mitigated	Low	Low	High	Low	Low	Medium	**Low**
Destruction of Pleistocene palaeontology and archaeology	Unmitigated	High	Low	High	High	High	High	**High**
	Mitigated	Low	Low	High	Medium	Low	High	**Low - Medium**
Destruction of Holocene archaeology	Unmitigated	Low	Low	High	Low	Low	High	**Low - Medium**
	Mitigated	Low	Low	High	Low	Low	Low	**Low**
Destruction of colonial heritage	Unmitigated	Low	Low	Low	Low	Low	Low	**Low**
	Mitigated	Low	Low	Low	Low	Low	Low	**Low**
Destruction of cultural landscape	Unmitigated	High	Medium	High	Medium	High	High	**High**
	Mitigated	High	Medium	High	Medium	High	High	**High**
Cummulative impacts	Unmitigated	Medium	Medium	High	Medium	Medium	Medium	**Medium**
	Mitigated	Medium	Medium	High	Medium	Medium	Medium	**Medium**
Positve contribution to conservation	Unmitigated	Low	Medium	High	High	Medium	High	**Medium**
	Partly mitigated	Medium	Medium	High	Medium	Medium	Medium	**Medium**

3.2.4 The Bantamsklip Site

Impacts on the Bantamsklip site will take place primarily during the construction phase. Changes to landscape qualities of the place will occur and persist until such time as the facility is fully decommissioned and demolished.

Infrastructural details such as road alignments, laydown areas and construction areas have been provided in conceptual form. However, this report offers general comment on relative sensitivity of parts of the study area.

During construction the following impacts are expected to occur:

- The landscape qualities of the place will change and the wilderness qualities of the site and surrounds will diminish as the industrial ambience increases. This in turn will affect the publicly perceived qualities of the region detracting from its identity as a wilderness area.
- Bulk excavation may disturb and destroy fossil material contained within the sediments overlying the Peninsula Formation.
- Bulk excavation will disturb and destroy mid-late Pleistocene archaeology and palaeontology contained in or on fossil dunes.
- Dune levelling, bush clearing and bulk excavation, road construction and fence building will destroy a large number of Late Stone Age middens. This will be particularly acute with respect to areas within 300 m of the coast. The volume of potential destruction will result in a significant cumulative impact on the population of well preserved shell middens in the Overstrand area.
- Late Stone Age human burials may be destroyed in any place where earthmoving takes place.
- Site preparation will result in partial destruction of the historic boundary wall that crosses the study area.
- Construction of perimeter fences may partially impact the remains of the Old Cape Road.

During the decommissioning phase the following impacts may occur:

- Destruction of structures more than 60 years of age; and
- Earthmoving on un-modified landscapes may impact physical heritage.

3.2.5 Cumulative impacts

Neither SAHRA nor Heritage Western Cape has conducted a systematic assessment of the potential population of archaeological sites on the south coast or the amount of undisturbed shoreline that survives. Given the extent of littoral sprawl of urban development from Hermanus to Gansbaai and the low proportion of coastal landscape that is protected, a worst case scenario (i.e. destruction of a large proportion of archaeological sites in the study area) would make a significant impact on the 'regional estate' of archaeological sites, although it must be noted that the proposal for Nuclear-1 includes a 200m coastal strip (where the vasdt marority of the archaeological sites occur) will be kept free of development.

A concern is the loss of wilderness landscape and uninterrupted views, which gives the Overstrand region its particular character, and makes the R43 a scenic drive. Quantification of this impact is not possible as the field of landscape heritage study is in its infancy in South Africa.

Indications are that the construction of transmission lines that will integrate the facility with the national grid will need to cross iconic Cape landscapes, resulting in significant impacts in terms of setting and scenery. Public response with respect to the scoping phase of the EIA has been vigorous with respect to issues with such as damage to scenery (Lita Webley and Stephen Stead pers. comm.).

Table 2. Summary of the impacts for the Bantamsklip site.

<u>Impact</u>		Intensity	Extent	Duration	Irreplacable resources	Consequence	Prob.	SIGNIFICANCE
Destruction of Miocene palaeontolgy	Unmitigated	Low	Low	High	Medium	Low	Medium	**Low**
	Mitigated	Low	Low	high	Medium	Low	Medium	**Low**
Destruction of Pleistocene palaeontology and archaeology	Unmitigated	High	Low	High	Medium	Medium	Medium	**Medium**
	Mitigated	Medium	Low	High	Low	Medium	Medium	**Medium**
Destruction of Holocene archaeology	Unmitigated	High	Low	High	High	High	High	**High**
	Mitigated	Medium	Low	High	Low	Medium	Medium	**Medium**
Destruction of colonial heritage	Unmitigated	Low	Low	High	Low	Low	Low	**Low**
	Mitigated	Low	Low	High	Low	Low	Low	**Low**
Destruction of cultural landscape	Unmitigated	High	Medium	Low	High	High	High	**High**
	Mitigated	High	Medium	High	High	High	High	**High**
Cummulative impacts	Unmitigated	High	Medium	High	Medium	High	High	**High**
	Mitigated	Low	Medium	High	Medium	Medium	High	**Medium**
Positve contribution to conservation	Unmitigated	Low	Medium	High	Medium	Medium	High	**Medium**
	Partly mitigated	Medium	Low	High	Low	Medium	Low	**Low - Medium**

3.2.6 The Thyspunt site

Impacts on the Thyspunt site will take place primarily during the construction phase. Changes to landscape qualities of the place will occur and persist until such time as the facility is fully decommissioned and demolished.

3.2.7 The nuclear corridor

During construction the following impacts are expected to occur:

- The landscape qualities of the place will change, the wilderness qualities of the site and surrounds will diminish as the industrial ambience increases. This in turn will affect the publicly perceived qualities of the region detracting from its identity as a wilderness area. Since Thyspunt is a fairly variable landscape, ultimately the choice of site within the nuclear corridor is likely to play an important role in the degree to which impacts will occur and the degree to which mitigation is required. The 100 m high dune ridges as well as the choice of location along the shore will play an important role in reducing the visual impact of the facility. However, since design details are not available, comment can only be made in general terms.
- Bulk excavation may disturb and destroy fossil material contained within the sediments of the Algoa group.
- Bulk excavation will disturb and destroy mid-late Pleistocene archaeology and palaeontology contained in or under the vegetated and shifting dunes. Destruction of very rare ancient human remains is also possible.
- The setback of the development 200 m from the coastline will prevent the destruction of the majority of the prolific archaeological sites along the coastline and in the long-term assist in their conservation in a strictly access controlled area, although there is potential for destruction of Late Stone Age middens further inland (between 200 m and 300 m of the coast). Destruction of these sites will be much less acute further inland in the vegetated dune areas. Pleacing a facility adjacent to Thysbaai beach or within the vegetated dunes as proposed will be greatly reduce the impacts on Late Stone Age middens, since they tend to be more common adjacent to rocky shores, and in areas where there are surface water sources.
- Late Stone Age human burials may be destroyed in any place where earthmoving takes place.
- The proposed activity will threaten the future of the St. Andrews shack (a place of tradition and living heritage) as it will lies within the access controlled area.

- It is likely that a building greater than 60 years of age (but of low significance) will need to be demolished to make way for the proposed HV-yard.

During the decommissioning phase the following impacts may occur:

- Destruction of structures more than 60 years of age; and
- Earthmoving on un-modified landscapes may impact physical heritage

3.2.8 Cumulative impacts

SAHRA has not conducted a systematic assessment of the potential population of archaeological sites on the Eastern Cape south coast or the amount of undisturbed shoreline that survives. Binneman and Webley (pers. comm.) of the Albany Museum have expressed concern at the number of archaeological sites that have been previously recorded by the Museum and were recently destroyed by prolific development in the St. Francis area, often without mitigation. Conservation issues are acute in the Eastern Cape due to lack of professional staff available to control the situation. The Thyspunt site is highly rich in heritage and the quality and quantity of archaeological material is extraordinary. The cumulative impact of the proposed activity will be significant unless there is a regional effort to conserve coastal landscape.

A concern is the loss of wilderness landscape and un-interrupted views, which give the region its particular character. The recent proposal to construct wind energy facilities at a possible site to the north of Thyspunt and Oyster Bay will negatively affect the sense of country that can be experienced in the area today. According to the Thyspunt transmission line EIA scoping report (Sivest (Pty) Ltd 2009) the grasslands between Thyspunt and Humansdorp have high scenic values and these will be negatively impacted.

Table 2 Summary of Impacts for the Thyspunt site

Impact		Intensity	Extent	Duration	Irreplacable resources	Consequence	Prob.	SIGNIFICANCE
Destruction of Miocene palaeontolgy	Unmitigated	Low	Low	High	Low	Low	Medium	**Low**
	Mitigated	Low	Low	High	Low	Low	Low	**Low**
Destruction of Pleistocene palaeontology and archaeology	Unmitigated	Low	Low	High	Medium	Low	Medium	**Low**
	Mitigated	Low	Low	High	Low	Low	Medium	**Low**
Destruction of Holocene archaeology	Unmitigated	High	Low	High	High	High	High	**High**
	Mitigated	Low	Low	High	Medium	Low	Medium	**Low**
Destruction of colonial heritage	Unmitigated	Low	Low	High	Low	Low	Medium	**Low**
	Mitigated	Low	Low	High	Low	Low	Low	**Low**
Deatruction of living heritage	Unmitigated	Low	Low	High	Low	Low	Medium	**Low**
	Mitigated	Low	Low	Low	Low	Low	Low	**Low**
Destruction of culural landscape	Unmitigated	High	Medium	High	High	High	High	**High**
	Mitigated	High	Medium	High	High	High	High	**High**
Cumulative impacts	Unmitigated	High	Medium	High	High	High	Medium	**Medium - High**
	Partly mitigated	Medium	Medium	High	Medium	Medium	Medium	**Medium**
Positive contribution to conservation	Unmitigated	Low	Medium	High	High	Medium	High	**Medium**
	Mitigated	Medium	Medium	High	Low	Medium	Low	**Low - Medium**

3.2.9 Access roads

It will be necessary to construct access roads to the nuclear power station. Since ultra-heavy loads will need to be transported, a well engineered transport system will be required. The impacts of these options is summarised below.

Roads from Humansdorp to the site

Alternatives for off-site access routes have only been provided for the Thyspunt site at this stage. These access roads are excluded from the Nuclear-1 EIA application but are discussed briefly below. Three alternative access roads from Humansdorp to the site have been considered.

Option 1: Humansdorp to site via the DR1762 to Oyster Bay.
Option 2a: Humansdorp to site via the R330 to St. Francis
Option 2b: Humansdorp to site via the R330 to St. Francis and then following the east-west link to the DR1762

Options 1, 2a and 2b are all acceptable in heritage terms as these routes all follow established roads and are not expected to create any major new impacts. Should any significant re-alignment of these routes be required, they will be subject to EIA and/or HIA processes of their own.

There are three proposed access roads from Cape St. Francis and Oyster Bay areas to the site. One of these will be used by ultra-heavy vehicles.

- **The western access road** (light and heavy delivery vehicles) has been assessed as far as the thick vegetation cover will allow. Indications are that the distribution of archaeological sites along the alignment is much lower than would be expected for a coastal alternative. While it is possible that some impacts will occur, it is expected that these can be mitigated as long as site inspection during bush clearing can take place. The proposed route is acceptable[5].
- **A northern access road** (light vehicles) to the site was proposed at an earely stage of planning but has since been rejected due to unacceptable impacts on the mobile dune system and is therefore not further considered.
- **The eastern access road** from St. Francis to the site has been identified for use by ultra-heavy vehicles and transport of employees only. This alignment has been assessed as far as thick vegetation will allow. Archaeological sites have

[5] A more detailed assessment of this route is presented in an appendix to the EIR version 2.

been identified in road cuttings in the existing property development areas west of Cape St. Francis, indicating that there is a strong likelihood that archaeological sites may be impacted. Mitigation should be achievable, provided that sites can be identified during and after bush clearing, and then adequately sampled.

3.2.10 Transmission lines

Two 400 kV, two 132 kV transmission lines and one 22 kV line will link the proposed HV yard (pan-handle) with the nuclear power station. These will need to cross the landscape including the dune system via a 145m wide corridor. There is a likelihood of archaeological sites occurring in this corridor, especially in the dunes. Since the area of permanent ground disturbance caused by the towers is small the overall significance of the impact on archaeological material is low. The dune field sites are easily mitigated through excavation and sampling. Such mitigation would need to be implemented if any disturbance by construction work is envisaged.

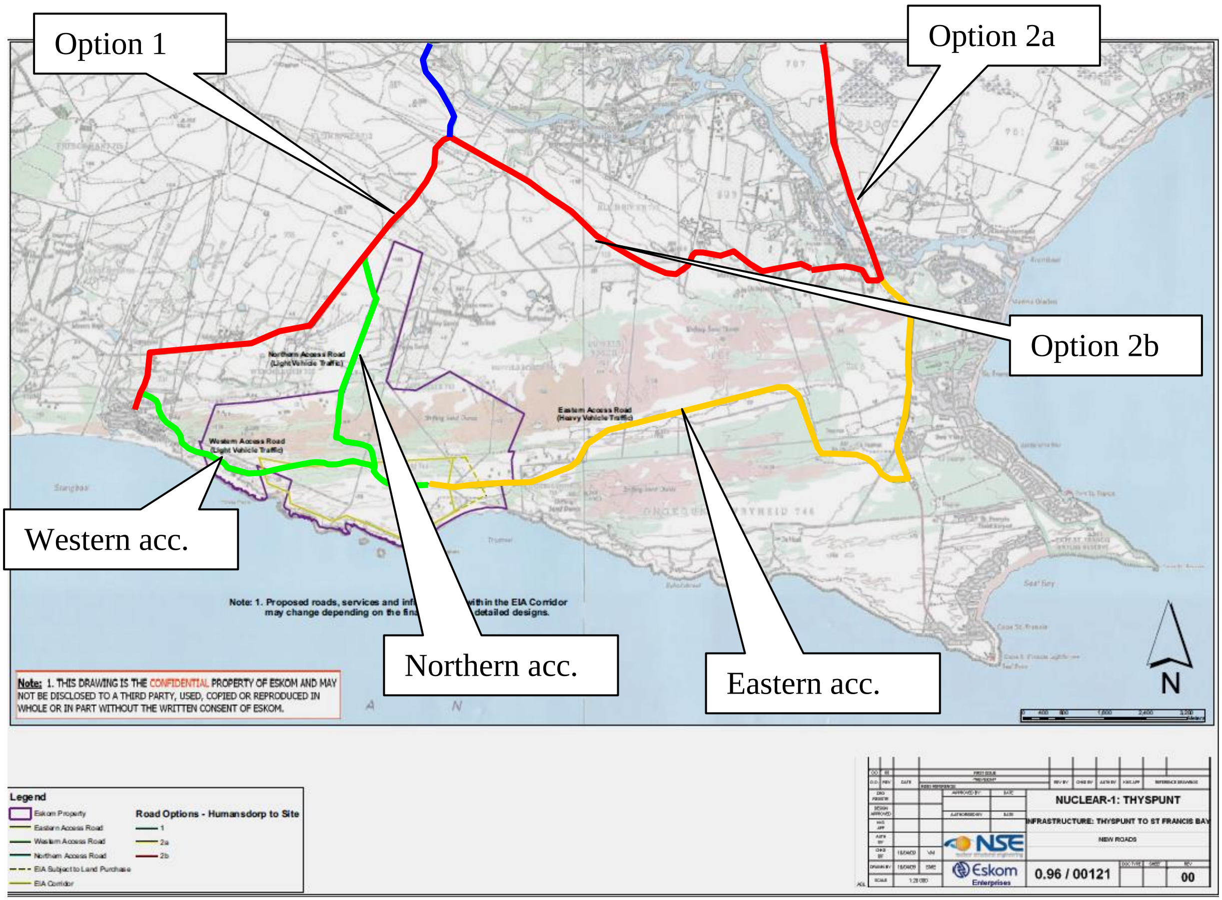

Figure 22 Alternative access roads to Thyspunt site

4 ENVIRONMENTAL ASSESSMENT - COMPARISON OF THE THREE SITES

4.1 Duynefontein

- The amount of Late Stone Age heritage that will be impacted is substantially less than that of Bantamsklip and Thyspunt with the result that the impact on the National Estate will be far less acute.
- Duynefontein is palaeontologically highly sensitive. However, if the applicant commits to a comprehensive mitigation programme, there is real scientific benefit to be had from the opportunity to collect fossils, record their context and examine the profiles of deep excavations into caenozoic deposits.
- No colonial period heritage is likely to be impacted.
- In cultural landscape terms the nuclear industrial presence is already established and accepted as a landmark by most Capetonians.

In summary Duynefontein is therefore the least sensitive of the three alternative sites.

4.2 Bantamsklip

Bantamsklip is almost as sensitive in terms of its heritage richness as Thyspunt, however mitigation measures stand a better chance of success than at Thyspunt since heritage sites are more visible and accessible. Much of the necessary sampling can be done prior to commencement of construction work.

- The preservation and volume of archaeological sites is exceptional.
- Mitigation will be lengthy, expensive and resource intensive requiring up to a year’s lead up time (depending on where the nuclear power station is located) before construction work can commence.
- The natural heritage landscapes of the place are excellent and make an important contribution to sense of place in the region. Unlike Thyspunt, Bantamsklip is a relatively flat area, which means that the proposed nuclear power station and associated infrastructure will be visible from Pearly Beach and the R43.

4.3 Thyspunt

Of the three sites, mitigation of impacts to physical heritage material at this site is going to be the most difficult due to accessibility problems. However, physical impacts are expected to be moderate. This could result in localised delays during construction if mitigation excavations cannot be performed in time for the planned start of construction.

- Both the archaeological and palaeontological heritage is prolific and represents a very wide range of material, much of it is very well preserved. However, it is focused in its spatial distribution, which means that physical impacts to archaeology can be minised, provided that infrastructure is placed as planned, within the vegetated dune system.
- The wilderness qualities of this portion of the coast are exceptional and make a substantial contribution to the character of the region. Depending on where the power station is to be situated within the nuclear corridor, it may be possible to keep landscape impacts localised. However the HV yard and transmission lines leaving the yard will be highly visible, as they cross the flat rural pasture lands to the north of the site.

