DINOSAUR DREAMING

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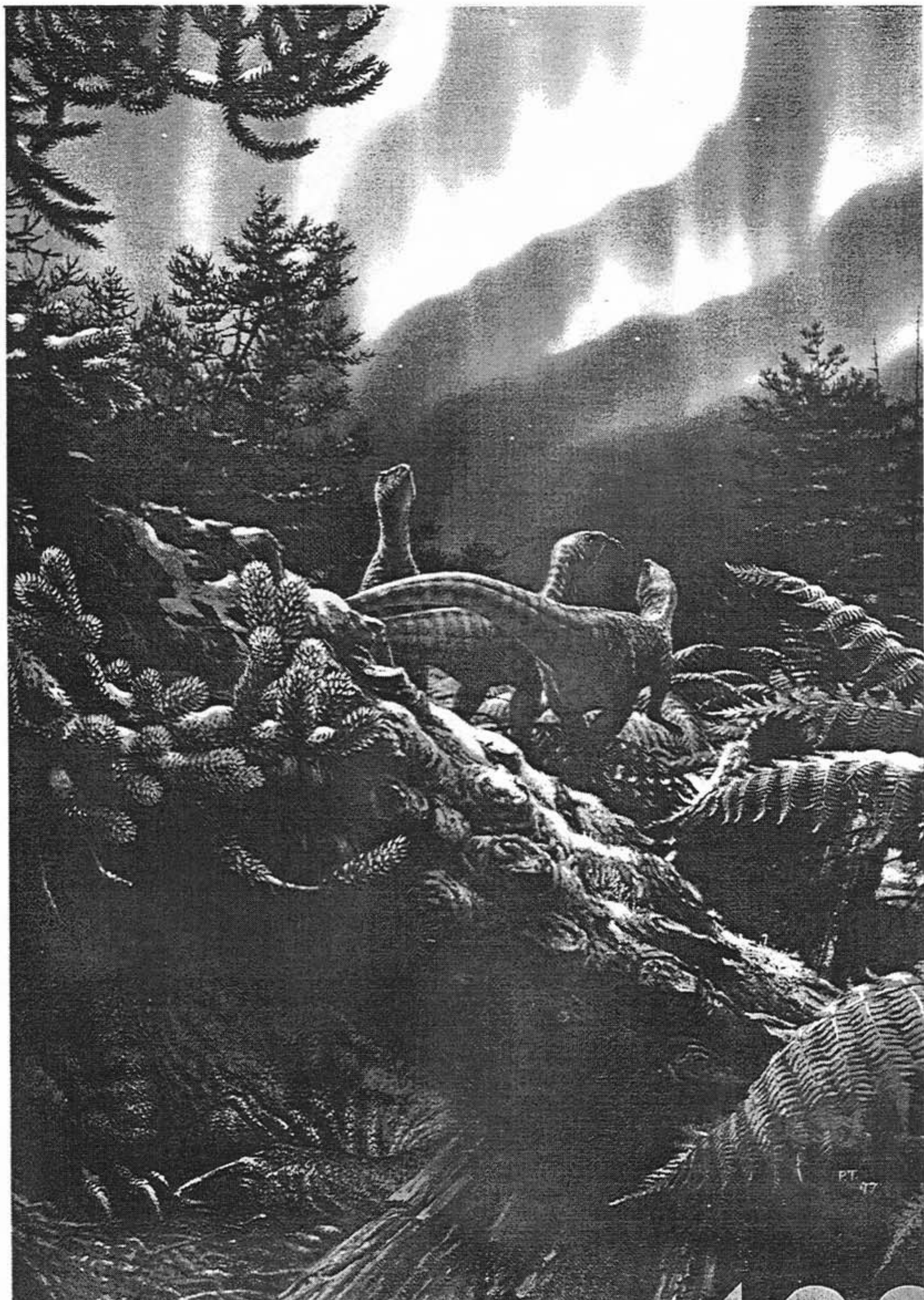


FLAT ROCKS SITE REPORT 1998

CONTRIBUTORS:

Lesley Kool - field report

Nick van Klaveren - excavation report

Doris Seegets-Villiers - taphonomic report

Drs. Tom Rich and Patricia Vickers-Rich - research report

Front cover: Painting by Peter Trusler: adopted by the Dinosaur Dreaming project.