4.4 The no-go alternative

Implementation of the no-go alternative will result in retention of the *status quo* until such time that alternative land uses are found. Thus, in the medium to long-term heritage impacts could be expected depending on future land use. Eskom has indicated that land will be sold if it cannot be used for power station development. Should any of the sites be used for poperty development, it is likely that heritage impacts in terms of archaeology and landscape will be severe. The westward expansion of St. Francis is a case in point. While the development of a nuclear power station on any of the proposed sites will result in moderate physical impacts, the conservation of landscapes within the owner-controlled zone as well as possible biodiversity offsets will be advantageous for heritage conservation in the long-term. Hense the no-go alternative is not necessarilty the best option for the sites in terms of general heritage conservation (unless the entire site is exluded from development activities, secured and actively conserved).

5 MITIGATION MEASURES

Since heritage is a finite resource that is sensitive to physical impact and change of context, other than avoidance or active conservation of the resource, mitigation options are limited and seldom wholly satisfactory. When a situation arises where the destruction of a resource is inevitable and cannot be avoided, mitigation actions tend to focus on "the rescue of knowledge". While this can be construed as a benefit for any community involved in the development and accumulation of knowledge, the end result is that the resource is either destroyed or its context (and therefore much of its meaning) is lost. Very often the success of mitigation is variable, as it depends on the skill of the heritage professional involved, his/her cultural biases and his/her access to resources and funding.

5.1 Mitigation objectives

5.1.1 Palaeontological material

Mitigation has a good prognosis for success and can result in benefits for science, knowledge and education provided that the work is adequately resourced and professionally accomplished. Typically mitigation will require the physical rescue of material from excavations, the recording and logging of cores, profiles and sections as well as curation and indefinite storage of any fossil material found. Palaeontologists welcome the opportunity to examine deep cuttings, as under normal research circumstances opportunities to do so are few and far between. Palaeontological resources can be extensive and specific specimens can be very rare. They are often highly inaccessible, lying under metres of rock and sediment. The success (or not) of mitigation is directly proportional to time and resources afforded to the palaeontologists and the ability of the construction operation to tolerate their work.

In the case of this project (all of the three sites), the object of mitigation is to use the rare opportunity of a deep excavation to increase scientific knowledge for the common good, and thereby derive benefit from what would otherwise be a thoroughly destructive process and an irretrievable loss.

5.1.2 Archaeological heritage

Being aware of the finite qualities of this heritage resource, archaeologists favour conservation *in-situ* where ever feasible and possible. If *in-situ* conservation cannot be achieved, mitigation can only be achieved though archaeological sampling. The affected sites will need to be fully or partially excavated in a scientific way, the resulting material sorted, curated and stored in an approved facility so that a physical archive of information is stored for the benefit of anyone who would wish to utilise it in an appropriate way. The process is time and resource-consuming and the skills required are demanding and expensive. Furthermore, all excavated material has to be stored indefinitely, which in turn is a huge burden on cash-strapped museums with limited storage space. It is likely that in the case of this project, a dedicated facility in each province will need to be built to house heritage material in a controlled environment. At Thyspunt, there is an opportunity to position infrastructure in such a way that physical impacts will be minimal, and those that do occur should be entirely mitigable through archaeological sampling, or by prefereably active conservation. At Bantamsklip a 200 m setback will reduce impacts, while at Duynefontein positioning of the power station will not reduce the impact due to the widespread nature of the archaeological and palaeontological heritage.

The object of mitigation weith Nuclear-1 is to conserve archaeological material whereever possible in for example exclusion zones or nature areas (as has been the case with Koeberg Nature ReserveDuynefontein). Given the bulk of the proposed activities, mitigation through scientific excavation remains the only option available at Dynefontein and Bantamsklip, and less so at Thyspunt. The goal would be to ensure that as representative as possible a range of sites are thoroughly sampled and studied before they are destroyed by construction activities.

5.1.3 Cultural landscapes

Conservation of landscape is normally achieved by making heritage and aesthetics (in the broadest sense of the word) a key informant in any planning process. In the context of this project the sheer bulk and non-negotiable design qualities of a nuclear power station, high voltage yards and transmission lines do not lend themselves to mitigation, as the presence of a large new intrusion will destroy the completeness of the cultural landscape and alter the context of the heritage.

In terms of aesthetics, there are details that can be applied to the overall planning to ensure that vistas are enhanced, historic features and places are conserved, infrastructure sprawl is contained and landscapes are conserved, even if they are visually compromised. Entrance gates, admin facilities, roads and fencing should be treated in a way that is sensitive to scenery, tourism and culture. Unfortunately however, the bulk and scale of the proposed activities is largely non-mitigable.

5.2 Recommended mitigation measures

5.2.1 General mitigation key principles

This section of the report does not intend to be prescriptive at this early stage of the process, but recognises that mitigation measures will need to be discussed and workshopped with key project personnel, so that they can lock in with the construction schedule and methodology. HWC, SAHRA and potentially Iziko Museums of Cape Town and Albany Museum of Grahamstown would be responsible for storage of specimens and will need to be consulted.

(a) Locating the proposed activities

The most effective method of mitigation of heritage impacts is to position infrastructure in areas that will have the least impact. This is particularly relevant to Bantamsklip and Thyspunt, where the location of the activities is the first and most effective line of defense. In this regard, please refer to the conceptual layout plans for the power station in the Environmental Impact Report.

At Duynefontein, adjustment of the position of the facility is unlikely to reduce the impact.

At Bantamsklip, locatingthe proposed activity 200 m from the high water mark will make a significant difference in favour of the conservation of coastal middens, as the bulk of archaeological sites lie within 200 m of the rocky shoreline. Unfortunately there is very little that can be done to alleviate impacts to the character and landscape setting of the area.

At Thyspunt, the choice of position of the proposed activity will make a significant difference to the degree of impact. Locating the facility adjacent to the Thysbaai beach or within the central vegetated dune area is much more preferable to a location adjacent to the western rocky shoreline, where most archaeological sites are situated. Similarly setting the facility back from the shoreline by about 200 m will avoid impacting well preserved archaeological sites along the shoreline. The 80-100 m high dunes to the immediate north will assist in limiting the visibility of the facility, which is expected to be about 65 m in height.

(b) Mitigation prior to construction

A second principle is that *as much mitigation work as possible* should happen in advance of commencement of construction activities, as attempting archaeological or palaeontological rescue work on a busy 24-hour construction site is extremely difficult. Since all three proposed sites have potentially serious heritage issues to be mitigated, the applicant is requested to be pro-active by commissioning the required work as soon as possible. In the event of personnel having to undertake archaeological or palaeontological rescue work during the course of construction, they will need the co-operation of construction staff to allow them the necessary time to do the required rescue work. This could vary between two hours and two weeks. Unless suitable circumstances can be created for this to be achieved, mitigation will fail.

(c) Mitigation of finds during the construction period

As a guiding principle it is important that a clear chain of communication be developed between the construction team on site and a heritage consultant and his/her team who can be on call to attend meetings, conduct site inspections, perform emergency rescue work and resolve any queries. The heritage consultant should be a professional archaeologist or palaeontologist with full principal investigator (PI) accreditation in pre-colonial and Pleistocene archaeology. This process needs to be in place before the inception of construction work. The success of any mitigation measures for both palaeontology and archaeology is dependent on the willingness and co-operation of project managers, site engineers, foremen and the workers themselves. Without their willingness to become involved as part of the heritage management process, the chances of successful mitigation are considerably diminished. It would be of benefit to identify and invite key personnel to attend a "short heritage course" to enable them to assist in the recognition of fossil material and work out a process for consultation, collections of specimens and temporary on-site curation.

(d) Mitigation plan

A fourth principle is that, given the complexity of the mitigation required for any one of the three sites, a "mitigation plan" be developed through workshopping specific mitigation proposals with the respective archaeology and palaeontology committees of SAHRA and HWC. These organisations and the applicant will need to be satisfied that the proposed sampling strategy is appropriate and realistic before excavation and destruction permits can be issued. The mitigation measures detailed in this report form a basis from which such a plan could be developed. In the case of Thyspunt, depending on where infrastructure is to be located, very little mitigation may be required. The scope of mitigation work will need to respond to the final layout.

(e) Maritime heritage

Since all three sites are coastal and will involve engineering work off-shore, there is a remote possibility that impacts to protected shipwrecks may occur. The impact would depend on the form of engineering taking place. This issue will need to be addressed by means of specific heritage impact assessments once there is further clarity on the routing of marine infrastructure such as spoil and cooling water pipelines.

(f) Human remains

Human remains can be found anywhere on the landscape, and almost inevitably in areas where there are concentrations of archaeological sites. Unfortunately SAHRA has not yet developed clear protocols with respect to human remains. However, special permitting requirements need to be fulfilled, and the excavation work may only be done by an archaeologist. Certain communities have sensitivities with respect to the manner in which their ancestral remains are treated. At all sites, the community identified as I&APs must be informed and consulted when human remains are uncovered, and if necessary the reburial of any human remains should be facilitated.

(g) Education and science

A principle worthy of consideration is that of developing the information that will be gained from the heritage management process into an educational resource – a booklet, pamphlet or even a small display that could be included within a visitor or information centre. Obviously the potential for this is dependent on the outcomes of the heritage management process. However, the idea can be proactively considered and a decision made "down the line" in consultation with I&APs.

(h) Consideration of aesthetics

Where possible, it is strongly recommended that planning, layout, road construction and infrastructure is not solely based on engineering requirements (although in this particular project it is acknowledged that engineering and safety requirements are central). The design of the nuclear island and turbine halls are effectively non-negotiable due to the requirements of function and safety. However, a great deal can be done to make sure that other infrastructure is aesthetically pleasing and in empathy with the landscape and cultural and natural heritage. To this end, it is recommended that the applicant should consult with urban design specialists who can assist with environment and heritage friendly layout and structures.

5.2.2 Site-specific mitigation requirements (key elements of a mitigation plan)

(a) Duynefontein

Archaeology: The main area of concern that has been identified is the EIA corridor north of the existing Koeberg Nuclear Power Station or any place where land surface disturbance is envisaged. It is essential that an archaeologist is appointed well in advance of construction to undertake the following tasks:

- Undertake the sampling and curation of material from all identifiable Late Stone Age sites that will be affected by the proposed activity.
- Undertake a series of trial excavations throughout the development area and beyond to define the extent of the Pleistocene fossil-bearing sediments as manifested at the site of Duynefontein 2.
- Based on these findings design and implement a sampling strategy (in consultation with other heritage I&APs) to systematically record, collect and curate Pleistocene archaeological and palaeontological remains.
- Work with the applicant to ensure that a suitable facility for the safe indefinite storage of any finds is made available – be it at a museum or a specially designed facility on the site.
- During the construction period (especially land clearing and bulk excavation) an archaeologist and/or representative must initially be on site at all times when bulk excavation takes place. If there is good reason to believe that certain activity areas are not sensitive, the frequency of monitoring can be decreased.
- In the event of a find of fossil bone or artefactual material, the archaeologist will need to identify the horizon that the find is associated with and, if necessary, be given the opportunity and budget to bring a "rescue" team onto site to excavate the find, expose the material and sample it accurately and adequately.The fact that old land surfaces and the fossil faunas that inhabited them are preserved in the study area, means that there is a possibility that fossil human remains may exist on or close to the site. Fossil human remains from the late Pleistocene (and earlier) are exceptionally rare and of exceptional scientific importance on a global scale. Any find of this kind must be removed with appropriate care by an archaeologist. In the unlikely event of such a find occurring, the applicant must facilitate the necessary work in such a way that it is done to the highest standards, and as quickly as is reasonable.

Palaeontology: The areas of concern are any places where deep bulk excavation needs to occur – i.e. the nuclear island and turbine hall sites. The difficulty with mitigation of this kind is that it will have to take place during the construction phase while bulk excavation is taking place. Successful and cost-effective monitoring depends a lot on the goodwill and co-operation of managers and on-site construction personnel. In order to spot the rare occurrences, it is desirable to have the co-operation of the people "on the ground". These personnel include supervisory/inspection roles, such as engineers, surveyors, site foremen, etc., who are willing and interested to look out for occurrences of fossils. These personnel are also critical in informing excavator operators and manual workmen, who being close to the sediments, would be more likely to spot smaller fossils.

For the purposes of planning and cost containment, the contracted specialist must be informed of the scheduled excavation planning and the progress being made i.e. would need to establish liaison protocols with a suitably-placed persons. A prescribed data requirement is adequate 3D spatial referencing. For this the specialist would require the assistance of the surveyor, co-ordinates and base maps to plot the locations of finds during monitoring, the measured sections, samples and other observations.

In general, fossil bones are sparsely scattered in coastal deposits and much depends on spotting them as they are uncovered during digging. In contrast, shelly layers are usually fairly extensive and normally are exposed in the sides of the finished excavation, when they can be documented and sampled easily.

- If major bone finds are encountered, the contracted specialist should be immediately alerted. A temporary pause in activity at the limited locale will be required. The strategy is to "rescue" the material as quickly as possible. The method would be to remove representative samples and "best" material in encased blocks.
- In the case of considerable occurrences of bones, the methods could include the removal of a large, disturbed sample by excavator and conveying this by truck from the immediate site to a suitable place for "stockpiling". This material could then be processed locally, by sieving and further preparation.
- Isolated finds that are turned up should be handed over to a designated person for safekeeping, noting as far as possible where they came from. Excavated material with a clump of bones included can be stockpiled temporarily for safekeeping, until the site visit by the palaeontologist.

When the phases of bulk excavation are near or at completion and before the walls are sheet piled/gunited:

- The excavation faces will be inspected for fossil content;
- Any already-rescued material as above will be examined, processed and packaged;
- Representative samples of fossils will be collected;
- In the case of shelly beds, bulk samples will be taken;

- If material is delicate/poorly-preserved, it will be removed within blocks of the enclosing sediment, reinforced if required by encasement; and
- Key vertical sections representative of the exposures will be identified. These will be described in detail sedimentologically (logged), photographed and sampled, to fully record the contexts of the fossils.

(b) Bantamsklip

The key concern at Bantamsklip is to reduce the impacts to Late Stone Age archaeological sites that are threatened by the nuclear power station footprint. Lesser issues are the rescue of Middle Stone Age artefact scatters that lie on the fossil dunes and the conservation of colonial heritage elements that exist on the site.

Archaeology: The heritage resources within 300 to 400 m of the coast are substantial (well in excess of 115 occurrences). It is not feasible in terms of time frame, skills availability or a storage resource to sample them all, which means that significant loss will occur, unless it is possible to reduce the impact through avoidance of sensitive areas.

- The impact of the nuclear corridor on Late Stone Age coastal sites will be considerably reduced by the creation of a 200 m wide buffer zone between the facility and the coast. This should be treated as a conservation area with minimal intervention. Engineering solutions will be needed to deal with the cooling requirements of the plant. If this is not achievable, the impact to the resource will be considered to be "high".
- It is recommended that 20 Late Stone Age archaeological sites representing a full range of site context, character and cultural affinity within or close to areas of impact be identified and comprehensively sampled, analysed and radio-carbon dated (estimated duration: 1 year fieldwork pre-construction, 1 year follow up analysis).
- The archaeologist must sample the Middle Stone Age scatters on the fossil dunes and curate the material.
- Work with the applicant to ensure that a suitable facility for the safe indefinite storage of any finds is made available, be it at a museum or a specially designed facility.
- During the construction period (especially land clearing and bulk excavation) an archaeologist and/or representative must initially be on site at all times when bulk excavation takes place. If there is good reason to believe that the site is not sensitive, the frequency of monitoring can be decreased.
- In the event of a find of fossil bone or artefactual material, the archaeologist will need to identify the horizon that the find is associated with and, if necessary, be given the opportunity and budget to bring a "rescue" team onto

site to excavate the find, expose the material and sample it accurately and adequately.

- The fact that old land surfaces and the fossil faunas that inhabited them are preserved in the study area means that there is a possibility that fossil human remains may exist on or close to the site. Fossil human remains from the late Pleistocene (and earlier) are exceptionally rare and of exceptional scientific importance on a global scale. Any find of this kind must be removed by an archaeologist with exceptional care. In the unlikely event of a find such as this occurring, it is requested that the applicant facilitates the necessary work in such a way that it is done to the highest standards, and as quickly as is reasonable.
- A conservation plan should be drawn up to guide the future conservation and use of the Groot Hagelkraal farm complex. This is to safeguard its significant characteristics and formulate parameters for maintenance and/or changes.

Palaeontology has not been identified as a major heritage issue at Bantamsklip. However, precautions must be taken in case significant material comes to light.

- The archaeologist who is to be on site at all times during bulk excavation must also play a monitoring role in terms of palaeontological occurrences.
- In the event of a find, a professional palaeontologist must be contacted to evaluate the situation and implement emergency rescue steps, if warranted.
- A palaeontologist should make regular site inspections during bulk excavation and blasting of bedrock. In the event of a find, he/she must be given opportunity and resources to implement sampling and rescue as he/she deems fit.

(c) Thyspunt

The volume and diversity of archaeological and pleistocene palaeontological material at Thyspunt is very high but focussed in certain geographical areas. Despite this wealth of heritage, an extensive program of survey and trial excavation has demonstrated that it is possible to largely avoid impacts to physical heritage, provided that infrastructure is set back from the shoreline by 200 m and confined to the archaeologically “dead zone’’ in the vegetated dunes (south of the Oysterbay Mobile Dune Field).

Archaeology: Sensitive areas must be avoided. Creating a protected setback of 200 m wide from the shoreline would result in the conservation of a substantial number of archaeological sites, such that only moderate mitigation will be required. Similarly, as per the conceptual layout plan for this site, major infrastructure within the active dune system (besides power lines) must be avoided. The vegetated dunes contain very little by way of archaeological material, which means that the currently proposed position of the power station is optimal.