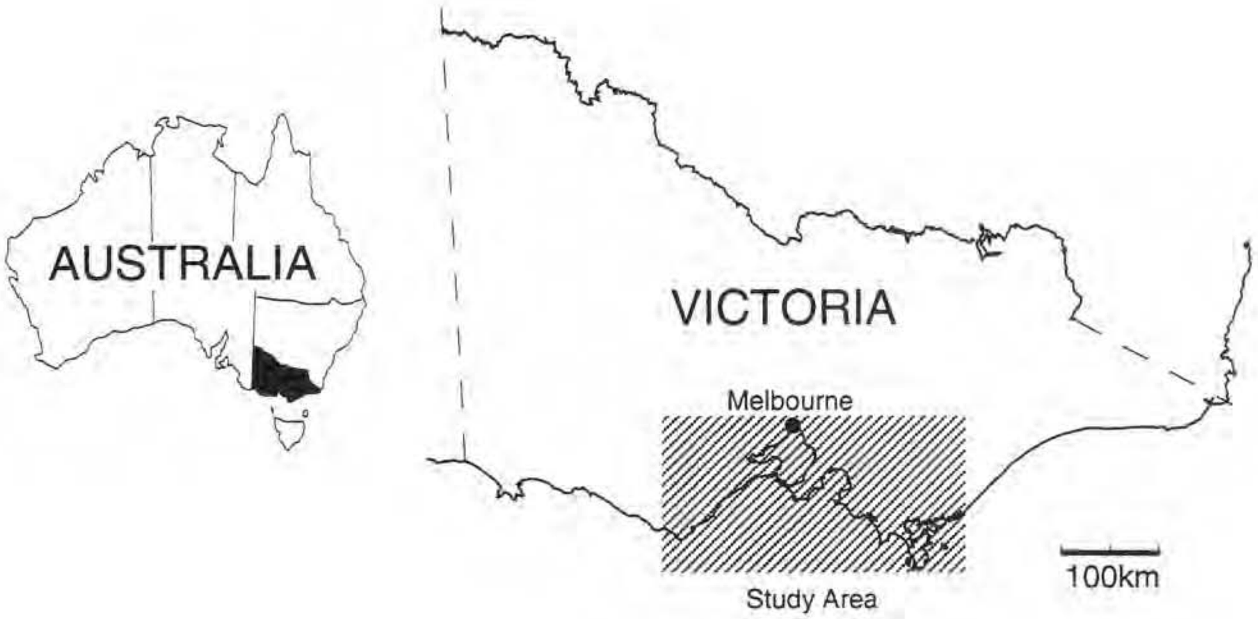
DINOSAUR DREAMING 1998
ANNUAL REPORT

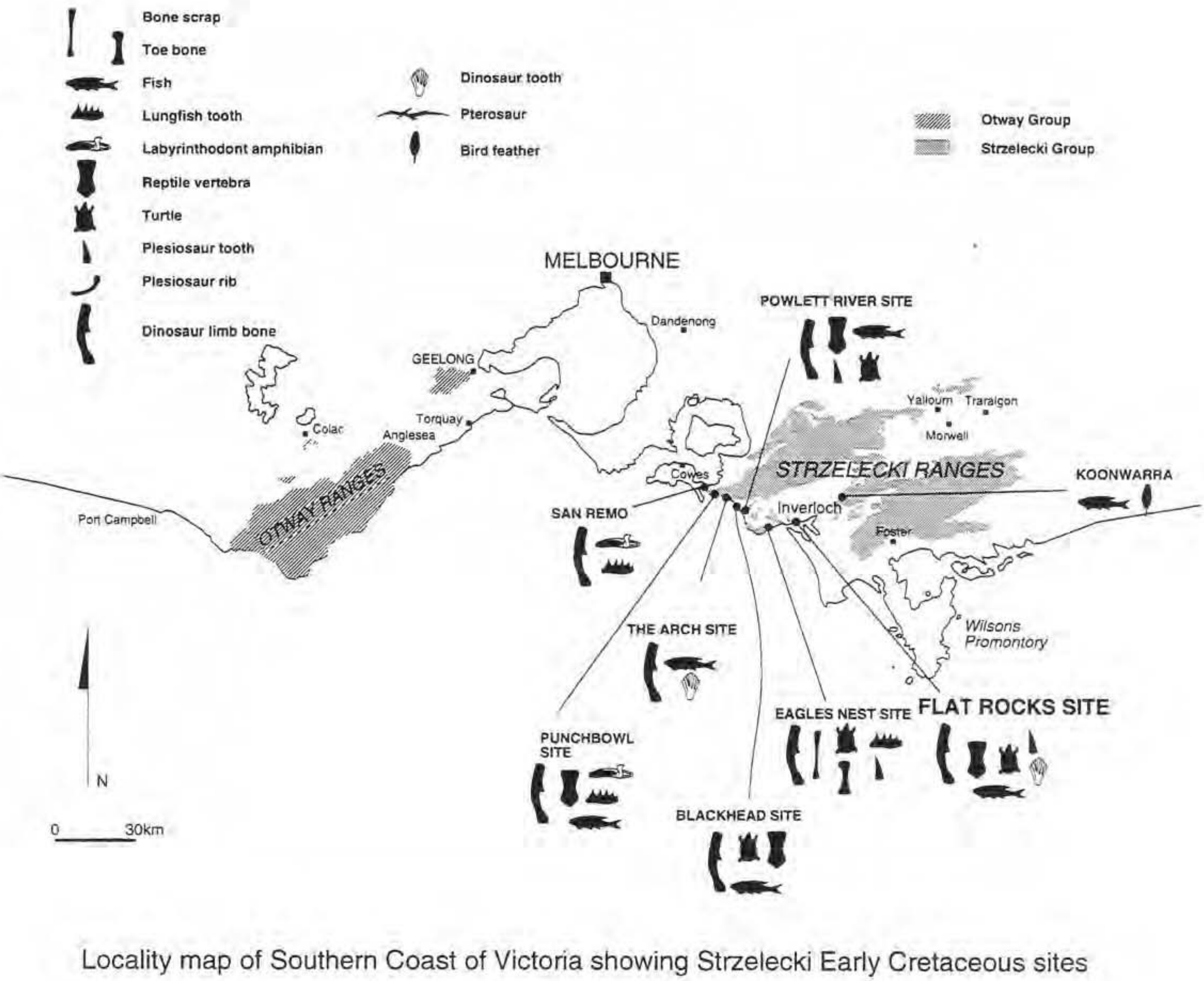
Field Report by Lesley Kool

Dinosaur Dreaming 1998 was the fifth field season at the Flat Rocks site, Inverloch, Victoria, and in some ways was the pivotal point in our excavations so far. The six week field trip involved almost 40 volunteers, some coming from as far away as Germany, Canada and Ireland to join the excavations. The difference between the 1998 excavations and the previous four field seasons was reflected in the considerable time spent implementing and modifying a system to keep most of the sand out of the excavation during high tides. This was also the first year in which the fossiliferous layer was mapped in detail by one of the members of the crew, Doris Seegets-Villiers, who is studying the taphonomy of the site. Taphonomy is the study of the process of accumulation of a fossil assemblage. A detailed description of the new system is included below, as well as Doris' first report on the data collected so far. It is hoped that both the new system and Doris' study will greatly enhance our chances of performing a more thorough investigation of this unique site.

The Flat Rocks site was discovered in 1991 as part of a prospecting program whereby the Strzelecki coastal shore-platform, from San Remo to Inverloch, was systematically searched at low tide, looking for exposed bones. The prospecting programme began about 1988 and since that time many exposed bones have been collected. Large areas of the shore-platform are often covered by sand, but as luck would have it, on the day the area west of Inverloch was prospected, the sand had been swept from the rocks by strong winds and high seas. Consequently, more than 20 small bones were discovered in an exposed fossil layer, approximately 4 metres wide, stretching up the beach and into the cliff. This represented the largest concentration of fossil bones found anywhere along the Victorian coastline, and after a preliminary excavation the following year, extensive excavations began in 1994.