- Given that much of the anticipated footprint of the proposed Nuclear-1 site and possible subsequent expansion phases lies in densely vegetated areas, the likely impact on physical heritage in these areas is low. There is a possibility that some minor impacts may occur in the 200 m coastal strip. However, these impacts could be handled through archaeological sampling, setting up localised exclusion areas or micro-siting of infrastructure away from sensitive areas.
- In any place where the shoreline is to be affected by cooling inlets or outlets, or cooling retention dams, archaeological sites in the shoreline area will need to be fully sampled. If these services are placed in subterranean tunnels under the shoreline, few impacts are expected.
- Work with the applicant to ensure that a suitable facility for the safe indefinite storage of any finds is made available, be it at a museum or a specially designed facility in the Eastern Cape Province. Indications are at this time that a small dedicated museum on site would suffice.
- During the construction period (especially land clearing and bulk excavation) an archaeologist and/or representative must initially be on site at all times that bulk excavation is taking place. If there is good reason to believe that the site is not sensitive, the frequency of monitoring can be decreased.
- In the event of a find of fossil bone (which in the case of Thyspunt is a very strong possibility) or artefactual material, the archaeologist will need to identify the horizon that the find is associated with and, if necessary, be given the opportunity and budget to bring a "rescue" team onto site to excavate the find, expose the material and sample it accurately and adequately.
- The fact that old land surfaces and the fossil faunas that inhabited them are preserved in the study area means that there is a possibility that fossil human remains may exist on or close to the site. Fossil human remains from the late Pleistocene (and earlier) are very rare and of exceptional scientific importance on a global scale. Any find of this kind must be removed by an archaeologist with appropriate care. In the unlikely event of a find such as this occurring, the applicant must facilitate the necessary work in such a way that it is done to the highest standards, and as quickly as is reasonable.
- If the construction process with respect to the proposed HV yard requires the demolition of the abandoned cottage at Welgelegen (Pennysands), a demolition permit will need to be obtained from the Provincial Heritage Authority. Prior to demolition the building should be recorded through measured drawings and photography so that an archive of information is created.
- The impact to the cultural landscape cannot be mitigated, However, the acquisition of land for conservation purposes is of benefit to all aspects of heritage conservation.

Living heritage. The St. Andrews shack is a place associated with intangible heritage in terms of tradition.

- Negotiations should be held with St. Andrews school to allow the traditions that have become associated with the shack to continue. This could be done through retention of the shack *in-situ*, or the negotiation of a suitable offset with St. Andrews (i.e. building a similar facility close by).

5.2.3 Effectiveness of mitigation measures

As stated earlier in this report, avoidance is always the best conservation option for heritage. Restitution and rectification is not practicable in this discipline, given the finite nature and irreplaceable character of heritage. The only option that is left is the rescue of an archive of material, which is a crude compensation for the loss of something that can never be replaced. Unless impact avoidance can be achieved, the success of mitigation will at best be partial and loss will have to be tolerated.

Duinefontein: Mitigation will involve extensive archaeological and palaeontological sampling. The archaeological material is ancient, and is common human heritage that cannot be attributed any groups of persons alive today. The presence of the site close to a major urban center where the necessary expertise is available bodes well for successful mitigation. Dedicated storage facilities for specemins may be required.

Bantamsklip: Mitigation through archaeological sampling will be necessary if the proposed power station is situated within 200 m of the high water mark. Although archaeological sites are common, their diversity is fairly low which means that it will be feasible to obtain a representative sample of the archaeologicasl material. Dedicated storage may be necessary. The site is relatively close to Cape Town where the expertise to do the work exists.

Thyspunt: as a result of recent work in 2011 it has been established that avoidance of impacts to heritage is achievable. Moderate amounts of mitigation of archaeological material may be necessary along the Eastern Access Road and at potentially places where infrastructure may encroach within 200 m of the coast.

5.2.4 Recommended monitoring and evaluation programme

Since heritage practitioners have no quantifiable data about the extent of the "National Estate" even at a regional level, there is no yardstick that can be used to measure the effectiveness of a mitigation programme. In terms of the author's standards, if the archive of information and materials derived from rescue sampling can be used by others in dissertations, research publications or dissemination of public knowledge, then mitigation is deemed to be partially successful.

Unfortunately, it is more feasible to maintain a schedule of loss of heritage rather than a schedule of successful mitigation. Nevertheless the following measures are suggested as a means of judging the effectiveness of mitigation.

- The audit of heritage resources on the nuclear power station sites (and in any other Eskom owned property) should be an ongoing process. In order to measure the success of mitigation, as much as possible needs to be known about population diversity and age of heritage sites. The survey which has just been completed is a substantial start to this process.
- During the process of construction a book should be maintained that records as much as possible with respect to sites that are found in buried sediments during the construction stage. Not only would this be a critical contribution towards judging the amount of palaeo- and archaeo-heritage that lies buried on the property, but it would also assist in establishing an overall conservation goal. Ideally heritage casualties should be less than the number of heritage sites which are actively conserved – a site conserved for every one that is destroyed should be a minimal goal to aspire to.

6 CONCLUSIONS AND RECOMMENDATIONS

During the Nuclear Sites Investigation Programme (NSIP) that took place in the late 1980s and early 1990s various studies took place to inform the selection of candidate sites for future nuclear power stations. At that time comprehensive heritage studies had never been conducted in South Africa. What methodology did exist was rudimentary, home grown and conducted within the narrow and flawed framework of the National Monuments Act of 1969. While archaeological sites enjoyed a measure of protection, heritage as the term is understood today had no place in development decisions in South Africa. The notion of cherishing a landscape or designing a development in such a way to be sympathetic to the heritage of a place was seldom considered in engineering solutions. Even within the NSIP report, the cultural environment was never afforded anything more than a cursory sentence.

The sites that have been selected for the proposed activity are primarily based on their geological and engineering suitability to the task (a primary consideration in nuclear engineering). It would appear that other disciplines were either not considered or viewed as sacrificial under the primary concerns of safety and engineering suitability. The result of this legacy is that the sites of Duynefontein, Bantamsklip and Thyspunt, despite their exceptional heritage qualities, have been identified for the proposed nuclear power station. All three of these sites are highly sensitive in heritage terms. Within the ambit of the related disciplines of heritage, they are all undesirable as the cost to the National Estate is going to be high, unless properly mitigated. However, given the broader picture, the procurement of power (in particular non-greenhouse gas producing alternatives) is critical for the future well-being of the nation, which is currently suffering from a deepening energy shortage.

In the heritage section of the draft scoping report five sites were ranked in order of preference. The preferred sites (in heritage terms) of Schulpfontein and Brazil on the west coast were eliminated on grounds of overall feasibility leaving the three most sensitive alternatives for consideration in the EIA phase. Their qualities are summarised as follows:

Duynefontein: Of the three sites, this is marginally the least contentious. In cultural landscape terms the nuclear industrial presence is already established and accepted as a landmark by most Capetonians. Any additions to this will be additions to an already established identity.

Late Stone Age heritage that will be impacted is substantially less than that of Bantamsklip and Thyspunt with the result that the impact on the National Estate will be far less acute.

Duynefontein is palaeontologically highly sensitive. However, if the applicant commits to a comprehensive mitigation programme, there is real scientific benefit to be had from the opportunity for the collection of fossils, recording their context and examining the profiles of deep excavations into Caenozoic deposits.

Thyspunt: Both the archaeological and palaeontological heritage is prolific, but spatially highly focused, which means that impacts are avoidable and mitigation through archaeological sampling (if needed) is feasible. The wilderness qualities of this portion of the coast are exceptional and make a substantial contribution to the character of the region, and the contiguity of the strong cultural landscape qualities of the place. Furthermore, the archaeological landscape is very undisturbed, in that environmental factors that influenced how people used this landscape remain legible to this day.

Bantamsklip: Situated within the scenic Overberg South Coast region, the site is very sensitive on a number of heritage dimensions. By Western Cape standards the preservation and volume of archaeological sites is exceptional. Mitigation will be lengthy, expensive and resource-intensive. Furthermore, the natural heritage landscapes of the place are excellent and make a real contribution to sense of place in the region. The power station is likely to be visible over a wide area, while the transmission lines that will leave the site will impact the scenic qualities of large tracts of some of the Western Cape’s iconic and treasured landscapes (Webley and Hart in prep.).

The no-go alternative: On all three sites, the no-go alternative is undesireable, as Eskom will need to sell the land if it is not to be used for construction of a nuclear power station. Unless the land can be guaranteed to be used for nature conservation purposes, it is highly likely that some form of property development will take place in years to come. The impacts of property development in heritage terms can be severe and has generally a poor record of successful mitigation despite heritage legislation and constitutional cultural rights.

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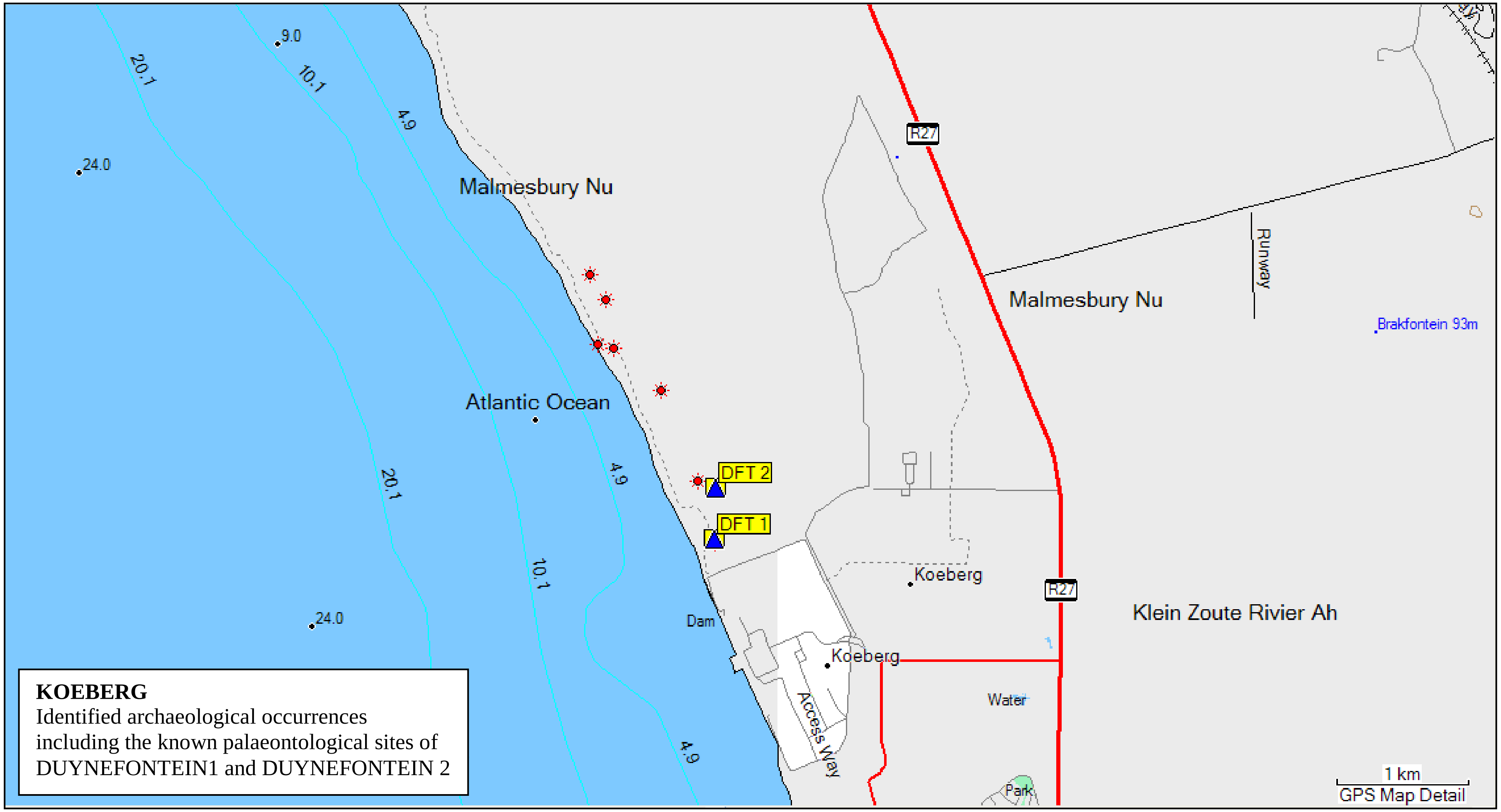
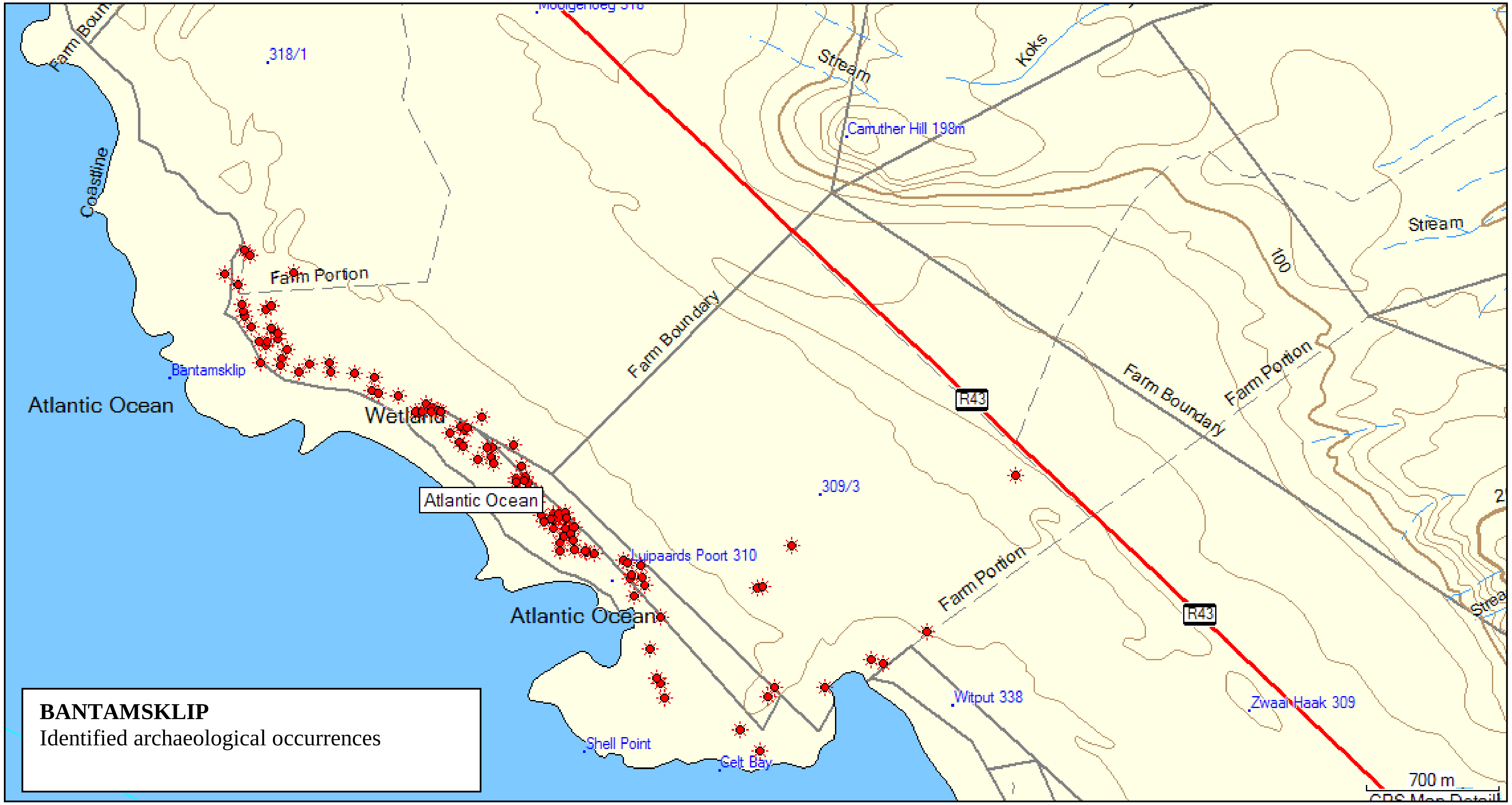
APPENDIX 1

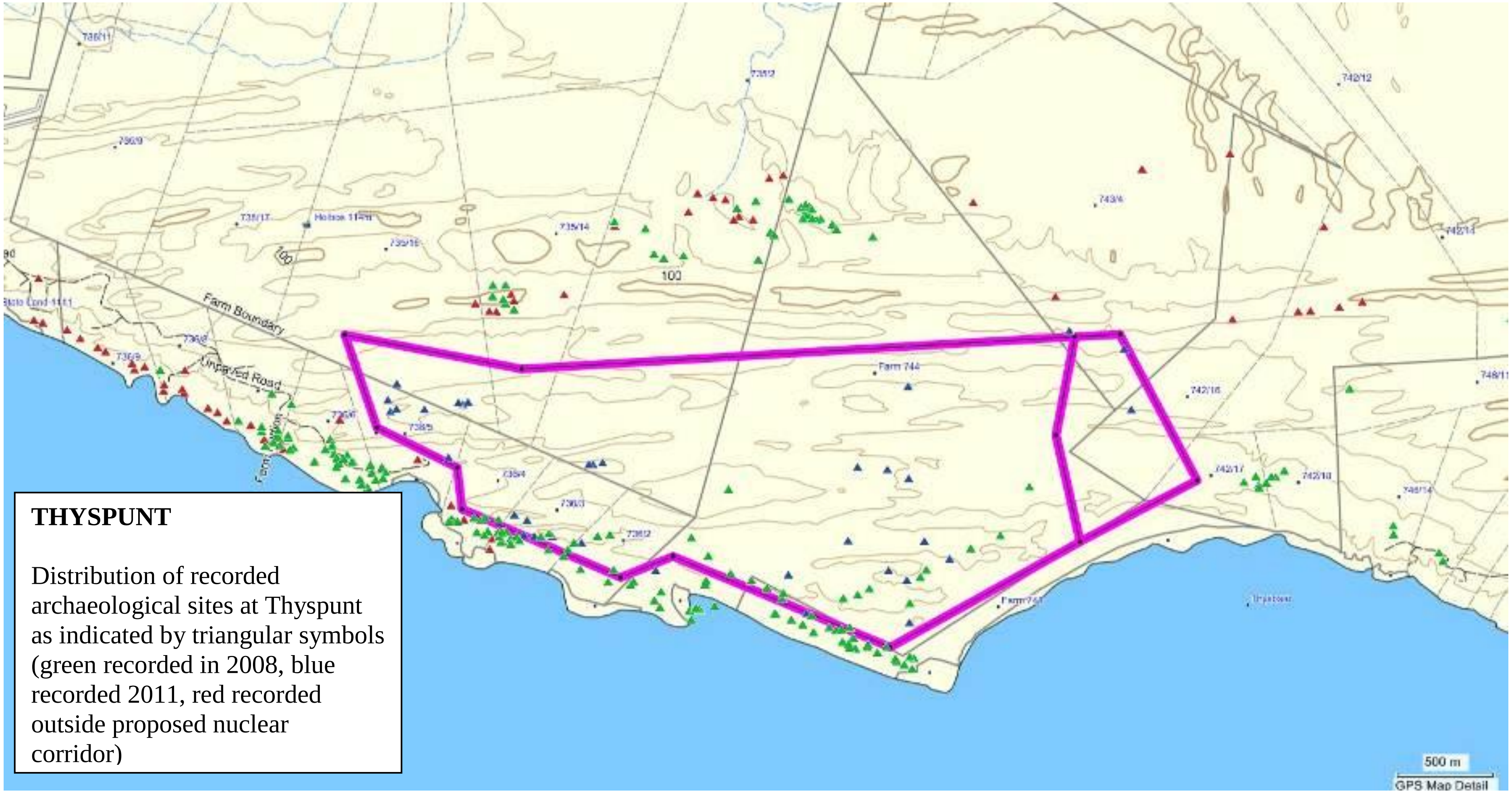
INVENTORY OF OBSERVATIONS



KOEBERG
Identified archaeological occurrences including the known palaeontological sites of DUYNEFONTEIN1 and DUYNEFONTEIN 2



BANTAMSKLIP
Identified archaeological occurrences



THYSPUNT

Distribution of recorded archaeological sites at Thyspunt as indicated by triangular symbols (green recorded in 2008, blue recorded 2011, red recorded outside proposed nuclear corridor)

THYSPUNT

Trial excavation sites and inspected grid points. Red symbols were not excavated due to environmental restrictions

THYSPUNT

Team search tracks within the proposed nuclear corridor.

DUYNEFONTEIN - INVENTORY OF OBSERVATIONS		
SITE NO	LAT/LONG	COMMENT
Cliff1	S33 39 18.9 E18 25 06.7	*Interesting exposure through layers exposed by cliff.*
DUYNEFONTEIN 1	S33 40 07.0 E18 25 41.6	*Bown soil horizon, with fossil teeth and bones. No cultural material noted. Large bovid metapodial with possible carnivore damage in the form of a notch close to the distal articular end.*
DUYNEFONTEIN 2	S33 39 54.3 E18 25 41.8	*Site of Duynefontein 2 excavation and Pleistocene fossil site.*
Fence	S33 36 53.7 E18 24 23.7	*Thin scatter of shell – Donax serra.*
Kbga	S33 40 07.6 E18 25 41.4	*Thin scatter of white mussel (Donax serra) shells on brown soil surface which appears to underlie calcareous fossilised dune remnants. Also present is an upper grindstone/ hammerstone.*
Kbgd	S33 39 52.4 E18 25 36.4	*Thin scatter of white mussel shell.*
Kbge	S33 39 30.0 E18 25 25.7	*Thin scatter of white mussel shell.*
Kbgf	S33 39 07.8 E18 25 09.4	*Thin scatter of white mussel shell.*
Kbgg	S33 39 01.7 E18 25 04.6	*Thin scatter of white mussel shell associated with hammerstone, broken quartzite.*
Kbgh	S33 39 19.6 E18 25 11.6	*Thin scatter of white mussel shell.*
Kbgi	S33 14 58.2 E18 33 49.5	*Exposure along road next to fence of small amount of white mussel shell. No cultural material. The vegetation is extremely thick in the northern parts of the property and the only material to be seen has been exposed by road works or similar disturbance.*

BANTAMSKLIP - INVENTORY OF OBSERVATIONS		
SITE NO	LAT/LONG	COMMENT
1	S34˚43'491 E19˚35'189	*Small shell scatter exposed in road, mostly Turbo spp. and limpet.*
2	S34˚43'675 E19˚34'964	*Small shell scatter with quartz core and flake.*
3	S34˚43'519 E19˚34'990	*Scatter with MSA radial cores, broken hammerstone and broken natural point and LSA quartzite core and shell.*
4	S34˚43'557 E19˚34'717	*Road cuts through thin midden with shell, quartzite cores and retouched flake.*
5.1	S34˚43'589 E19˚34'660	*Partial exposure of ?large buried midden.*
5.2	S34˚43'606 E19˚34'695	*Continuation of midden, patchily visible.*
5.3	S34˚43'622 E19˚34'785	*Continuation of midden.*
6	S34˚43'614 E19˚34'892	*In old road cutting. Two horizons visible, one thin at 2-3m, one richer at 1m. Lower horizon original landsurface. Large quartzite artefacts and side struck flakes.*
7	S34˚43'334 E19˚35'542	*Seen in road. Shell and large number of quartzite flakes, cores and manuports.*
8.1	S34˚43'200 E19˚34'566	*Large scatter over two hillocks with shell, quartzite flakes and cores and quartz pieces.*
8.2	S34˚43'180 E19˚34'552	*Continuation of midden over fossil dune surface with MSA components.*
9	S34˚43'144 E19˚34'550	*LSA/MSA scatter on fossil dune surface - big quartz chunks, grindstone and shell.*
10	S34˚43'137 E19˚34'505	*Scatter of Turbo spp. and quartzite on fossil dune surface.*
11	S34˚43'131 E19˚34'492	*Lower grindstones on fossil dune surface.*
12	S34˚43'182 E19˚34'514	*Midden cut by road, 500mm thick, 200mm below surface. Shell, large quartzite cores and flakes.*
13	S34˚43'106 E19˚34'361	*Midden visible in road, Turbo spp. and limpets.*
14	S34˚43'100 E19˚34'320	*Ephemeral lens cut by road, Turbo spp., Haliotis spp. and limpet.*
16	S34˚43'835 E19˚34'034	*Cut by road, Shell, quartzite flakes; behind primary dune. Worth sampling.*
17	S34˚42'723 E19˚33'999	*Historical wall: calcrete blocks with sand infill.*
18.1	S34˚42'507 E19˚33'229	*Midden near fishtraps. Shell, marine mammal bone, quartzite flakes and quartz chunks. No fish bones evident. Worth sampling.*
18.2	S34˚42'465 E19˚33'201	*More of the midden.*
18.3	S34˚42'436 E19˚33'177	*Continuation of midden over mound.*
18.4	S34˚42'423 E19˚33'171	*Open, flat area on crest of mound.*
18.5	S34˚42'401 E19˚33'166	*Edge of midden.*
18.6	S34˚42'344 E19˚33'157	*South end of midden that extends over ridge.*
19	S34˚42'262 E19˚33'195	*Minor midden with shell and flaked quartzite.*
20	S34˚42'248 E19˚33'178	Midden, pottery sherd noted.

21.1	S34˚42'595 E19˚33'475	Scatter cut by road and exposed by drilling activity.
21.2	S34˚42'573 E19˚33'402	Visible on crest of dune due to erosion, deposits lower on slope covered by hillwash.
21.3	S34˚42'556 E19˚33'308	Midden forms mound of solid shell debris, quartzite and quartz. A survey peg has been placed in the ground on the mound.
21.4	S34˚42'575 E19˚33'302	Extent of midden mound toward shore.
21.5	S34˚42'595 E19˚33'365	Still evident in road cutting.
22	S34˚42'646 E19˚33'619	Thin scatter of shell near road.
23	S34˚42'653 E19˚33'639	Haliotis spp. and Turbo spp. with high concentration of limpet. Evident on slope of dune, but not on the crest.
24	S34˚42'662 E19˚33'709	Historical wall: calcrete blocks with sand infill, associated with sandbags.
25	S34˚42'708 E19˚33'768	Buried horizon, evident in road cutting. 600mm deep, 300mm thick, mostly Haliotis spp. with some Turbo spp.
26	S34˚42'706 E19˚33'795	Small thin scatter of Turbo spp. with Burnupena spp., Haliotis spp. and limpet.
26	S34˚42'766 E19˚33'889	Haliotis spp. midden, slightly buried on the seaward side of an old dune. Large manuports and some quartzite chunks.
27.1	S34˚42'793 E19˚33'919	Extensive midden, mostly Haliotis spp., on seaward side of dune. Partially buried.
27.2	S34˚42'844 E19˚33'988	Still visible, with dense concentrations of Haliotis spp. Some shells stacked four deep.
27.3	S34˚42'856 E19˚34'039	Peters out where intersected by road.
28	S34˚42'896 E19˚34'117	Mound of dense Haliotis spp. and Turbo spp., approx 1m deep. Extends over a series of small rises. Apparently differential concentrations of shellfish types in different areas: Haliotis spp./Burnupena spp. - limpet/Burnupena spp. - largely limpet. Also quartzite chunks and grindstones.
29	S34˚42'891 E19˚34'150	Concentration of largely limpet and Burnupena spp. on an obvious mound.
30	S34˚42'861 E19˚34'137	On fossil dune, mostly Burnupena spp. and limpet. Large manuports and flaked quartzite.
31.1	S34˚42'801 E19˚34'109	On fossil dune, mostly Burnupena spp. and Turbo spp.. Ochre stained grindstone.
31.2	S34˚42'808 E19˚34'034	Deposit still visible.
31.3	S34˚42'810 E19˚34'018	Turbo spp., Burnupena spp. and Haliotis spp. on landward side of dune.
32	S34˚43'080 E19˚34'272	Small dense scatter of Turbo spp. and limpet with manuports.
33.1	S34˚43'062 E19˚34'285	Shell, manuports and flakes in depression on top of dune. Worth sampling.
33.2	S34˚43'056 E19˚34'305	Continuation of midden.
33.3	S34˚43'074 E19˚34'315	On top of dune.
33.4	S34˚43'039 E19˚34'288	Still evident on landward side of dune, slightly covered by new dune.
33.5	S34˚43'010 E19˚34'266	Still continuous along dune.
33.6	S34˚43'014 E19˚34'250	Small concentration within continuous ribbon of deposit.
34	S34˚43'012 E19˚34'239	Modern Haliotis spp. poachers midden.

35.1	S34˚42'949 E19˚34'190	Dense scatter of shell, Turbo spp., Haliotis spp. and limpet.
35.2	S34˚42'963 E19˚34'191	Continues at this point. Some longicosta visible.
36	S34˚42'935 E19˚34'186	Buried midden with Turbo spp., limpets, chiton and flaked quartz.
36.1	S34˚42'913 E19˚34'159	Big midden, covering ridge and forming mound.
36.2	S34˚42'903 E19˚34'146	Top of midden mound with marine mammal bones showing cut marks.
37	S34˚42'906 E19˚34'119	Midden of largely limpet with some Turbo spp., Haliotis spp. and chiton. Flaked quartzite.
38.1	S34˚42'25.5 E19˚35'23.5	Scatter along dune ridge with shell, quartzite flakes and large bovid bone.
38.2	S34˚42'24.9 E19˚35'20.8	Scatter thins out at this point.
39	S34˚43'29.4 E19˚35'00.9	Thin scatter of abalone fragments on calcrete surface.
40	S34˚43'31.4 E19˚34'38.0	Fish trap.
41.1	S34˚43'28.9 E19˚34'37.1	Extensive ribbon of midden running along immediate coastal dune. Shell, quartzite flakes and chunks.
41.2	S34˚43'27.8 E19˚34'36.2	Continuation of ribbon.
41.3	S34˚43'22.8 E19˚34'35.0	Continuation of ribbon, thinning out adjacent to shallow bay.
41.4	S34˚43'17.8 E19˚34'37.2	Ribbon of midden still visible.
42	S34˚43'13.9 E19˚34'31.7	Midden cut by road, shell, quartzite cobbles and flakes.
43.1	S34˚43'06.7 E19˚34'23.3	Midden cut by road, quarzite chunks and flakes.
43.2	S34˚43'06.3 E19˚34'21.5	Continuation of midden.
44	S34˚43'06.1 E19˚34'16.3	Lense in midden cut through by road intersection.
45	S34˚43'10.2 E19˚34'31.0	Midden on dune crest.
46	S34˚42'45.7 E19˚33'56.4	Dense pile of Haliotis spp. on edge of dune mound close to road. Worth sampling.
47	S34˚42'34.0 E19˚33'13.9	Wreck of trawler on rocks.
48	S34˚42'31.1 E19˚33'15.0	Dense midden with large Haliotis spp., Turbo spp., limpet and broken quartzite.
48.1	S34˚42'30.5 E19˚33'15.4	Continuation of midden.
48.2	S34˚42'30.1 E19˚33'17.6	Inland limit: north extent of large coastal dune.
49.1	S34˚42'28.3 E19˚33'16.2	Continuous foredune midden cut by road at this point.
49.2	S34˚42'25.1 E19˚33'15.0	Concentration in foredune midden.
49.3	S34˚42'24.4 E19˚33'16.2	Northerly extent of foredune midden. Worth sampling.
50	S34˚42'18.9 E19˚33'06.5	Possible fish trap.
51.1	S34˚42'34.1 E19˚33'28.3	Massive dune cordon midden.
51.2	S34˚42'31.8	Near northern inland extent of midden.

	E19˚33'19.4	
51.3	S34˚42'29.2 E19˚33'17.6	Concentration further inland.
52	S34˚42'35.9 E19˚33'33.5	Midden on dune crest manifested in road, quite dense, many quartzite cobbles.
53	S34˚42'36.5 E19˚33'37.7	Northern and eastern extent of midden.
54	S34˚42'41.1 E19˚33'48.4	Dense buried lense eroding out of dune base. Usual material plus Burnupena spp. - possible localised utilisation.
55	S34˚42'41.7 E19˚33'48.4	Small midden.
56	S34˚42'42.5 E19˚33'49.5	Small contained scatter.
57.1	S34˚42'42.2 E19˚33'50.9	Small midden with grindstone.
57.2	S34˚42'42.3 E19˚33'51.3	Continuation of midden.
57.3	S34˚42'44.9 E19˚33'55.9	Continuation of midden.
57.4	S34˚42'45.2 E19˚33'56.8	Continuation of midden.
58	S34˚42'48.3 E19˚33'56.0	Quite dense concentration of midden.
59.1	S34 43 01.3 E19 34 12.9	Midden in dense bush, on edge of 2nd dune cordon. Includes Burnapena spp, typical shellfish range - very large.
59.2	S34 43 00.0 E19 34 15.8	Continuation of midden.
59.3	S34 42 59.8 E19 34 17.2	Continuation of midden.
59.4	S34 43 00.6 E19 34 17.5	Continuation of midden.
59.5	S34 43 00.7 E19 34 17.4	Continuation of midden.
59.6	S34 43 02.2 E19 34 19.3	Continuation of midden.
59.7	S34 43 02.7 E19 34 17.7	Continuation of midden.
59.8	S34 43 02.4 E19 34 14.9	Continuation of midden.
59.9	S34 43 01.3 E19 34 12.8	Continuation of midden.
59.11	S34 43 00.1 E19 34 12.3	Continuation of midden.
59.12	S34 42 59.9 E19 34 14.8	Continuation of midden.
59.13	S34 42 59.9 E19 34 14.8	Continuation of midden.
60	S34˚42'58.1 E19˚34'10.4	Midden in dense bush, typical shellfish range.
61	S34˚42'58.0 E19˚34'10.1	Midden between two dunes.
62	S34˚43'05.4 E19˚35'04.4	Turbo spp. midden turned up by mole heaps in dense bush.
63	S34˚43'05.4 E19˚35'04.4	Material turned up in mole heap on seaward slope far inland.
64	S34˚43'12.5 E19˚34'57.3	Extensive but thin scatter on fossil dune surface.
64	S34˚43'12.3 E19˚34'58.5	Deposit on fossil dune surface. No shell visible, but large quartzite grindstone and several quartzite chunks.