When first discovered, the fossil layer was exposed level with the surrounding rocky shore platform. Excavation of this fossil layer during the first four field trips resulted in a wedge shaped hole reaching a depth of up to 60 cms below the level of the shore platform. Deepening the hole brought logistical problems with the amount of sand that was dumped during each high tide. By the end of the 1997 field season it was taking up to 2 hours to remove the sand in the hole and expose the fossil layer at the base. It was this problem that prompted Nick van Klaveren, the site excavation manager, to design a unique system, which we hoped, would prevent much of the sand filling the hole. Preparation for the system began long before the field season commenced with discussions with engineers and other professionals. Materials were purchased and many large feed bags were filled with empty plastic bottles in readiness for the beginning of the 1998 field season.





Locality map of Southern Coast of Victoria showing Strzelecki Early Cretaceous sites

In our naivety we thought Nick's system, which is explained in detail in his report, would take 7-10 days to set up. In reality, it took almost 4 weeks to function efficiently. During that time there was a certain amount of adjustment and modification necessary to cut down the time it took to remove the system each day. As well as this, we had to calculate the time needed to replace the tarpaulins, bags, mesh and steel bars before the next tide inundated our excavations. On the first day we trialled the system, we drastically underestimated the time needed to put the equipment back and ended up knee deep in water as we struggled to secure the last steel bar. However, by the fourth week we were able to empty the hole in just over an hour and, at the end of the 1998 dig, we were able to fill in the hole in just over half an hour.

This year's experience with Nick's system taught us a great deal, not least being that you should never underestimate the power of Mother Nature. We learned from our mistakes and Nick is already working on an improved system for next year, which should increase our access time to the excavation face considerably.

The unexpected time spent perfecting Nick's system meant that not as much fossiliferous rock was excavated as in previous field seasons. Consequently only just over 500 individual bones and teeth were catalogued by the end of the dig. This was a lower number than in previous field seasons, but some very interesting material was collected. A number of small hypsilophodontid jaws were recovered, including a well preserved maxilla with 3 teeth. Also some larger than average hypsilophodontid femora (thigh bones) were collected which are of interest to Drs. Tom Rich and Patricia Vickers-Rich, who are studying the variation in shape of these diagnostic bones. For more information on the hypsilophodontid femora, see Tom and Pat's report below.

A number of small hollow, bones, exposed in cross-section, may shed some light on the elusive mammals. Unfortunately many of the bones have been damaged during their transport down the river system over 115 million years ago. It is the ends of the bones which are so important as they tell us what that bone is and often, to which group of animals it belongs. Small shafts without ends are generally scientifically useless.

Some of the most exciting finds this year were not as a result of the 1998 field season, but were from previous field seasons. As a result of the discovery of the tiny mammal jaw, subsequently named *Ausktribosphenos nyktos*, during the 1997 field season, it was decided that a concerted effort should be made to re-examine all specimens previously collected before this dig. This meant looking at bones that were collected as early as 1991, when the site was first discovered. Hundreds of bones are collected and catalogued each field season. These were assigned a rating number between five and one, which reflected their order of preparation. This rating is very subjective, as usually only a cross-section of the bone is exposed and a decision as to its importance must be made at the moment of its discovery. Any one with any knowledge or experience in fossil preparation will know what a slow and painstaking task it is. A bone may take anywhere from a few hours, up to a few weeks to be removed completely from its rocky tomb, and some are so fragile or incomplete that they can never be fully prepared. Consequently, of the hundreds of bones collected each year, only a small percentage are prepared, and they usually consist of what are perceived to be the most scientifically important specimens, the bones that will provide the most information about the animal that it originated from. The backlog of unprepared bones grows each field season, and so it was quite a daunting task to check each and every one, just in case we missed something. Each bone has to be unwrapped, examined under the microscope, and relabelled with the date on which it was checked. Approximately half the bones have been checked in this way so far, and three more mammal jaws have been identified. Two of the jaws were collected in 1995 and one from 1993. The discovery of these jaws indicates a number of significant aspects to our research:

- The discovery of the first jaw in 1997 was not a fluke. These mammals were obviously more common than we thought they were. We just did not know what to look for.
- At least three jaws were originally misidentified, and in the case of one, was not even picked up. It was on the back of a rock that had been collected because it contained a turtle limb, and so we only have half the jaw. This tells us that we have to improve our skills in looking at bones in the rock. More care will be necessary in checking all sides of the rock being broken up. It also indicates that really small bones have to be looked at under the microscope before being wrapped and catalogued. A handlens is sometimes not sufficient.
- Now that we know the size range of these tiny animals, we can be more aware of what to expect. Tiny jaws mean tiny bones, which may or may not be preserved, but at least we are now looking for them. Before the first jaw was found we did not know they even existed.

This does not mean we will not be looking for other exciting finds in the rock. We now know that we have evidence of birds at this site, with the discovery of a furcula or wishbone and a possible limb bone. This is the first skeletal evidence of Early Cretaceous birds in Victoria, following on from the bird feathers found at Koonwarra, an inland site north of Inverloch, in the 1960's.

Other exciting discoveries are discussed in Drs. Tom Rich and Patricia Vickers-Rich's report on their recent trip to Europe and North America.

As preparation of this year's and previous field trips continues, it is inevitable that more discoveries will come to light. The diversity of the fauna from the Dinosaur Dreaming site is steadily increasing, adding more pieces to the puzzle and giving us more questions to answer.

Another important aspect of the 1998 field season, were the school visits to the site. As part of our commitment to science education, we offered guided tours of the site including talks given by geologists, sedimentologists and palaeontologists. The wonderful quality of this site is that students and the public can see evidence of ancient volcanics and earth movements, in the form of large faults, as well as the fossils. We had a great response from the local primary and secondary schools, as well as schools from further afield, and we hope to run a similar programme next year.

We had set up a small dinosaur display at the Bunurong Environment Centre in December 1997 and that was still available during the field season to visitors to the site. The posters and casts of some of the animals we had discovered during previous digs, displayed at the centre, all helped to put the significance of this area into perspective.

Inverloch was the chosen venue for Dr. Tom Rich's first public lecture about the tiny mammal jaw, which was found during the 1997 field season. An interested audience of close to 150 people turned up to hear more about this ancient animal and to witness the launching of "Friends of Dinosaur Dreaming". This research fund was set up to allow the general public to be personally involved in Australia's only working dinosaur dig. 'Friends' who joined the fund before the 1998 Dinosaur Dreaming field season were invited along to the special 'Friends' day during the dig where they were given a personal tour of the site by members of the excavation crew and saw the excavations taking place. We currently have over 70 families and individual 'Friends' and their generous support will be going a long way towards making Dinosaur Dreaming 1999 a reality.

We also produced a small booklet with relevant information about the site, which was available at the Environment Centre, as well as at the site during the field season. This will be updated before next year's field season.

We have adopted one of Peter Trusler's most recent paintings as the site emblem. This painting depicts three hypsilophodontid dinosaurs, soon to be named after Qantas, looking up at the Aurora Australis while an ornithomimid dinosaur, *Timimus hermani*, lies curled up asleep in the lower left corner. We felt that this painting epitomised the essence of Dinosaur Dreaming, and it will feature on our field T-shirts from now on.

Excavation Report by Nicholas van Klaveren

The Flat Rocks Fossil locality was excavated for a period of six weeks, from the beginning of February to mid March 1998. All material was collected under permit NP 978/111 of the Department of Natural Resources and Environment, Victoria. In the 1997 field season all easily removable fossiliferous conglomerate was excavated from 188 metres east (mE) to 200 metres east (See Map 1), except for a thin veneer of Middle Clay Gall Conglomerate on the floor against the northern highwall. With the discovery of the jaw of *Ausktribosphenos nyktos* at 99.5 mN, 199 mE at the eastern edge (seaward) of the main excavation area (Area 3, Map 1), it was decided to concentrate on the surrounding area to try and find additional mammalian material.

Excavation Methods.

The excavation method this year continued to include the use of large wedges and sledge hammers to remove the bulk of the fossil layer from the targeted area. Exposed specimens were removed with a diamond saw blade equipped Stihl TS 460 Cutquik. This year the upper two fossil-rich layers were exposed in their true thickness (~ 0.40 metres). It was found that wedges driven into the underlying Lower Sandstone Unit resulted in severe fracturing of the rock, with only small pieces progressively flaking off the front of the working face. These pieces were usually of the friable Upper Clay Gall Conglomerate. This method was then switched to the base of the Middle Sandstone Unit, which has at its base a semi continuous coaliferous horizon. The relatively easy fracturing of the coal allowed good access and resulted in rapid removal of the fossiliferous matrix. The process was then repeated for the Middle Clay Gall Conglomerate by driving wedges into the Lower Sandstone Unit.

Technical Innovations:

A number of technical innovations were attempted to alleviate the increasing time spent removing sand and water which had accumulated during the intervening high tides.

Water influx is an ever-present problem making working conditions difficult. A rough calculation is that each cubic metre of saturated sand at 20% porosity yields 200 litres of water (40 buckets). Therefore, with a large amount of surrounding sand, the inflow is considerable. A sump was excavated at Area 2 (see Map 1) and a large green plastic bin with holes drilled in its side was buried to its top. The top was then secured with a bicycle cable and the bin was filled with water at the change of tide to prevent positive buoyancy. This first attempt at securing the lid failed as wave action tore it off. The lid was recovered at the end of the surf beach two days later.

The lid was then secured with chains and although it kept the lid on, a small gap between the edge of the lid and the top of the bin allowed the ingress of sand and the next day was found to be brimful of sand. The solution was to fill the bin with PEP bottles of water, in small sacks, and place a plastic sack between the lid and body of the bin as a seal. Wooden braces were then constructed and placed on top of the lid to keep it from shifting, in addition to the chain. Later a wooden internal cross brace was added to support the inner walls and prevent them from buckling inwards from the weight of the surrounding sand.

From the outset the submersible electric pump performed adequately, until damage to the float switch in the final week of the dig prevented its use. The only drawback was the necessity to run it intermittently due to the shallowness of the sump and the need to conserve generator fuel. The sump pump also saw service in dewatering the main hole, although its output was about half that of the petrol driven impeller pump. Though the sump markedly reduced the ingress of water, a member of the crew was still required to constantly bail the pooling water in the excavation area. Later in the dig the water was diverted into shallow sumps and channeled there by the construction of slits in the rock with the rocksaw.

A construction of steel beams, rock anchors, mesh, plastic tarpaulins and various packing materials (sacks of PEP bottles and plastic drums) was built this year in an effort to displace the large volume of sand that infills the excavation area at each high tide.

First in the process of construction was the levelling of the perimeter of the targetted excavation pit, using petrol-driven jackhammers, and surveying of the points for the various split pins and rock anchors. After delays in acquiring some of the pins and the correct size of drill steel, the split pins (for the mesh edges) and the rock anchors (beam fastening) were drilled, inserted and grouted.

In its first trial (despite some trouble fastening the last girder) it securely held down the volume of bags over a five by five metre area. However sand infiltrated beneath the bags and was almost equal in volume to the amount of sand that normally filled in the pit, with the addition of wet compressed bags above. The time taken to remove this configuration to the point of excavating fossils was over three hours.

The second attempt involved the addition of tarpaulins above and below the bags, but the result was the same as before with the tarpaulins being immovable with the weight of sand upon them. It was also found that one of the long split pins securing the thin beams at the shallow end of the excavation area was unable to carry the load and was pulled free.

On the third day a decision was made to halve the working area and exclude the previously excavated area. A sandbag wall was added to exclude the sand from the abandoned area. This addition of saturated sand behind the sandbag wall exacerbated the water influx problem, which, however diminished as the sand was depleted, unlike the more constant inflow from the larger mass of sand higher up the beach.