THYSPUNT – INVENTORY OF OBSERVATIONS		
SITE NO	LAT/LONG	COMMENT
1	S34 11 01.6 E24 40 54.8	*Shell mound covered by bush at shore, possibly deep and stratified.*
2	S34 10 58.1 E24 40 49.1	*Thin scatter in thick bush close to sea with fresh water.*
3	S34 10 57.9 E24 40 49.1	*Scatter on side of mound, pottery, flaked quartzite and possible grindstone.*
4	S34 10 57.8 E24 40 44.2	*Part of a very large midden near fresh water close to sea.*
5	S34 10 51.0 E24 40 28.7	*Midden on top of hill under bush. Near fresh water.*
6	S34 10 55.8 E24 40 46.4	*Thin scatter with large quartzite cobbles and shell.*
7	S34 10 57.3 E24 40 50.1	*Large midden next to road. Shell and quartzite chunks.*
8	S34 10 57.9 E24 40 51.8	*Thin scatter of limpet and quartzite flakes.*
9.1	S34 11 07.4 E24 41 12.1	*Midden on the side of the road, 1m thick with flaked quartzite cobbles in possible hearth-like feature. Possible human bone.*
9.2	S34 11 07.8 E24 41 12.8	*Eastern concentration of this midden with lots of flaked quartzite.*
10	S34 11 07.8 E24 41 13.3	*Midden on top of first dune ridge.*
11	S34 11 09.5 E24 41 17.3	*Midden on the side of the road, obscured by bush and very fragmentary. Near fresh water.*
12	S34 11 09.4 E24 41 19.5	*Across road: very thin scatter of shell.*
13.1	S34 11 10.1 E24 41 18.8	*Very fragmented shell next to road, near fresh water.*
13.2	S34 11 09.6 E24 41 21.6	*Same midden in road cutting.*
13.3	S3411 09.6 E2441 22.7	*Midden still visible in road cutting.*
14	S3411 11.1 E24 41 22.8	*Buried midden deposit turned up by borehole drilling.*
15.1	S34 11 10.2 E24 41 29.0	*Large cobbles and flakes on dark quartzite. Usual shell with burnapena and many periwinkles.*
15.2	S34 11 10.3 E24 41 30.3	*Same midden further along the road, where it thins out.*
16	S34 11 10.8 E24 41 32.3	*Large mound 1-2m thick. Under bush with shell and many flaked quartzite cobbles.*
17	S34 11 11.4 E24 41 37.0	*Large mound with very large cores and flakes on dark grey quarzite. Usual shell species.*
18	S34 11 10.3 E24 41 41.8	*Very large, prominent mound 300m from sea and 2-3m thick. Usual shells with numerous periwinkles. Lots of quartzite flakes and some silcrete. Worth sampling.*
19	S34 11 10.7 E24 41 44.4	*Large midden close to sea 2-3m thick. Usual shell with nothing predominating. Flaked quartzite cobbles and flakes with silcrete. One long quartzite flake and flaked kabeljou stone tools.*
20	S34 11 32.4 E24 42 45.9	*Large deflated midden close to sea, usual shells. Totally overgrown, only edges visible.*
21	S34 11 31.7 E24 42 44.3	*Continuous midden along slope. Fragments of shell visible between bushes.*
22	S34 11 31.1 E24 42 42.7	*Continuation of midden, large quartzite cobbles.*

23.1	S34 11 29.0 E24 42 34.3	*Fragments of shell on slope, not very dense but extensive.*
23.2	S34 11 28.9 E24 42 33.1	*Continuous to this point.*
23.3	S34 11 27.8 E24 42 31.7	*Still visible at borehole T89, very light here.*
24	S34 11 25.5 E24 42 33.2	*Fragments of shell covered by vegetation, quartzite flakes also present.*
25	S34 11 25.7 E24 42 31.6	*Buried deposit turned up in mole heap.*
26	S34 11 23.2 E24 42 18.0	*Shell scatter with quartzite flakes under thick bush.*
27	S34 10 32.5 E24 41 24.8	*Marginal site in dune belt. Shell, bone and teeth, flaked quartzite, fossilized coprolite.*
28	S34 10 31.5 E24 41 23.1	*Three quartzite flakes, bone and shell.*
29.1	S34 10 30.8 E24 41 22.7	*Scatter of shell and large quartzite flake situated around a small koppie*
29.2	S34 10 30.3 E24 41 20.4	*Towards west of scatter, high density of stone. Cores and flakes suggest knapping floor with possibility for refits.*
30	S34 10 28.5 E24 41 20.5	*Bone site with bone scattered down dune slope. Possibly not archaeological - no artefacts.*
31	S34 10 17.9 E24 41 45.2	*Bone and shell with some quartzite flakes deflated onto grey humic surface next to fresh water pool.*
32	S34 10 19.0 E24 41 51.6	*Shell, bone deflated onto grey surface.*
33	S34 10 24.0 E24 41 55.3	*Fossilized bone, red quartzite flakes and Turbo.*
34	S34 10 15.6 E24 42 10.2	*Donax shells, finegrained potsherds with red slip, two flattened, slightly everted rimsherds.*
34	S34 10 14.4 E24 42 14.1	*Donax midden 10cm thick on grey humic floor. Some other shell present. One quartzite flake. Worth sampling.*
36	S34 10 14.1 E24 42 20.8	*Plentiful shell including brown mussel with numerous quartzite flakes also on the red quartzite. Large fossilized bone on calcrete surface.*
37	S34 10 24.2 E24 42 14.5	*Small slight scatter of shell in dune.*
38	S34 09 06.2 E24 42 27.6	*Ruined house on panhandle. Solder house with C19th beams, muurkas and sash windows.*
39	S34 11 00.8 E24 40 53.4	*South of large midden, near fresh water. Shell, flaked quartzite and bone.*
40.1	S34 10 59.7 E24 40 55.8	*Large midden is exposed in road at this point.*
40.2	S34 10 58.7 E24 40 58.0	*Visible eastern extent of midden, beyond here it is too thickly vegetated to be visible.*
40.3	S34 10 59.6 E24 40 58.7	*PERIMETER OF MIDDEN*
40.4	S34 11 00.6 E24 40 58.2	*PERIMETER OF MIDDEN*
40.5	S34 11 00.9 E24 40 56.7	*PERIMETER OF MIDDEN*
40.6	S34 11 02.1 E24 40 55.0	*PERIMETER OF MIDDEN*
40.7	S34 11 01.7 E24 40 53.7	*PERIMETER OF MIDDEN*
40.8	S34 11 00.7 E24 40 53.5	*PERIMETER OF MIDDEN*
40.9	S34 11 00.6 E24 40 50.5	*PERIMETER OF MIDDEN*

40.11	S34 10 58.8 E24 40 48.6	*PERIMETER OF MIDDEN*
40.12	S34 10 56.6 E24 40 48.2	*PERIMETER OF MIDDEN*
40.13	S34 10 56.7 E24 40 50.9	*PERIMETER OF MIDDEN*
40.14	S34 10 57.9 E24 40 52.1	*PERIMETER OF MIDDEN*
40.15	S34 10 58.4 E24 40 55.6	*PERIMETER OF MIDDEN*
41.1	S34 10 53.8 E24 40 36.8	*Highest point of high mound. Megamidden near freshwater.*
41.2	S34 10 54.0 E24 40 39.0	*PERIMETER OF MIDDEN*
41.3	S34 10 55.5 E24 40 39.9	*PERIMETER OF MIDDEN*
41.4	S34 10 55.8 E24 40 39.2	*PERIMETER OF MIDDEN*
41.5	S34 10 55.1 E24 40 37.1	*PERIMETER OF MIDDEN*
41.6	S34 10 54.6 E24 40 35.8	*PERIMETER OF MIDDEN*
41.7	S34 10 55.2 E24 40 34.2	*PERIMETER OF MIDDEN*
41.8	S34 10 52.8 E24 40 33.4	*PERIMETER OF MIDDEN*
41.9	S34 10 52.7 E24 40 36.8	*PERIMETER OF MIDDEN*
41.11	S34 10 53.5 E24 40 38.8	*Top of fresh water gully near Megamidden.*
41.12	S34 10 52.0 E24 40 33.4	*PERIMETER OF MIDDEN*
42	S34 10 46.5 E24 40 35.5	*Deposit turned up in borehole drilling upcast. Proves existence of buried deposit.*
43	S34 10 48.3 E24 40 39.5	*Light scatter of shell, possibly washed off crest of hill which has no deposit and is calcrete.*
44	S34 10 54.1 E24 40 47.4	*Haliotis shells on calcrete surface.*
45	S34 10 55.2 E24 40 47.8	*Small midden with shell on seaward slope of second dune ridge.*
46	S34 10 57.3 E24 40 48.7	*Concentration of shell within 164-178 including burnapena and chipped quartzite.*
47	S34 11 07.8 E24 41 11.5	*Small mound with scattering of shell, largely limpets.*
48.1	S34 11 07.2 E24 41 16.7	*Light scatter of shell and some flaked quartzite.*
48.2	S34 11 07.6 E24 41 18.1	*NORTHERN PERIMETER*
48.3	S34 11 07.1 E24 41 19.0	*NORTHERN PERIMETER*
48.4	S34 11 07.5 E24 41 21.7	*NORTHERN PERIMETER*
48.5	S34 11 09.5 E24 41 23.2	*Southeastern point north of road.*
49.1	S34 11 10.6 E24 41 24.2	*South of road, concentration of shell forms small mound with limpets, quartzite flakes and hammerstones, silcrete, and pottery. Worth sampling*
49.2	S34 11 11.5 E24 41 24.2	*PERIMETER OF 201*

49.3	S34 11 11.3 E24 41 22.2	*PERIMETER OF 201*
49.4	S34 11 10.3 E24 41 21.8	*PERIMETER OF 201*
48.5	S34 11 09.6 E24 41 22.4	*PERIMETER OF 201*
49.6	S34 11 10.3 E24 41 25.4	*PERIMETER OF 201*
49.7	S34 11 11.0 E24 41 26.0	*PERIMETER OF 201*
50	S34 11 12.6 E24 41 31.8	*Shell in drill upcast, proving buried deposit.*
51	S34 11 13.6 E24 41 35.0	*Small mound with scattering of shell.*
52	S34 11 12.5 E24 41 35.8	*Buried midden cut through by road at 400-500mm deep.*
53	S34 11 15.8 E24 41 38.4	*Light scattering of shell in drill upcast including flaked quartzite.*
54	S34 11 17.9 E24 41 44.0	*Very thin scatter of shell.*
55	S34 11 18.4 E24 41 48.5	*Shell and manuport in upcast of drilling. Near fresh water.*
56	S34 11 17.8 E24 41 49.2	*Deposit cut through by road.*
57	S34 11 19.5 E24 41 54.8	*Deposit in drilling upcast.*
58	S34 11 20.9 E24 41 53.4	*Possible hearthlike structure evident in road cutting: lots of broken quartzite chunks in distinct layer 200m below surface on charcoal rich layer. Spills across road with more stone visible, including more small, flaked pieces. Worth sampling.*
59	S34 11 22.1 E24 41 54.5	*Very dense, buried lense eroding from dune : 200mm thick, 500mm deep.*
60	S34 11 24.2 E24 42 00.9	*Midpoint between two fishtraps.*
61	S34 11 22.6 E24 42 02.7	*FISHTRAPS*
62	S34 11 21.9 E24 42 05.7	*FISHTRAPS*
63	S34 11 02.5 E24 42 08.5	*Between dunes 1 and 2. Fragments of pot, some conjoining. One quartzite core, some periwinkle shell. Cartridge cases evidence of modern hunting*
64	S34 11 20.7 E24 42 19.4	*Midden cut by road. Shell as well as manuports and flaked quartzite.*
65	S34 11 18.3 E24 42 03.7	*Trace of shell cut through by path.*
66	S34 11 17.7 E24 42 03.7	*Trace of shell cut through by path.*
67	S34 11 16.5 E24 42 08.9	*Quite sparse but deeply buried layer of shell cut through by road.*
68	S34 11 17.6 E24 42 13.1	*Scatter of shell in road, very fragmentary.*
69	S34 11 18.9 E24 42 16.3	*Quite dense midden cut through by road including some burnt shell. Extends on both sides of the road.*
70	S34 11 23.5 E24 42 25.4	*Scatter of shell on south side of road.*
71	S34 11 25.0 E24 42 23.6	*Slight scatter along road in fore dune.*
72	S34 10 23.8 E24 45 08.8	*Midden in road on estate 3-4kms from sea. Quite dense scatter including retouched silcrete.*
73	S34 11 30.6 E24	*Midden cut by road.*

	42 46.2	
74	S34 11 30.3 E24 42 45.4	*Continuation of midden with more dense occurrence of quartzite: flakes, hammerstones and cores.*
75	S34 11 30.7 E24 42 42.5	*Upcast in drilling, showing deposit is buried at the crest.*
76	S34 11 29.6 E24 42 38.8	*Slight scatter of shell, probably eroding out of mound to the north.*
77	S34 11 28.7 E24 42 36.8	*Light scatter of shell on crest of fore dune.*
78	S34 11 28.3 E24 42 36.9	*Point where light scatter is cut by road. More stone flakes as well as silcrete flake.*
79	S34 11 27.3 E24 42 34.0	*Dense midden cut throught by road. Slightly buried and 200mm thick.*
80	S34 11 28.2 E24 42 32.9	*Part of ribbon of midden on fore dune.*
81.1	S34 11 26.2 E24 42 25.8	*Sparse midden deposits of south slope of foredune, quite crushed.*
81.2	S34 11 24.2 E24 42 21.3	*Continuation of midden on fore dune.*
82	S34 11 20.0 E24 42 34.8	*On crest of second big dune ridge. Very light scattering possibly indicating buried deposit.*
83	S34 11 20.6 E24 42 31.9	*Very ephemeral traces of same midden.*
84	S34 11 22.7 E24 42 00.5	*FISHTRAPS*
85	S34 11 22.4 E24 42 01.6	*FISHTRAPS*
86	S34 11 22.4 E24 42 02.6	*FISHTRAPS*
87	S34 11 22.2 E24 42 01.9	*FISHTRAPS*
88	S34 11 19.7 E24 42 19.6	*Buried deposit visible in upcast from drilling.*
89	S34 11 13.6 E24 42 04.4	*Very ephemeral deposit, possibly indicating buried midden. Far from seashore.*
90	S34 11 10.5 E24 42 00.9	*Ephemeral deposit, possibly indicating buried midden.*
91	S34 11 09.8 E24 41 31.9	*Substantial amount of deposit in drill upcast.*
92	S34 11 02.0 E24 43 09.8	*Possible site in low area between dunes, could be shingle.*
93.1	S34 11 01.3 E24 43 53.5	*Midden on second dune ridge with good deposit. Seaward slope obscured by heavy bush, but big site over large area.*
93.2	S34 11 01.7 E24 43 56.5	*Continuation of midden on an adjacent hillock.*
94	S34 11 01.4 E24 43 57.9	*Midden cut through by road. Distinct lense above buried soil horizon 1m below present dune surface. Usual shells and flaked stone.*
95	S34 11 00.4 E24 43 59.9	*Very fragmented deposit cut through by road.*
96	S34 11 00.3 E24 43 59.0	*Small quantity of crushed shell cut through by road.*
97	S34 11 00.3 E24 43 55.9	*Good quantity of shell with usual species as well as flaked quartzite, possibly same deposit as above.*
98	S34 11 02.1 E24 43 56.5	*Midden cut through by road south of 255. Well buried by sand and bush and resting on buried soil horizon.*
99	S34 10 28.4 E24 41 23.1	*Scatter of flaked quartzite eroding on north side of dune.*
100	S34 10 23.3 E24 41 53.3	*Two hammerstones and two cores at base of dunes, possibly deflated.*

101	S34 10 23.6 E24 41 59.3	*Chipped and broken quartzite pieces eroding out of north slope of dune, possibly heat affected.*
102	S34 10 19.6 E24 42 17.1	*Scatter of limpet and donax near fresh water pan between dunes. Quite dense, but fairly crushed.*
103	S34 10 20.1 E24 42 17.8	*Concentration of shell in lense 150-200mm thick. Here, though not at 007, are also rolled pebbles, quartzite cores and chunks and a possible grindstone.*
104.1	S34 10 17.3 E24 42 23.9	*Numerous shells near freshwater pan.* *Possibly deflated onto partly fossilized surface. Massive potsherd and possible hearthlike structure.* *Evidence for spatial patterning with an apparent periwinkle processing site and localised concentrations of Perna perna.* *Worth sampling.*
104.2	S34 10 17.3 E24 42 23.9	*PERIMETER*
104.3	S34 10 16.7 E24 42 24.7	*PERIMETER*
104.4	S34 10 16.0 E24 42 24.3	*PERIMETER*
104.5	S34 10 15.5 E24 42 23.2	*PERIMETER*
104.6	S34 10 15.1 E24 42 24.2	*PERIMETER*
104.7	S34 10 15.8 E24 42 25.5	*PERIMETER*
104.8	S34 10 17.4 E24 42 27.2	*PERIMETER*
104.9	S34 10 17.6 E24 42 26.4	*PERIMETER*
104.11	S34 10 17.4 E24 42 25.6	*PERIMETER*
105.1	S34 10 17.4 E24 42 23.7	*Lens exposed in slope of dune. Possibly extension of complex.*
105.2	S34 10 19.2 E24 42 30.5	*Lens peters out here.*
106	S34 10 20.4 E24 42 37.9	*Light scatter of mostly limpet eroding out of sandbank sloping away from fresh water source.*
RA001	S34 09 58.4 E24 47 52.4	*Shell midden (LSA) on dune ridge.*
RA002	S34 10 19.5 E24 45 56.1	*Light shell scatter on edge of dune indicating possible buried lens in dune body.*
RA003	S34 10 23.9 E24 45 08.3	*Dense midden in track.*
RA004	S34 10 34.2 E24 44 49.8	*Midden with pottery in track.*
RA005	S34 10 29.2 E24 45 02.7	*Large dense midden in track and on dune top.*
RA005B	S34 10 30.9 E24 45 02.7	*Large dense midden exposed in track.*
RA006	S34 11 08.5 E24 44 23.9	*Large stone rich midden in track.*
RA006B	S34 11 10.0 E24 44 23.9	*Large stone rich midden in track.*
RA007	S34 11 13.0 E24 44 33.1	*Midden.*
RA008	S34 11 14.4 E24 44 34.0	*Midden.*
RA009	S34 10 42.6 E24 40 12.8	*Light scatter close to water seep.*

RA010	S34 10 49.9 E24 48 07.3	*Defineable midden in track.*
RA011	S34 10 42.6 E24 40 12.8	*Midden.*
RA012	S34 11 28.3 E24 42 36.9	*Midden.*
RA013	S34 11 27.2 E24 42 33.7	*Midden.*
RA014	S34 11 23.3 E24 42 17.7	*Midden.*
RA015	S34 11 25.5 E24 42 29.0	*Midden.*
RA016	S34 11 25.9 E24 42 30.4	*Midden.*
RA017	S34 11 28.6 E24 42 40.6	*Midden.*
RA018	S34 11 21.4 E24 42 45.4	*Midden.*
RA019	S34 11 17.1 E24 42 47.5	*Midden.*
RA020	S34 11 15.8 E24 42 48.7	*Midden.*
RA021	S34 11 12.3 E24 42 57.8	*Midden.*
RA022	S34 11 10.2 E24 43 03.8	*Midden.*
RA023	S34 10 59.3 E24 44 01.7	*Midden.*
RA024	S34 10 45.7 E24 44 15.0	*Midden.*
RA025	S34 10 33.9 E24 45 02.3	*Midden.*
RA026	S34 10 34.0 E24 44 47.8	*Midden.*

APPENDIX 2

PALAEONTOLOGICAL DESKTOP STUDY FOR BANTAMSKLIP (W. CAPE) AND THYSPUNT (E. CAPE) REACTOR SITES

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1. SUMMARY

The overall palaeontological sensitivity of both the Bantamsklip and Thyspunt Nuclear power station sites is only moderate to low, certainly compared with the Koeberg option, and there are no serious palaeontological grounds for choosing between them. The bedrock platforms beneath these two south coast sites are built of Table Mountain Group sediments of Early Palaeozoic age. These are moderately to highly deformed and unlikely to yield well-preserved fossil material; at most, sparse trace fossil assemblages are expected. A thin cover of Late Caenozoic / Neogene coastal sediments belonging to the Bredasdorp Group (Bantamsklip) or Algoa Group (Thyspunt) is also present. The palaeontological sensitivity of these younger sediments ranges from low to high. The Neogene units are poorly- to well-consolidated and mainly consist of sparsely fossiliferous aeolianites (wind-blown sands) of Quaternary age (<1.8 Ma), with occasional subsurface calcrete horizons. A limited range of terrestrial fossils, such as snail shells, rare vertebrate bones, teeth (perhaps associated with hyaena dens) and even trackways, as well as organic-rich peats or mudrocks might be encountered subsurface within these aeolianites, especially along palaeosol horizons. Thin pebbly layers directly overlying the Palaeozoic bedrock and buried beneath the aeolianites probably represent shallow marine to estuarine units of Mid to Late Pleistocene (and even Mid Holocene) age, such as the Klein Brak Formation (Bantamsklip) and Salnova Formation (Thyspunt). These last units are often characterised by a rich fossil fauna of shelly invertebrates ("Swartkops Fauna") that is of considerable palaeontological and palaeoenvironmental interest. In all cases, regular monitoring of all substantial excavations into Caenozoic coastal sediments by a qualified palaeontologist, with ample opportunity to sample fossiliferous units and record relevant sedimentological data, is strongly recommended. Possible impacts on older palaeontologically sensitive horizons present subsurface beyond the immediate reactor footprints will have to be assessed in more detail if one or other of these sites is finally chosen for a nuclear power plant.