Enveloping the bags and the drums in plastic tarpaulins and using sandbags to weigh down the edges provided a workable solution to the sand problem. This kept out a high proportion of the sand. The space originally taken up by sand was replaced by a large amount of water. This was pumped out using a petrol-driven pump, assisted by the small electric sump pump.

The mesh, selected for its light weight and ease of transport was adequate, but became damaged by the end of the dig due to tensional forces at its anchor points caused by the uplift of the packing materials.

Excavated areas:

Area 1

This area was excavated throughout 1997 during the one day digs and the first weeks of the 1998 field season while overburden was being removed from the main site at Area 3. It was preferentially excavated due to its shallow depth beneath the sand, making it easily accessible at times of high sand levels. This area is a continuation along the strike of the fossil horizons excavated at the main area. It is notably different however, in the fact that the Upper Clay Gall Conglomerate is absent and the middle layers appear to have had a lower stream energy at the time of deposition. The few small bones found here are mainly the remains of turtles and fishes.

Area 2

The sump area was excavated during the first week of the field season and was initially thought to be only a thin veneer of Middle Clay Gall Conglomerate, but was discovered to be three times the normal thickness. Unfortunately due to time constraints it was decided to jackhammer through this "thin veneer" leading to a small number of damaged specimens. This phenomenon will be further investigated during next year's field season, as the next excavation area will straddle the old sump area. This may represent the main channel area of the Middle Clay Gall Conglomerate.

Area 3

The work on the main excavation area began with the removal of approximately four cubic metres of sandstone overburden using petrol driven Cobra jackhammmers. Two interesting phenomena were observed during this process.

Firstly, at 197 mE, 101.5 mN the normally coaliferous Upper Sandstone Unit was replaced by a clean lens of well sorted sand containing occasional bones and secondly, at approximately 100 mN,200 mE a hypsilophodont femur with no ends was recovered in the Upper Sandstone unit.

Generally the results of excavating the main area were mediocre both in quality and the number of bones found. A ledge of about half a metre in width was left on the eastward (seaward) edge on which sandbags were placed to secure the edge of the tarpaulin. This was necessary to prevent incoming waves lifting the edge of the tarpaulin and depositing sand and especially seaweed beneath it. This ledge of fossiliferous rock will be removed when the "bridge" area (east of 201 mE) is eventually removed.

A small channel of feldspar rich sandstone (weathering to distinct white kaolin) was observed to run across the centre of the excavation area more or less north-south, but did not appear as rich in large limb bones as when last excavated in 1996. The northeastern area of Area 3 was not removed due to lack of time, but will be straddled by the 1999 excavation area (see Map 3). The overall thickness of the fossil units decreased drastically toward the northeastern corner of Area 3 and declined from 0.40

metres to less than 0.05 metres. This is probably the channel edge with higher energy regimes and thicker exposure toward Area 2.

Area 4

The thinly exposed eastern most part of the fossiliferous conglomerate was excavated exclusively during one day digs throughout 1997. The quality and type of bones recovered were quite poor. This is probably due to the fact that only the lower sandstone and lower clay gall conglomerate layers are found here in any thickness. These units are notoriously poor in dinosaur material. This area is effectively worked out as all the fossil rock has been removed from the shore platform. Any further removal of matrix from the working face at 93 mN, 203.5 mE would necessitate removal of overburden to the east. It would also draw attention to the location of the site with the addition of an artificial cliff, which would be permanently exposed along the eastern edge of the "bridge" area. The remaining rock will be removed during the final dig when the bridge area is removed.

Future Excavation Plans:

It is hoped in the near future that a program of diamond coring will be undertaken to ascertain the thickness of the fossil sequence in the more difficult areas at 104 mN, 200 mE and at 102 mN, 203 mE.

The 1999 field season will concentrate on the area outlined on map 3. A similar sequence of overburden removal and construction will follow this year's formula with additional improvements.

The addition of a second sump and sump pump at 102 mN, 199.5 mE should remove any pooling water in the excavation area and influx from the east.
A system of slit channels along the southward floor of the excavation area should direct flow away to the lower lump and away from the working face.

Other improvements on this year's dig will be:

Acquisition of heavier mesh, and additional beams at the western and eastern edges to replace the chains.

Raising the overall height of the mesh and beams to the maximum extent will reduce the sand accumulation on top of the construction at low tide.

Draining the hole will be hastened by the addition of a second sump and an additional petrol impeller pump. A larger and more powerful all weather electric generator will allow the sump pumps to operate at higher output (this year the sump pump operated at about 50% due to the limitations of the generator).

Insertion of the rock anchors will be improved by pre-measuring the lengths and then cutting them to size, ready for insertion, before the field season starts. The purchase of a second drill steel will permit both Cobra jack hammers to be used simultaneously, which should halve the time taken to drill the necessary holes. The hire/donation of the use of a diesel compressor, airline and rockdrill could further speed the drilling process.

The 1999 excavation area appears to be over the main channel area for at least the middle fossil-bearing units. Higher stream energy is often represented by the presence of larger bones and relict deep pools, both of which may lead to the discovery of articulated fossils.

The system outlined by Nick van Klaveren is vital to the continuation of excavations at this particular site. Being an inter-tidal site, we will always have the problem of inundations at high tide. The fossil layer itself is dipping at approximately 15° N, so the further north we follow the layer, the deeper we go below the shore platform. We have no idea how extensive the fossil layer is at this stage, but the cross-section exposed in the working face suggests that it is continuing under the shore platform. Sample coring 1-2 metres to the north of the excavation face may give us a better indication as to the situation of the fossil layer.

Being able to keep out a large proportion of the sand during the field trips is imperative, as under normal circumstances the amount of sand infilling the excavation would take too long to remove before the next tide.

Preliminary Taphonomic Report: by Doris Seegets Villiers

The fifth field trip to Inverloch was the first undertaken as part of a Ph.D. thesis. The aim of this project is to get a better insight into the sedimentology and taphonomy of the Inverloch fossil site.