Sensitive units within the Site Vicinity (40 km radius) include the Cederberg Formation (Late Ordovician invertebrates and fish), Baviaanskloof Formation (Early Devonian

invertebrates, trace fossils and possible primitive vascular plants) as well as the De Hoopvlei and Alexandria Formations (Miocene / Pliocene marine invertebrates, possible vertebrates).

2. INTRODUCTION

A brief desktop study of palaeontological heritage beneath the proposed Nuclear 1 reactor sites at Bantamsklip (Western Cape) and Thyspunt (Eastern Cape) is undertaken here, largely based on unpublished geological reports commissioned by Eskom, geological maps and sheet explanations published by the Council for Geoscience, Pretoria, as well as the extensive palaeontological literature. Excavations for the proposed Nuclear 1 reactor(s) would cut back the entire Caenozoic cover down to the underlying bedrock. Only the immediate footprint (Site Location, ie. ≤ 1km radius) of the two reactor sites has been considered in detail at this stage. However, brief reference is also made to highly fossiliferous formations within the broader region (Site Area, ie. 8km radius, or Site Vicinity ie. 40km radius) that may well be affected by peripheral development. More comprehensive reviews of regional palaeontological heritage will be necessary once the site or sites for new nuclear reactors are finally chosen and the entire development footprint is defined.

3. BANTAMSKLIP

The geological setting for the Bantamsklip Nuclear 1 site on the coast southeast of Gansbaai is summarised in the geological report by De Beer (2007a). This report includes a recently compiled 1: 50 000 scale geological map. The broader geological context is shown on the published 1: 250 000 Worcester sheet and outlined in the accompanying sheet explanation (Gresse & Theron 1992).

The site is located on top of a wave-cut platform incised into tough quartzitic bedrock of the Peninsula Formation (lower Table Mountain Group). Apart from at the rocky coastline itself, where a modern gravel and boulder beach as well as coarse beach sands are found, the platform is mantled with a thin (11m or less) veneer of less well consolidated late Caenozoic sediments of the Bredasdorp Group. Logs of borehole cores through the Caenozoic cover beneath the site location are given in a report on the subsurface geology by De Beer (2001). The site has been cored more recently (C. De Beer, P. Siegfried, pers. comm. 2008) but borehole logs were not available at the time of writing.

3.1. TABLE MOUNTAIN GROUP

3.1.1. Peninsula Formation

Continuous, gullied rocky outcrops of Peninsula Formation, dipping at 18º to 30º, are seen at the coast at Bantamsklip and extend at shallow depths as a buried wave-cut platform around 0 to 4m amsl underneath the entire site location. The Peninsula succession is dominated by quartzites (ie. well-cemented sandstones) and less well-cemented quartzitic sandstones, but there are also thin mudrock horizons which, being more susceptible to weathering and erosion, are generally poorly exposed, even at the coast.

The Peninsula Formation is a predominantly fluvial succession of Early to Late Ordovician age with minor shallow marine to estuarine intercalations (Broquet 1992, Hiller 1992, Thamm & Johnson 2006). Age-diagnostic organic-walled microfossils (e.g. acritarchs) are likely to occur in finer mudrocks within the marine-influenced, heterolithic parts of the succession, but these fossils have yet to be successfully isolated. Body fossils are unknown from this formation, although impressions of rounded mudflakes have occasionally been misinterpreted as moulds of shells. So far only a modest range of trace fossils have been recorded from the Peninsula Formation, mostly in association with heterolithic subunits that are attributed to shallow marine or estuarine settings. They include Ordovician forms of the trilobite burrow Cruziana (Rugosa Group) recorded, for example, from Bettys Bay (Potgieter & Oelofsen 1983), arthropod trackways attributed to trilobites and water scorpions (eurypterids), complex annulated "worm burrows" of the ichnogenus Arthrophycus, a small range of horizontal burrows (Palaeophycus etc), Skolithos-dominated "pipe rock", and the large (up to 25cm wide) cyclindrical burrow Metaichna (See review in Almond 2008).

The palaeontological sensitivity of the Peninsula Formation as a whole is considered to be low. According to De Beer (2001, 2007b) the Peninsula Formation bedrock at Bantamsklip shows high levels of deformation (shearing, brecciation, quartz veining, extensive jointing). The Palaeozoic bedrock here is therefore unlikely to yield palaeontologically significant trace fossils or other palaeontological material.

3.2. BREDASDORP GROUP

The Caenozoic cover at Bantamsklip varies from 3m (to the SE) to 11m (to the NE) in depth, with an average thickness of 5-9m (De Beer 2001). Preliminary borehole investigations within the reactor site location, all within 300m of the modern coastline, show that these superficial deposits mainly consist of unconsolidated to semi-consolidated aeolian sands underlain by thin, laterally impersistent horizons of calcretised sands and marine gravels. Note that the various sedimentary units recognised in these earlier borehole cores were defined lithologically and were not assigned to recognised formations of the Bredasdorp Group. In the absence of age-diagnostic data, such as fossils, the lithostratigraphic correlations proposed below for these subsurface units are necessarily tentative.

Comprehensive reviews of the Bredasdorp Group succession, including palaeontology of the various formations, are given by Malan (1986, 1989, 1990), Malan and Viljoen (1990), Maud and Botha (2000) as well as Roberts *et al.* (2006). Recent dating information is given in the unpublished report for Eskom by Roberts (2006). Detailed lithostratigraphic, palaeoenvironmental and palaeontological discussions for each formation are provided in the Lithostratigraphic Series publications published by the South African Committee for Stratigraphy (SACS; e.g. Malan 1989b, c, 1991a,b).

3.2.1. Pre-Pleistocene units

Pre-Pleistocene sediments of the Bredasdorp Group do not appear to be present at the Bantamsklip site location. This situation is to be expected for a site overlying such a low-elevation (2-4m amsl), rocky coastal platform, since older Neogene units were generally completely scoured off during transgressive events of later, Quaternary age. Note, however, that within the wider development footprint of the reactor site (Site Vicinity) fossiliferous sediments of the Late Miocene / Early Pliocene De Hoopvlei Formation are likely to be encountered subsurface at elevations over 18m amsl (above mean sea level). The fossil biota of this nearshore marine / estuarine unit has been reviewed by Spies *et al.* (1963) and Malan (1991b) and mainly comprises bivalve and gastropod molluscs, flat-shelled irregular sea urchins (Echinodiscus) and a range of foraminiferan microfossils. Terrestrial and aquatic vertebrate remains may well also occur here. Although they have not been widely recorded so far from Neogene sediments along the south coast, important vertebrate fossils are known from contemporary units of comparable facies along the west coast (e.g. Hendey 1984, Pether *et al.* 2000, Roberts *et al.* 2006). Late Pliocene / Early Pleistocene dune sands of the Wankoe Formation overlying the 18m amsl coastal erosion surface, including the De Hoopvlei deposits, contain sporadic fossil shells of terrestrial gastropods (snails) such as Dorcasia, Tropidophora and Achatina (Malan 1989b).

3.2.2. Klein Brak Formation

This heterogeneous subunit of the Bredasdorp succession comprises a range of shallow marine, beach, estuarine and lagoonal deposits, both cemented and uncemented, that are related to a number of successive Pleistocene transgressions. These include the MIS 11 as well as the MIS5e (Eemian Interglacial) packages of c. 400 000 and c.120 000 BP that overlie wave-cut platforms along the south coast at elevations below 18m amsl (Malan, 1991a, Roberts 2006).

Thin gravel horizons overlying Peninsula Formation bedrock and mantled by unconsolidated sands (but apparently in no case by heavily calcretised sands) were intersected by boreholes at Bantamsklip at elevations of –3m to +2m with respect to modern sea levels (De Beer 2001). The gravels are variable in thickness and elevation, reflecting irregular bedrock topography such as buried gullies. They average less than 1m in thickness but reach up to 2.4m closer to the coastline in the southern part of the site. The level of cementation and shell content of the gravels are not recorded in the available borehole logs. These buried gravels are provisionally interpreted here as erosional relicts of the Klein Brak Formation, although at such low elevations, at least close to the modern shoreline, they might also (if only in part) date from the Mid Holocene sea level high (See Section 3.2.5. below).

In the NE corner of the Bantamsklip site a 2.2m thick layer of clay directly overlying Peninsula Formation bedrock was intersected by a single borehole (BK5, 300-400m from the present coastline). The clay underlies calcretised aeolianites (unlike the gravels described above) and is tentatively interpreted as a back-barrier lagoon or coastal lake deposit referable to a Late Pleistocene age marine highstand (ie. part of the Klein Brak Formation).

The Klein Brak Formation is often highly fossiliferous, being characterised by the predominantly estuarine to shallow marine "Swartkops Fauna" of Pleistocene age (Martin 1962, Barnard 1962, Davies 1972, Kilburn & Tankard 1975, Malan 1991, Le Roux 1990a, 1993, Viljoen & Malan 1993). Excellent fossiliferous exposures are found in the Mossel Bay area and good coastal outcrops are also seen north of Gansbaai closer to Bantamsklip. Rich Klein Brak shelly assemblages are dominated by a variety of gastropods and bivalves. Among these is the spectacularly large (30cm) bivalve Panopea glycimeris that suggests warmer Pleistocene sea temperatures than recorded at present along the south coast (Tankard 1975, Pether 1987, 1988). Trace fossils include pelleted-walled burrows of the ichnogenus Ophiomorpha (Malan et al. 1994). Fossil plants, including wood and pollens of Fynbos Biome angiosperms (e.g. Stoebe, Polygala, Anthospermum) are also known from the Klein Brak succession (Malan 1991, Malan *et al.* 1994). The thin clay horizon detected c. 9m subsurface in the northeast portion of the Bantamsklip site may well contain well-preserved plant material (including palynomorphs) as well as non-marine molluscs, and perhaps even freshwater vertebrate remains.

3.2.3. Waenhuiskrans Formation

Small, scattered surface exposures of consolidated coastal aeolianites up to 1.5m thick at Bantamsklip are well-cemented on top but poorly cemented below (De Beer 2001). Partially- to well-calcretised sands with thin calcrete layers, lying beneath unconsolidated sands and immediately above Peninsula Formation bedrock, were intersected by boreholes at elevations of 4 to 7m amsl. They are thickest (up to 4m) in the northern portion of the site area and occur widely at elevations below 7m amsl along this stretch of coastline, overlying an erosional surface of probable Late Pleistocene

(Eemian) age. These calcrete-rich, semi- to well-consolidated aeolianites are provisionally assigned here to the Late Pleistocene Waenhuiskrans Formation (cf De Beer 2007a, p.12 who refers to Wankoe Formation aeolianites at Bantamsklip). Similar semi-consolidated aeolianites mantling almost the entire width of the coastal plain here are mapped as Waenhuiskrans Formation on the 1: 250 000 Worcester sheet (also on recent 1: 50 000 geology map given in De Beer 2007), though relicts of Wankoe dune sands might well be preserved below surface at higher elevations (above 18m amsl) inland.

The Waenhuiskrans Formation has so far only yielded a sparse range of body fossils. These are mostly terrestrial gastropods of the genera Achatina, Dorcasia, Tropidophora, Trigonephrus and Ferissia – all snails except for the last, which is an extant brackish-water slug (Malan 1989c, Roberts *et al.* 2008). Allochthonous marine fossils include wind-blown foraminiferans and sand-worn shell fragments. Fascinating assemblages of Late Pleistocene last interglacial vertebrate trackways, ascribed to African elephants, antelopes, equids, carnivores and tortoises, as well as rhizoliths (plant root traces, cf Klappa 1980) and calcretised termitaria, have recently been recorded from well-dated (MIS 5e to 5b) Waenhuiskrans aeolianites at Still Bay by Roberts (2003) and Roberts *et al.* (2008).

Comparable consolidated Late Pleistocene aeolianites of the Sandveld Group (Langebaan Formation) on the SW Cape coast have yielded a wide range of terrestrial vertebrate fossils, especially mammals, from pre-historic hyaena dens (NB the dens and associated fossils are much younger than the aeolianites themselves). The most famous site is at Swartklip on the False Bay coast, but sparse vertebrate remains have also been recorded from consolidated dunes further east (e.g. Spies *et al.* 1963). At Swartklip the Florisian mammal fauna from the last "glacial " (c. 110 000 BP) includes bones and teeth of a wide range of carnivores such as lion, leopard, brown hyaena and black-backed jackal as well as herbivores such as extinct giant long-horned buffalo, hippo, white rhino, zebras and various antelope. Hyaena coprolites and ostrich remains also occur (Singer & Fuller 1962, Hendey & Hendey 1968, Klein 1975, 1980, 1983, 1984, 1986). Modern human footprints dated to 117 000 BP (late MIS 5e) are recorded from Langebaan Formation aeolianites on the West Coast (Roberts & Berger 1997, Pether *et al.* 2000).

Given the similar depositional setting, a wide range of terrestrial body fossils, such as listed for the Langebaan Formation above and for Holocene aeolianites below, may also be present if searched for in the Waenhuiskrans succession. However, the overall palaeontological sensitivity of this unit can be provisionally rated as low.

3.2.4. Strandveld Formation

Inside the modern gravel and boulder beach at Bantamsklip the site is mantled with unconsolidated sands which grade inland into stabilised, partly vegetated dunes of the Holocene Strandveld Formation. An active dune field with barchanoid dunes up to 30m high is present to the north (Pearly Beach Nature Reserve) and east of the site (De Beer 2001).

Unconsolidated superficial sands in borehole cores at Bantamsklip attain a maximum thickness towards the interior of 11m. The sands are fine, with a coarser component of comminuted (finely ground) shell material and minor silt. They are provisionally assigned to the aeolian Strandveld Formation but relicts of older, Pleistocene dunes (Waenhuiskrans Formation, discussed above) may also be represented within this unit. The interface between these two similar aeolian sand successions may be hard to detect, although it is often marked by a pronounced pedogenic horizon (Roberts *et al.* 2008).

An authoritative and useful review of the palaeontological potential of Quaternary coastal sands is provided by Pether (2007b) and appended with this report. Categories of potentially valuable fossils mentioned by Pether (ibid.) that may be preserved in, and recovered from, these sands include:

rare fossil bones, teeth and other remains of mammals (eg rhino, elephant, bovids, moles), reptiles (eg tortoises, lizards), and ostriches (eg egg shells);
terrestrial gastropods;
plant remains such as charcoal, decayed plant roots;
calcareous and siliceous microfossils (foraminiferans, ostracods, diatoms);
organic-walled microfossils (pollen, spores) from mudrocks deposited in interdune ponds and vleis, which may also contain fossil frogs, fish, aquatic snails and plant macrofossils (reeds, leaves, seeds, roots etc), and
trace fossils (eg mole and arthropod burrows, vertebrate tracks).

3.2.5. Mid Holocene Sea Level High marine deposits

Marine gravels and cobble-beds with a thin covering of shelly marine or aeolian sand, in part grass-covered, are situated between the modern beach and stabilised dunes (De Beer 2001). Some of these nearshore deposits are probably attributable to the Mid Holocene sea level highstand that reached up to 2-3m amhsl around 3-4000 BP (Miller *et al.*, 1993, Roberts 2006). These Mid Holocene beds, which in some cases may have been cast high onto the beach during major storms, contain subfossil shells of potential interest for palaeoenvironmental reconstructions (eg for palaeotemperature, palaeosalinity and archaeological studies). Examples of such deposits further east along the South Coast that have been dated to the Mid Holocene to Recent are assigned by Roberts (2006) to local equivalents of the Klein Brak Formation (ie the Salnova Formation of the Algoa Group). A distinct topographic step in the landscape observed by D. Roberts (pers. comm.) may represent the inner edge of a Mid Holocene raised beach, in which case there would probably be useful palaeontological material at its base (currently mantled with Recent sands).

4. THYSPUNT

The proposed Nuclear 1 reactor site at Thyspunt, on the coast southwest of Humansdorp, is situated on top of a low-lying coastal platform that has been carved by wave action into resistant, quartzite-dominated sediments of the Nardouw Subgroup (upper Table Mountain Group / TMG). The TMG platform surface mostly lies between 4 to 8m amsl, rising to a maximum of 10m amsl, and is mantled with a thin veneer of late Caenozoic coastal sediments of the Algoa Group.

An outline of the geological setting and subsurface geology at Thyspunt is given in several Eskom technical reports by De Beer (2001, 2007) and Goedhart (2007). The site lies on the published 1: 250 000 Port Elizabeth geological sheet (See also sheet explanation by Toerien and Hill 1989). Detailed 1: 50 000 geological maps for the study area have now been compiled but were not available at the time of writing. Borehole cores through the Caenozoic cover are briefly described and discussed by De Beer (2001) and Goedhart (2007). Later borehole core data has since been obtained (De Beer pers. comm.) but were also not available for this report.

4.1. TABLE MOUNTAIN GROUP

The Thyspunt reactor site overlies the WNW-ESE striking contact between the Goudini Formation (in the NE) and Skurweberg Formation (in the SW) of the Nardouw Subgroup, as proven by borehole coring (De Beer 2001). These units were previously known as the Tchando and Kouga Formations respectively, and the older terms appear in some earlier geological reports. The lithostratigraphy and sedimentology of the Nardouw Subgroup are reviewed by Malan and Theron (1989), Broquet (1992), De Beer (2002) and Thamm and Johnson (2006), and the palaeontology of these beds has been reviewed by Almond (2008).