Sedimentology deals with the description, classification, origin and processes of formation of sedimentary rocks. Therefore, it was necessary to describe the different sediments as closely as possible, noting distinctive features such as grain size, degree of rounding, composition of particles, bed thickness and extent, to mention just a few.

At first we tried to describe as many samples in the field as possible but, as it turned out, prolonged weathering and uneven breakage made this task quite difficult. It was almost impossible to see the characteristic features of the sediment on a weathered surface. In the end we opted to cut out wedges with a rock saw. The freshly cut clean surfaces revealed very detailed information about the different features, thus making it easier to subdivide the sediment block into different sequences.

At the Inverloch site there are at least three different pulses that led to the deposition of these ancient river sediments. All three pulses are built in more or less the same way. They all begin at the base with a conglomerate, a rock type that contains visible (>2mm) particles, in our case mainly mud, clay and sometimes quartz, that are fairly well rounded. The clasts either touch each other (=clast-supported) or they "swim" freely in a matrix of mainly sand (=matrix-supported). Rock with somewhat fewer large clasts is described as a pebbly sandstone. The term "pebbles" means that the size of the grains lies between 4-64mm.

Finally, the last member in this sequence is represented by pure sandstone. The particles in these sandstones, mainly quartz and little feldspar, are a mixture of rounded and angular shapes. From these observations we can make a statement about the transportation velocity of the river system. The first part of the sequence, the conglomerate, requires fast flowing water to actually transport material, whereas sand particles require lower velocity to move them

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From the degree of rounding we can conclude the time that the different particles spent being moved. Quartz is a mineral that is fairly resistant to weathering and forces that wear on it during transportation. A quartz grain that is rounded indicates that it has travelled a long way or that it has been reworked a few times. However, when quartz is still angular the grain has not travelled far or been reworked much. Finding both types of grains in the same deposit simply indicates that the rounded particles have been transported much further and/or that they have very likely been reworked, whereas the angular grains have been part of the "transportation" only for a comparatively short amount of time. If we think about the muds and clays in the same way, we come to a different conclusion. Mud and clay are much softer than quartz and therefore it takes much less time to actually round these particles. So if we have, as in our sediments, very well rounded particles of that kind, we can conclude that they were transported for a relatively short time and were only transported to such an extent that they did not disintegrate.

Putting this information together we can conclude the following: The angular quartz and the muds and clays were transported for the same relatively short amount of time in our river system. The energy of the river was just strong enough and worked long enough to very well round the mud and clay clasts but not destroy them. The quartz fragments were hardly affected at all. At the same time as the river transported these angular quartz, mud and clay particles it caused some erosion as well, by cutting through preexisting sediments, reworking other sediments and adding those better rounded quartzes to the cycle.

During the Early Cretaceous, when rivers were depositing the Inverloch sediments, the supercontinent Gondwana was actually in the process of splitting apart. This action produced a rift valley. In this valley rivers were flowing. The banks of the rivers were inhabited by a diverse flora and fauna. We also know that during that time Australia was further south than it is today. In fact it was that far south that it was situated well within the Antarctic Circle. The climate would have been much colder than it is today. From geochemical investigation we know that the average temperature would have been between -5°C to about +6°C. This is confirmed by some sedimentary structures found in the vicinity of the actual site. Such structures could form only where it was cold enough for the ground to freeze and thaw each year. The fossil plant material preserved in the sediments suggest a high precipitation possibly falling as snow during the winter months, which would have melted during spring, causing a vast amount of water to run through the valleys. Material, be it plant, animal or sediment, would have been picked up and transported as far and as long as the river had the power to carry it. Gradually, with decreasing water velocity, the river would have begun to deposit the larger material. The clay interclast conglomerate was very likely formed when floods overtopped river levees, spread out across the floodplain, ripping up mud and transporting it a short distance. With further decreasing velocity the pebbly sandstone and finally the sandstone would have formed. As mentioned before, we do have at least three repetitions of that sedimentation cycle. Unfortunately, we will never be able to determine the time frame behind the entire deposition. Each cycle represents one event. But we cannot say if these three cycles were deposited in three consecutive years or if there has been a number of years in between.

This year, in many regards, was meant to be a year of trying different methods. It was not only trying to find out if Nick's excavation system would work and be sufficient to keep water and sand out. It was as well the first year we tried to retrieve as much fossiliferous material as possible while, at the same time, getting detailed information on the sediments. We not only had to describe the different rocks but also we needed to map the different outcrops of the individual layers. The method we used was simple but gave us enough information to work with. All we needed were compass, line, level, plumb bob, tape measure and a stick. All measurements were taken from a fixed orientation point and horizon. First we drew lines along the boundaries of the different layers. Then we placed the stick on the start of one of those lines. With the help of line, plumb bob, level and tape measure we determined the distance and depth of the given point from our fixed point. The compass gave us the direction of that newly measured point from the fixed point. Next, we repeated the procedure along several positions on all lines. Unfortunately, we found out very quickly, that it was impossible to work two teams (one digging up rock and the other one describing and measuring the deposits) in the area of excavation at the same time. With hammers and chisels being used almost constantly, it turned out to be too dangerous for several people to work in the excavation at the same time. For next year we therefore need to work out a plan that will allow us to work on the excavation and to gain the necessary information on the sediments during the field season at the same time.

The second part of the thesis deals with the taphonomy of the site. It will hopefully reveal all the influences and effects that worked on the bones from the time the animal died to the time we dig it up.

In this regard this year again, was a year of trying different methods. For taphonomic studies it is important to find out if there is any preferred pattern in the orientation of bones. Orientation is preferably measured on bones that are still in situ (meaning the bone is still attached to the sediment it was found in) by measuring the deviation from North. Furthermore it is necessary to record the exact position of each bone. Therefore, the distance from a measuring point and the depth from a fixed horizon are recorded, using the same method described above. The type of layer the bone was found in is important to note as well. However, not all bones are found *in situ*. In fact, most of the bones we record are found when the rock is taken from the hole to be further broken down. Therefore I opted to introduce a further means of gaining information. Before we started excavating, we drew arrows on the rock surface that were orientated parallel to North. Using this method, we at least got a coarse orientation of bones, but could never record their exact position on the map.

For next year the plan, so far is, to keep going with measuring and describing the different layers and getting more information on the bone orientation *in situ*, but at the same time recording all other measurable orientations as well.

Though it is not really part of a report I'd like to thank all the members of the team this year who had to endure frustration because my work slowed the process of getting "the good stuff" out considerably. Thanks as well to my personal slaves who were willing to sometimes stand knee deep in water, holding sticks, measuring tape etc. and still give me a smile of support. And finally thanks to all those who lend their ear and a helping hand when things surrounding the thesis got a bit tough.

Extract from Drs. Tom Rich and Patricia Vickers-Rich's summary of their trip to Europe and North America (4 April – 24 May 1998):

Most of the material carried with us to twelve museums for the purpose of identification turned out to belong to groups previously represented in the Early Cretaceous tetrapod fauna of Victoria. Three, however, were new to that assemblage.

A specimen thought to be the furcula of a bird was confirmed to be just that. This was the first instance of osteological remains of a Cretaceous bird from Victoria. Previously, isolated feathers had been found at Koonwarra. A real surprise, however, was what appears to be the fused parietal bones from the skull of a snake. Finally a large dromaeosaurid theropod dinosaur ulna was identified as such.

A snake skull was completely unexpected from the Victorian Cretaceous for two reasons. First, snake skulls are quite fragile. One would expect that if one found a snake skull, one would have previously encountered numerous snake vertebrae because not only are there far more of these in a single skeleton but they are a much sturdier element. Second, Clemens and Nelms (1993) noted that close relatives of modern terrestrial ectotherms such as snakes and lizards, were noticeable by their absence from the Late Cretaceous Alaskan dinosaur assemblages which otherwise closely resembled contemporaneous dinosaur assemblages from lower latitudes in Wyoming, Montana and Alberta where such ectotherms are not only present but a major part of those collections. Until the discovery of this possible snake, the Victorian polar dinosaur assemblage showed the same bias. Clemens and Nelms (1993) considered that the lack of terrestrial ectotherms was consistent with the polar position of Alaska in the Late Cretaceous with its consequent low mean assemblage (Rich, Gangloff and Hammer 1997). If the specimen proves to be a snake when its analysis is complete, this interpretation will have to be modified.

The presence in the Victorian dinosaur assemblage of dromaeosaurid theropod dinosaurs, the "raptors" of Jurassic Park, had long been indicated by a number of small to medium sized teeth. An ulna from here carried on this trip shows that not only were small dromaeosaurids present in Victoria, but an unusually large form lived alongside them.

A long-term goal central to the Victorian dinosaur project, has been to acquire variation data on the femora of small, bipedal ornithischian dinosaurs. The need for this is because half the dinosaurs from Victoria are hypsilophodontids, a subdivision of this group and those taxa are best represented by isolated femora. As the femora are the most abundant elements preserved, of necessity, small ornithischian taxonomy is heavily weighted towards analysis of that one bone.

Earlier visits to museums in both England and the United States had not revealed a sample of complete small ornithischian dinosaur femora large enough to be statistically significant, however, the Humboldt Museum, Berlin, finally provided just such a sample. It consisted of fifteen femora ranging in length from 119.6 mm to 366 mm of *Dryosaurus lettow -vorbecki*. Not only were eleven linear measurements recorded for each bone, but also visual comparisons were made of qualitative characters. These latter were the most important. What they showed was that the femora were remarkably consistent in the most minor features despite varying in size by a factor of three. It indicates that in recognising six femoral classes thought to represent a different genus among Victorian bipedal ornithischian dinosaurs, if anything, that is a conservative estimate of the actual diversity in this group. This amount of diversity among small bipedal ornithischians is unmatched in the more abundant dinosaur assemblages elsewhere where the total number of dinosaurian taxa can be as much as ten times that of Victoria.

Study of the dentitions of hypsilophodontids in a number of museums showed that while there is significant variation in the teeth of the Victorian members of this family, they do group together in a way clearly distinguishable from all the others examined. This is suggestive that the Victorian hypsilophodontids radiated within the continent of Australia perhaps from a single genus rather than their remarkable diversity being due to several episodes of interchange with other continents.

Clemens, W.A. & Nelms, L.G. 1993. Paleoecological implications of Alaskan terrestrial vertebrate fauna in the latest Cretaceous time at high latitudes. Geology 21:503-506.
Rich, T.H., Gangloff, R.A. & Hammer, W. 1997. Polar Dinosaurs. In: Padian, K. & Currie, P.J. (eds.), The Dinosaur Encyclopedia. Academic Press. Pp. 562-573.

FUTURE PLANS FOR THE DINOSAUR DREAMING PROJECT:

In many ways the 1998 Dinosaur Dreaming field season was one of transition. It was obvious by the end of the 1997 field season that it was becoming logistically too time consuming to continue exposing the site the way we had done in previous field seasons. The depth of the excavations below the shore platform and the limited time available each day to expose the fossil layer necessitated a different system. Nick van Klaveren spent many months of his own time before settling on a system, which we ultimately adopted. Transforming theory into practice took longer than we anticipated, but we now have a working system that we can build on and improve for the up coming season.

We also learned that we need to integrate Doris's data retrieval procedures into the daily excavation process, as her work is also vital to the overall understanding of this site.

The 1998 field season was also the first time an intensive training program was introduced to teach new volunteers how to recognise the small bones and teeth which represent the ancient fauna. The ability to recognise the different cross-sections, textures and colour variation of selected individual bones gave volunteers the confidence to identify newly exposed bones once they began rock breaking. In the light of the discovery of the three additional mammal jaws from previous field seasons, the volunteer training program will be improved for the 1999 field season.