In terms of the wider development footprint (Site Area), it is noted that the Late Ordovician Cederberg Formation of the Table Mountain Group underlies the coastal plain to the east within 2km of the site location. This is a highly sensitive “red flag” unit in palaeontological terms, internationally famous for its unique post-glacial biota of invertebrates and primitive jawless fish showing soft tissue preservation (Almond, 2008 and refs. therein). Peripheral developments associated with the proposed nuclear reactor might well involve excavations into the mudrock-dominated lower Cederberg Formation

(Soom Member), in which case intensive palaeontological mitigation would be necessary.

Recent geological reconnaissance to the NW of Thyspunt has yielded fossil material of possible early vascular plants (Rhyniopsida?) from silty mudrocks of the Early Devonian Baviaanskloof Formation which lies at the top of the Table Mountain Group sequence (Mark Goedhart, pers. comm., 2008). Hitherto the Baviaanskloof Formation has yielded a small faunule of marine shelly invertebrates - predominantly articulate brachiopods (eg Pleurothyrella), with rarer bivalves, homalonotid trilobites, tentaculitids and bryozoans – as well as low diversity ichnoassemblages (eg Rosselia, Palaeophycus, rare Ruzophycus; Almond, 2008).

4.1.1. Goudini Formation (= Tchando Fm.)

At Thyspunt this succession of shallow marine to braided fluvial sediments of Early Silurian age (Malan *et al.* 1989) comprises dark grey quartzitic sandstones with a higher proportion (5-7%) of mudrock interbeds than seen within the younger Skurweberg Formation. The palaeontology of this formation is dealt together with that of the Skurweberg Formation below.

4.1.2. Skurweberg Formation (= Kouga Fm.)

The Skurweberg Formation, which crops out along the modern coast, consists of well-bedded, often massive grey quartzitic sandstones with rare (1%), thin (< 1m) mudrock interbeds (De Beer 2001). These last increase in frequency downwards in the succession towards the base of the formation. Some of the darker, more impure quartzites are intensely bioturbated. The Skurweberg sediments are Silurian in age and were deposited on a braided alluvial flood plain subject to occasional, transient marine incursions (Theron *et al.* 1989, Almond 2008).

Body fossils have not been recorded so far from the Goudini and Skurweberg Formations. However, a small range of shallow marine, estuarine and perhaps even freshwater trace fossils are known from low diversity (often monospecific) ichnoassemblages. These have mainly been recorded from the western outcrop area (western Cape Fold Mountains) and mostly from the more heterolithic (mudrock-rich and marine-influenced) parts of the Nardouw succession. The ichnofossils include rare trilobite scratch burrows (Cruziana) and arthropod tracks, annulated sediment-feeder burrows (Arthrophycus allehganiensis), and commoner sandstone horizons of "pipe rock" that are riddled with the simple vertical tube burrows (Skolithos) of suspension feeding invertebrates (Malan *et al.*, 1989, Theron *et al.*, 1989, Almond 2008). Vertical tube burrows with a petaloid array of horizontal lobes surrounding the aperture (possibly bivalve siphon traces) were reported from Table Mountain sandstone float blocks (well-rounded beach boulders) at St. Francis Bay (Tom Barry, pers. comm.. 2006). However, their precise stratigraphic provenance within the Table Mountain Group has not yet been established. A widespread marker bed of bioturbated siltstone occurs within the upper Goudini Formation in the Bredasdorp area (Malan *et al.* 1989) and may extend further east.

De Beer (2001) describes moderately high levels of deformation (eg ubiquitous jointing) as well as ferruginous weathering down to several meters within Nardouw Subgroup quartzitic rocks at Thyspunt. The mudrocks are strongly foliated, with some slickensides, and locally they are extensively weathered to white kaolinitic clay. These features suggest that well-preserved fossils of any sort are unlikely to be present within the Nardouw succession as a whole. The overall palaeontological sensitivity of these Palaeozoic TMG quartzites is in any case low.

4.2. ALGOA GROUP

The Nardouw platform at Thyspunt is mantled by Neogene coastal sediments of the Algoa Group that vary in depth from 12m in the SE to about 20m in the NW. Twenty-two boreholes, straddling the Goudini / Skurweberg contact in the underlying bedrock, were drilled through these superficial sediments, all situated within 250m of the current shoreline (De Beer 2001). The lithostratigraphic interpretation of the available core data given below is necessarily provisional, but essentially follows the analysis by Goedhart (2007).

The stratigraphy, palaeontology and sedimentology of Late Caenozoic coastal sediments of the Algoa Group along the south-eastern coast of South Africa have been reviewed by Le Roux (1986, 1987a,b, 1989a, 1990a, b. 1993), Maud and Botha (2000), as well as most recently by Roberts *et al.* (2006). New chronostratigraphic data is provided by Roberts (2006).

4.2.1. Pre-Pleistocene units

Since the wave cut platform at Thyspunt lies less than 10m above present sea level (and mostly below 8m amsl), it is unlikely that substantial relicts of pre-Pleistocene sediments of the Algoa Group are preserved below surface close to the modern coastline. It can be expected that these older coastal sediments would have been entirely or largely eroded away during the Mid to Late Pleistocene transgressions (MIS11, MIS5e) that reached up to 9-10m amsl (cf. Roberts 2006).

The shallow marine to estuarine Alexandria Formation does in fact occur widely in the subsurface above 18m amsl in the Oyster Bay – Humansdorp – Cape St. Francis area

(Site Vicinity). However, this is not reflected on published maps at 1: 250 000 scale (Goedhart 2007). A wide range of Miocene-Pliocene marine fossils – mainly molluscs, but also sea urchins (the “sea pansy” Echinodiscus), corals, bryozoans, brachiopods, sharks’ teeth, benthic foraminifera and trace fossils – have been recorded from the Alexandria Formation since the early twentieth century (e.g. Newton 1913, Du Toit 1954, Engelbrecht *et al.* 1962, King 1973, Dingle *et al.* 1983, Le Roux 1987a-c). These richly fossiliferous beds may well be affected by excavations into the interior coastal plain as part of the broader Nuclear 1 development footprint.

Pliocene to Early Pleistocene aeolianites of the Nanaga Formation also occur extensively at elevations above 18m amsl on the coastal plain inland of Thyspunt (see 1: 250 000 Port Elizabeth geological map), where their preservation has been promoted by Pliocene uplift in the Algoa region of some 30m (Roberts 2006). Older dunes up to 50m high amsl occur just 300m from the coast at Thyspunt and may belong to the Nanaga Formation. The sparse palaeontology of the Nanaga Formation is summarised by Le Roux (1992). The fossil biota consists of fragmentary marine shells, foraminifera (cf. McMillan 1990), and a small range of terrestrial snails (e.g. Achatina, Tropidophora, Trigonephrus, Natalina).

4.2.2. Salnova Formation

Occasional thin (1.2-1.6m) pebble beds with clasts up to 5cm and a sandy matrix (degree of cementation not recorded) were intersected by two boreholes at Thyspunt (DP1, PP4) at 2-6m amsl, where they probably infilled gullies in the bedrock directly beneath. These boreholes are situated some 200m inland of the present shoreline. Their low elevation suggests that they may be marine deposits of the last interglacial of Late Pleistocene age (Eemian transgression, MIS 5e) and are consequently assigned here to the Salnova Formation.

The Salnova Formation, which now incorporates marine deposits of several Mid to Late Pleistocene transgressions, is characterised by a rich, shallow marine to estuarine “Swartkops” fossil biota (Le Roux 1990b, 1991, 1993; see also palaeontological references for the co-eval Pleistocene Klein Brak Formation in section 3.2.2. above). Fossil assemblages are dominated by a wide range of molluscs (especially gastropods and bivalves). Compared with the older, Miocene / Pliocene Alexandria Formation of the Algoa Group, crab and sea urchin remains are also typically abundant in the Salnova Formation, while corals, brachiopods (lamp shells) and sharks’ teeth are generally absent (Le Roux 1991). Trace fossils include pellet-walled arthropod burrow systems of the ichnogenus Ophiomorpha and bivalve burrows, among others (ibid.). Vertebrate remains (rare bones, teeth) may also be present but are not well recorded.

Close to the modern shore, such pebbly beds, often admixed with shells, could be attributed to the Mid Holocene sea level highstand when they lie below about 3m amsl (see discussion in 3.2.5. above). Recent, dated cobbly deposits occurring up to 2.5m amsl at Cape St. Francis were attributed by Roberts (2006) to storm waves and were also assigned to the Salnova Formation, whose definition has evidently been broadened to include near-coastal marine deposits of Holocene as well as Pleistocene age.

4.2.3. Nahoon Formation

Up to 16m of semi-consolidated sands overlying Nardouw bedrock are recorded in borehole cores from Thyspunt (De Beer 2001, Goedhart 2007). Directly above the bedrock the sands sometimes contain large shell fragments. Vegetated sand dunes up to 25m high with abundant shelly material are seen in the study area, while older dunes (Nanaga Formation?) reach 50m amsl only 300m from the coast. Since the near-coastal sands at the Thyspunt site location apparently overlie a Late Pleistocene / Eemian wave-cut platform, these aeolianites are provisionally assigned here to the Mid to Late Pleistocene Nahoon Formation. The Nahoon dune sandstones are typically better consolidated than otherwise closely comparable aeolianites of the younger Schelm Hoek or older Nanaga Formations of the Algoa Group (Le Roux 1989b). No calcretes are recorded in the borehole logs, however.

The palaeontology of the Nahoon Formation has been briefly summarised by Le Roux (1989b). As with the broadly co-eval Waenhuiskrans Formation (Section 3.2.3 above), the biota is dominated by terrestrial gastropods that are commonest in palaeosol horizons. Cominuted shell debris, foraminiferans and rhizocretions (plant root casts) are also common (ibid., and McMillan 1990). Near East London mammal and bird trackways, including early human footprints, occur in Nahoon aeolianites dated to 200 000 BP (Mountain 1966, Roberts *et al.* 2006, Roberts in press, 2006). Occasional bone accumulations are attributed to much younger hyaena dens, as at Swartklip (See Section 3.2.3 above). Peat horizons are also recorded (Le Roux 1989b) and should yield useful data on contemporary vegetation and palaeoclimates (cf. Carr *et al.*, 2006).

4.2.4. Schelm Hoek Formation

Thin, calcareous, shelly and largely unconsolidated surface sands at Thyspunt can be assigned to the Holocene Schelm Hoek Formation (cf. Illenberger 1992). These Holocene deposits may be semi-consolidated at depth, and difficult to distinguish from the generally better cemented Nahoon Formation aeolianites. Active dunes are not present in the study area, but E-W striking modern dune fields are present to the north (Qw on 1: 250 000 Port Elizabeth geological map).

The palaeontology of superficial sands along the Cape coast is summarised by Pether (2008) as outlined in Section 3.2.4. above. Illenberger (1992) records fragmentary remains of molluscs, calcareous algae, and sea urchins as well as foraminiferans, terrestrial shales (eg Achatina) and root casts from the Schelm Hoek Formation in particular.

5. RECOMMENDATIONS

Detailed and comprehensive recommendations for palaeontological mitigation of coastal Caenozoic sites such as these have been given in the unpublished heritage reports for Koeberg by John Pether (2008) and Tim Hart (2008), as well as in the information document by Pether (2007a). In the case of Bantamsklip and Thyspunt regular monitoring of all deeper excavations into Caenozoic coastal sediments by a qualified palaeontologist, with ample opportunity to sample fossiliferous units and record relevant sedimentological data, is likewise strongly recommended.

Palaeontological mitigation of Table Mountain Group bedrock is not necessary since the sensitivity of the Table Mountain quartzite-dominated successions is generally low. However, should interesting Palaeozoic fossils be revealed during excavations, these should be sampled by the responsible palaeontologist.

Possible impacts beyond the immediate reactor footprint on older palaeontologically sensitive horizons such as the Cederberg Formation (Late Ordovician invertebrates and fish), Baviaanskloof Formation (Early Devonian invertebrates, trace fossils and possible primitive vascular plants), as well as the De Hoopvlei and Alexandria Formations (Mocene / Pliocene marine invertebrates, possible vertebrates) will have to be assessed in more detail should either site be finally chosen for a nuclear power plant.

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APPENDIX 3

SURVEYOR GENERAL'S OFFICE RESEARCH
Thyspunt and Bantamsklip

Liesbet Schietecatte (ACO)

BANTAMSKLIP

The proposed site "Bantamsklip" for the Nuclear 1 project encompasses the farms Hagelkraal (Farm 318) and Kleyn Hagel Kraal (Farm 321) both in the Bredasdorp district.

The farm Hagelkraal is a consolidation of portions of three farms: Groot Hagelkraal, Groenkloof and Buffel Jagt (Certificate for Amended Title, 24 October 1949, to Johannes Gerhardus Giliomee).

The farm Groot Hagelkraal (Farm 316, diagram 546/1831) was granted to Gideon Johannes Joubert (Daniel's son) in perpetual quitrent on the 6th of June 1831 (Sw. Q. 6-27). Groot Hagelkraal was subdivided in 1917 and Portion 1 was included in the farm Groenkloof (see below). The remainder of the farm was consolidated into the farm Hagelkraal in 1949. From the coastline inland, it is described as down pasture, heathy sandy flats and sour mountain ground. In Portion 1 next to the Cape Road is the position of a hut indicated.

A piece of land (unnamed) (Farm 315, diagram 921/1837) was granted to Johannes François du Toit in perpetual quitrent on 30 November 1837 (Sw. Q. 12-15). It was subdivided in 1917. Portion 1 was included in Groenkloof (see below). Another portion was included into the farm Hagelkraal in 1949. The Hagelkraal River runs through Portion 1; Portion 2 contains a rocky hill with heath and reed, from this hill tributaries run to a river standing in summer. Close to the river runs the road to Elim.

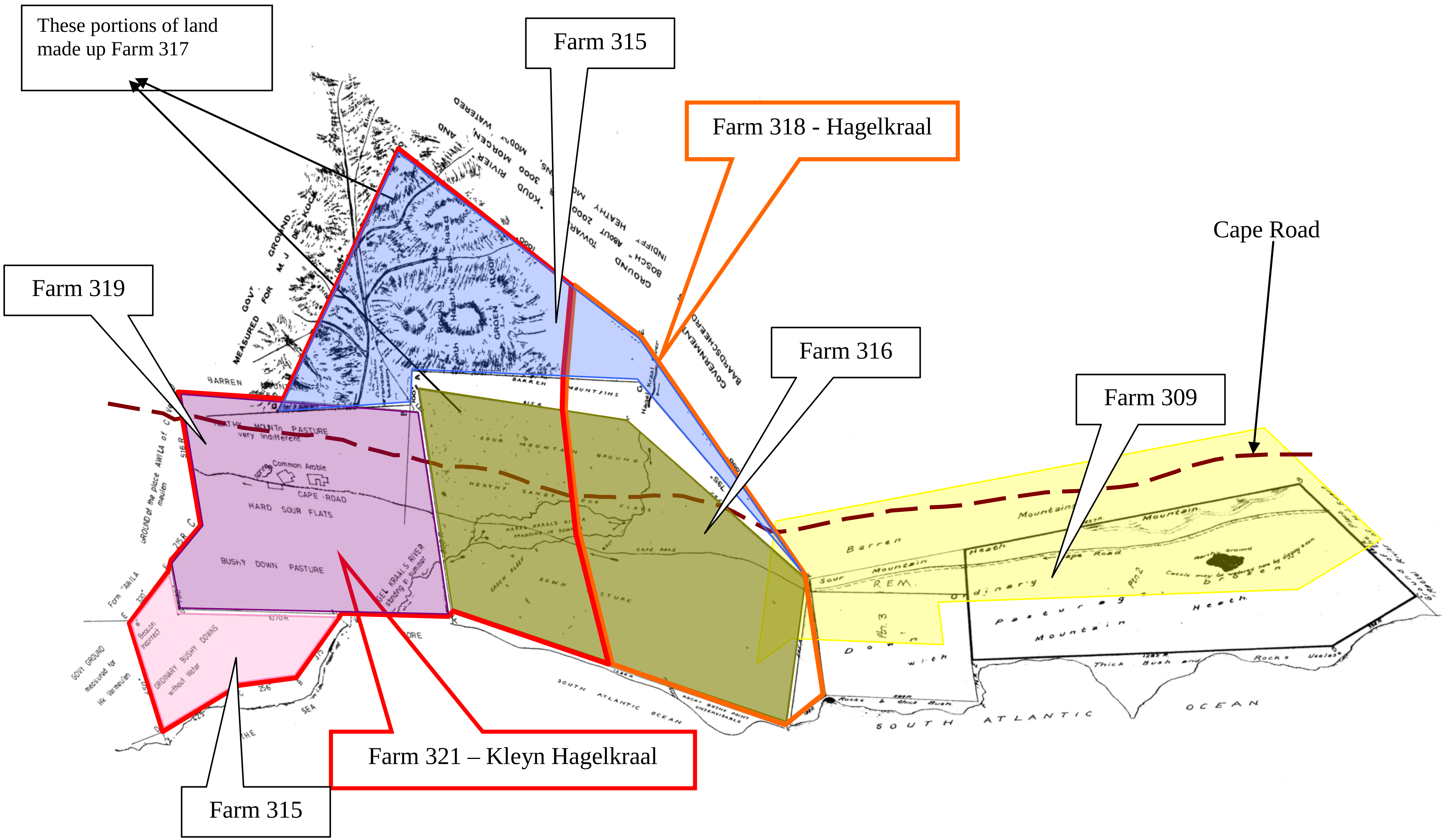
Buffel Jagt (Farm 309, diagram 561/1831) was granted to Petrus Jacobus Joubert in perpetual quitrent on the 6th of June 1831 (Sw. Q. 6-43). The farm was subdivided in 1889 and in 1949, Portion 1 was incorporated into the farm Hagelkraal. The Cape Road runs along the boundary of the farm, no structures are indicated, only marshy ground where cattle may be watered by digging a dam.

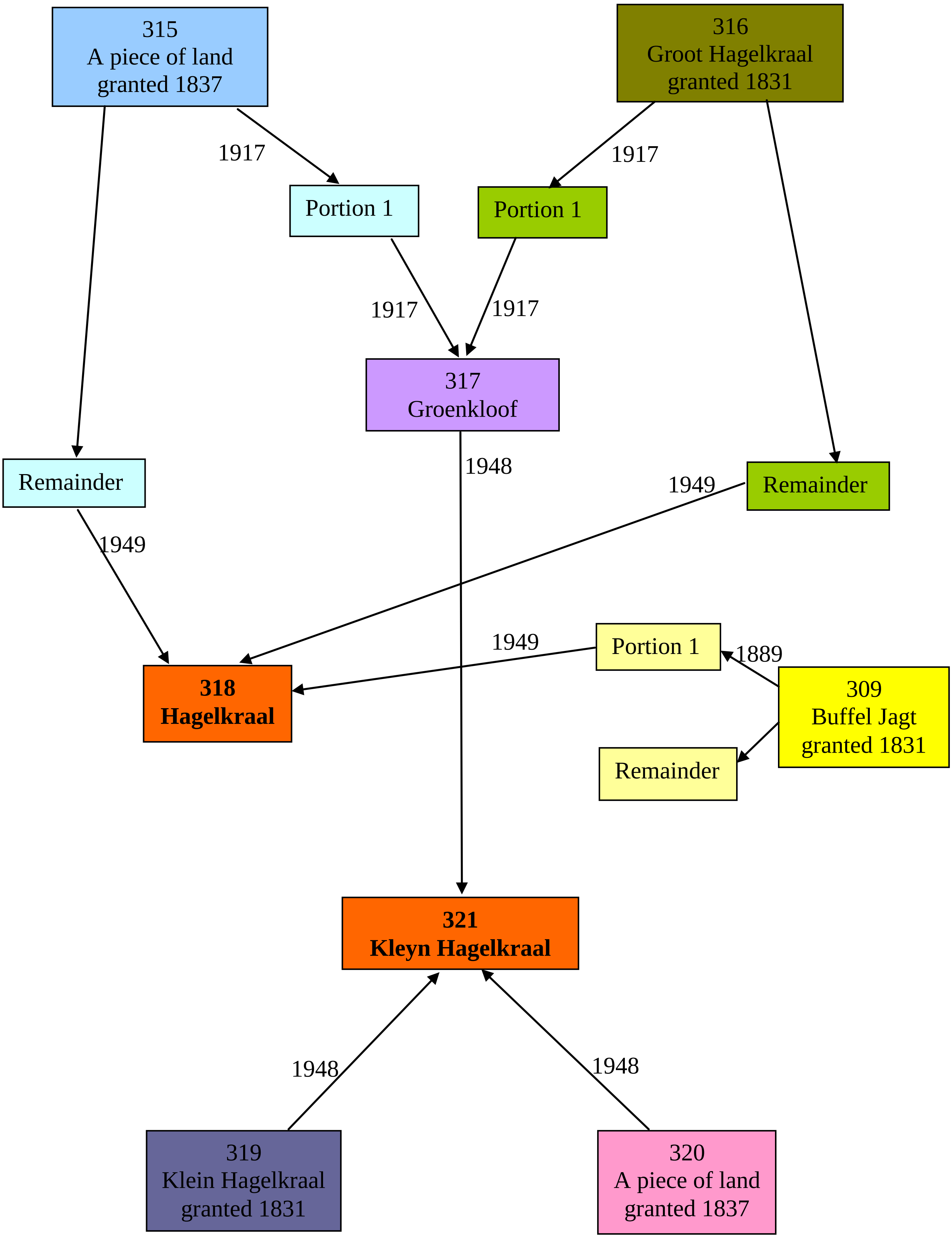
The current farm Kleyn Hagelkraal (Farm 321, diagram 121/1947) is a consolidation of the original farm with the same name, three portions of the farm Groenkloof and Farm 320 along the high-water mark of the Indian Ocean on 30 April 1948.

The original farm Kleyn Hagelkraal (Farm 319, diagram 572/1931) was granted in 1831 (Sw. Q. 7-2) to Gideon Joubert (Daniel's son) in perpetual quitrent. The Hagelkraals River runs through it and it had three plots of formally cultivated land along the Cape Road and near a spring. The original survey diagram did not indicate any buildings.

The farm Groenkloof (Farm 317, diagram 53/1917) was made up in 1917 of two portions: Portion 1 of Farm 315 and Portion 1 of the farm Groot Hagelkraal (see above).

Farm 320 (diagram 922/1837) along the high-water mark of the Indian Ocean was granted to Jacobus François du Toit (Andries' son) on the 20th of November 1837 on perpetual quitrent (Sw. Q. 12-16).


These portions of land made up Farm 317
Farm 315
Farm 318 - Hagelkraal
Cape Road
Farm 319
Farm 316
Farm 309
Farm 321 – Kleyn Hagelkraal
Farm 315
CAPE ROAD
HARD SOUR FLATS
BUSHY DOWN PASTURE
SOUTH ATLANTIC OCEAN


315
A piece of land
granted 1837
316
Groot Hagelkraal
granted 1831
1917
1917
Portion 1
Portion 1
1917
1917
317
Groenkloof
1948
Remainder
1949
Remainder
1949
1949
Portion 1
1889
318
Hagelkraal
309
Buffel Jagt
granted 1831
Remainder
321
Kleyn Hagelkraal
1948
1948
319
Klein Hagelkraal
granted 1831
320
A piece of land
granted 1837

THYSPUNT

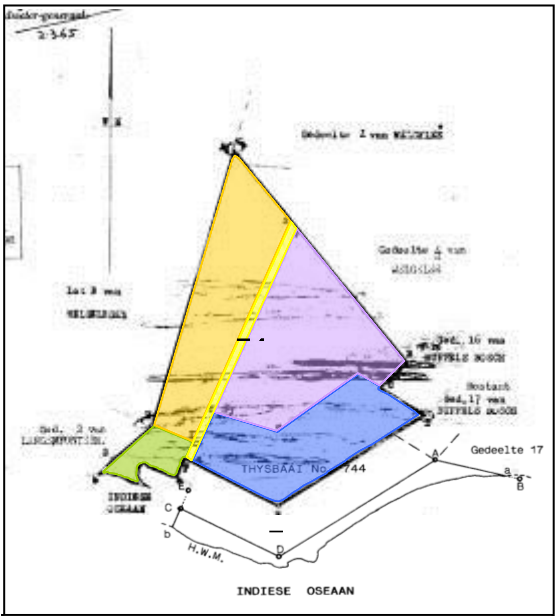


Figure 1: Farms 744 and 741. The portions of the farms comprising 744 are shown in colours corresponding to the diagrams below.

The proposed Thyspunt Nuclear I Power Plant is situated on the farms Thyspunt (Farm 744) and the Farm 741 in the Humansdorp District.

Farm 741 has always been unregistered state land.

Farm 744 comprises portions of the farms Welgeleë, Buffels Bosch and Langefontein. All three farms were originally granted between 1816 and 1817. They have been extensively subdivided but ownership of the portions largely remained within the same group of families (van der Wat, Moolman, Potgieter). In the 1950's and 1960's the farms were consolidated by the Land en Landboubank van Suid-Afrika and by Tzitzikama Estates (Pty) Ltd.

Farm Welgeleë (Farm 743, diagram11344/1964) comprises Lot A of farm Welgelegen and Portion C, Portion 15 and remainder of Portion D of the farm Buffels Bosch.

The farm Welgele

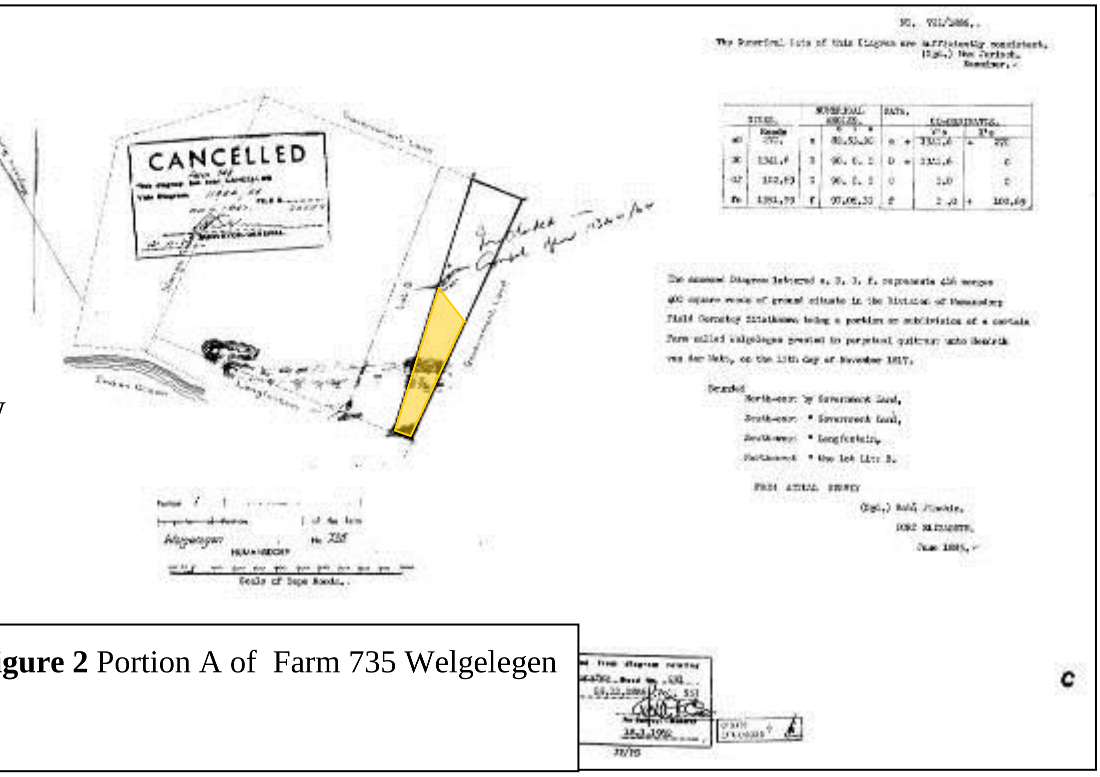


Figure 2 Portion A of Farm 735 Welgelegen

gen(Farm 735, diagram 721/1886) was first granted in 1817 in perpetual quitrent to Hendrik van de Watt; portion A was divided of in 1886 when H.J. Potgieter and 4 others sold it to Hendrik Frederick Peter Sinn. The original title deed diagram indicated one fresh water spring, no built structures and described the land partly as grazing land, partly as sand and thicket.

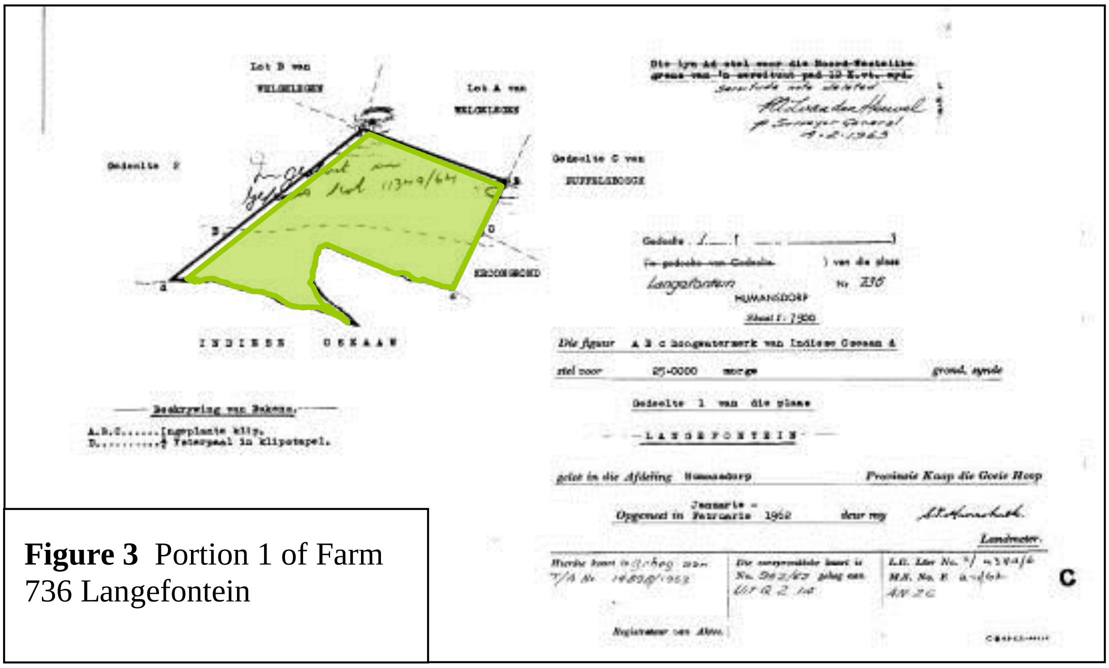


Figure 3 Portion 1 of Farm 736 Langefontein

Farm Langefontein (Farm 736, diagram 389/1817) was only named this when it became part of the Humansdorp District. It was originally Erf 467 in Oesterbaai. It was granted in quitrent in 1817 to Hendrik van der Watt. Portion 1 was divided of in 1963 when Tzitzikama Estate (Pty) Ltd sold it to Anthony Auret. The Surveyor General diagrams show the run-off of a spring to the ocean across the farm and a road along the coastline from the one end of the farm to the other.

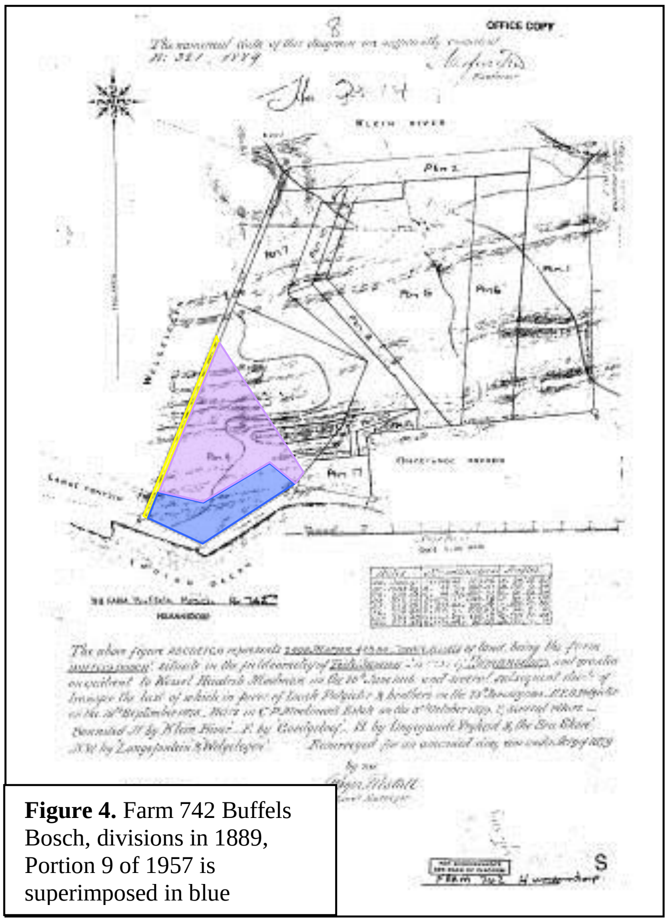


Figure 4. Farm 742 Buffels Bosch, divisions in 1889, Portion 9 of 1957 is superimposed in blue

Farm Buffels Bosch (Farm 742) was initially granted on quitrent in 1816 (UIT Qtr 1/38) to

Wessel Hendrik Moolman. It was regranted in 1890 under the Act "The Land Beacons Amendment and Extensions Act" (Act 9 of 1879) to Herman Jacobus Potgieter and 15 others who all held shares in the farm. The oldest title deed diagram (452/1816) shows the swamp and 2 roads but no structures or springs. Survey diagram 321 of 1889 shows a network of new roads, at the convergence of which 4 buildings are indicated next to 2 springs, furthermore 3 dams were present and the swamp is also still indicated. Portions 3 and 4 were divided of the original farm in 1891; Portion 9 was divided of Portion 4 in 1957.

APPENDIX 4

ST. ANDREWS COLLEGE SHACK

In 1959 a group from St Andrew's passed through the Oyster Bay area on an Exploration Society long walk, along the Tsitsikama coast from Eerste Rivier Mouth to the Cape St. Francis lighthouse. They met a farmer there who wanted to know if they had come to view their land. James Moolman, who had taught at St Andrew's from 1940-1946, had offered the school a piece of the farm, Welgelegen, owned by the Moolmans in appreciation for the pleasant time he had experienced, and what he had learned, during his time at the school. He was also anxious that city boys should have the opportunity to experience wilderness areas.

Since 1960 groups of boys, members of staff, old boys and those closely associated with St Andrew's College have had the privilege of visiting this magnificent piece of our coast. The "Shack" built out of Ford motor car packing cases has slowly been added to over the years and now boasts a ram pump, which slowly pumps the fresh water, siphoning out near the sea, into tanks supplying the shack, a toilet with a septic tank, and a wonderful shower. The basic design of the "Shack" has not changed over the years and remains a large room with a fireplace at one end, a big table in the middle and beds arranged around the sides. The kitchen is a little alcove off the main room. All communal activities such as preparing food, eating etc. are conducted around the large table in the middle of the room. The magnificent fireplace, which usually has an open fire blazing in it, acts as a magnet drawing those occupying the shack together with its warmth and comfort. Gas is used for cooking and heating water including the shower.

There are two basic rules which have to be followed in order to retain the privilege of visiting "The Shack": The first is that each trip has to be recorded in the journal. The name of each member of the group, what fish were caught, and the story of any "incident" which occurred must be recorded. As a result the whole history of "The Shack" is recorded from the very first trip.

Following the principle of 'enjoy this wonderful wilderness area but leave only footsteps', each group is expected to leave "The Shack" as they would like to find it: clean and tidy, fire laid neatly in the fireplace, enough wood available for at least a night, enough gas available, enough water in the tanks, and all rubbish taken away.

Recently, groups of boys from St Andrew's have been active chopping out alien and invader bush in the area, and gathering the rubbish jettisoned from boats at sea which collects along the rugged coastline. This is part of the outdoor education programme practiced at the school, which among other things, aims at awareness of the environment.

André Bouwer and Penny Tyson (St Andrews College)