Plans are well underway for the 1999 field season. It is anticipated that we will excavate the area immediately adjacent and to the west of the 1998 excavations, where Nick van Klaveren has anticipated the fossil layer is the thickest. A study of the rocky matrix in which the four mammal jaws have been found, suggests that they are not isolated to one particular layer. This is a good indication that they were more common than previously thought. With the improvements made to Nick's sand exclusion system and a tightening of the volunteer training program, we are very hopeful that Dinosaur Dreaming 1999 will produce an exciting result.

Of course, without the volunteers who gave us their time and enthusiasm, there would have been no field season. The work was often laborious and hard, especially removing the last of the wet sand from the hole, but every-one gave one hundred per cent, which is what makes a good crew. With so many people from all walks of life and from different backgrounds, it is always amazing to see how the love of fossils acts as a common bond. To everyone who participated in the 1998 field season I would like to offer my deepest thanks and hope to see some of you back again next year.

DINOSAUR DREAMING 1998 FIELD CREW

Marion Anderson
Helen Arcaro
Laura Carnegie
Mike Cleeland
Andre Coffa
David Davies
Alison Dorman
Peter Edwards
Caroline Ennis
Geoffrey Ennis
Allan Evered
Nicole Evered
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Christina Giatsios
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Gerrit Kool
Lesley Kool
Anne Leorky
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Geoffrey Meek
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Matthew Power
Michael Rinnecker
Andrew Ruffin
Doris Seegets-Villiers
Leah Schwartz
Lara Spine
Tomasina Spina
Daniel Timblin
Nick van Klaveren
Mary Walters
Sinead Weldon
Manuel Welt
Astrid Werner
Russell Wilk
Corrie Williams
David Young

The 1998 field season also depended a great deal on the generous support from a number of institutions, companies and individuals. We received logistical support in the form of tools and equipment, as well as monetary support which enabled us to feed and house the many unpaid volunteers who came from all over the world to take part in this unique dig. Finally we received moral support from the local people of Inverloch and the surrounding district. A number of fund-raising activities were organised before the field season, including the raffle of a gold-plated silver lapel pin, designed and produced by local jeweller, Denis Hawkins. This support is greatly appreciated by everyone involved in the Dinosaur Dreaming project and is vital to the continuation of the work at the Dinosaur Dreaming site.

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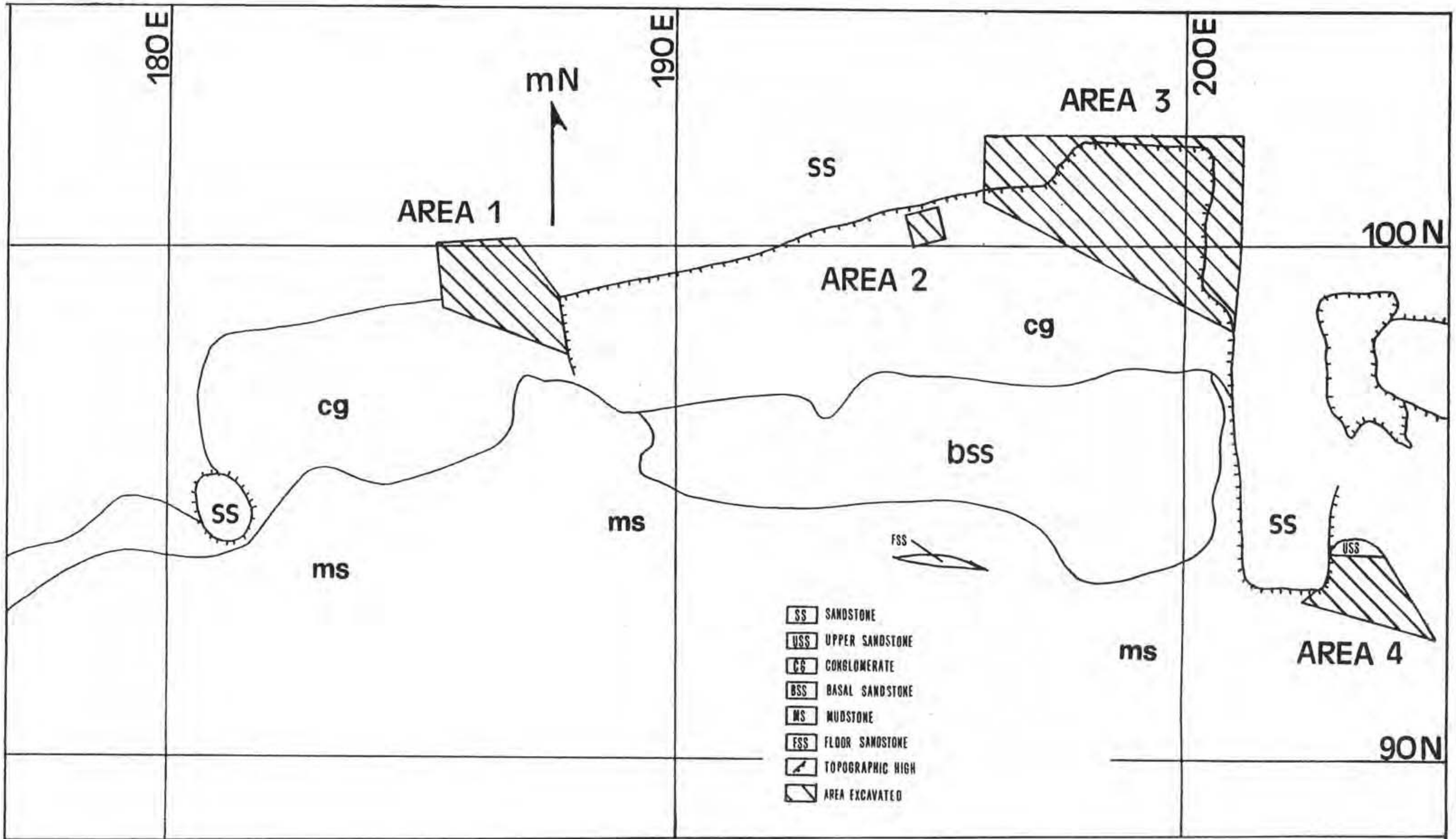

MAP NICK VAN KLAVEREN

DRAWN 26/3/98

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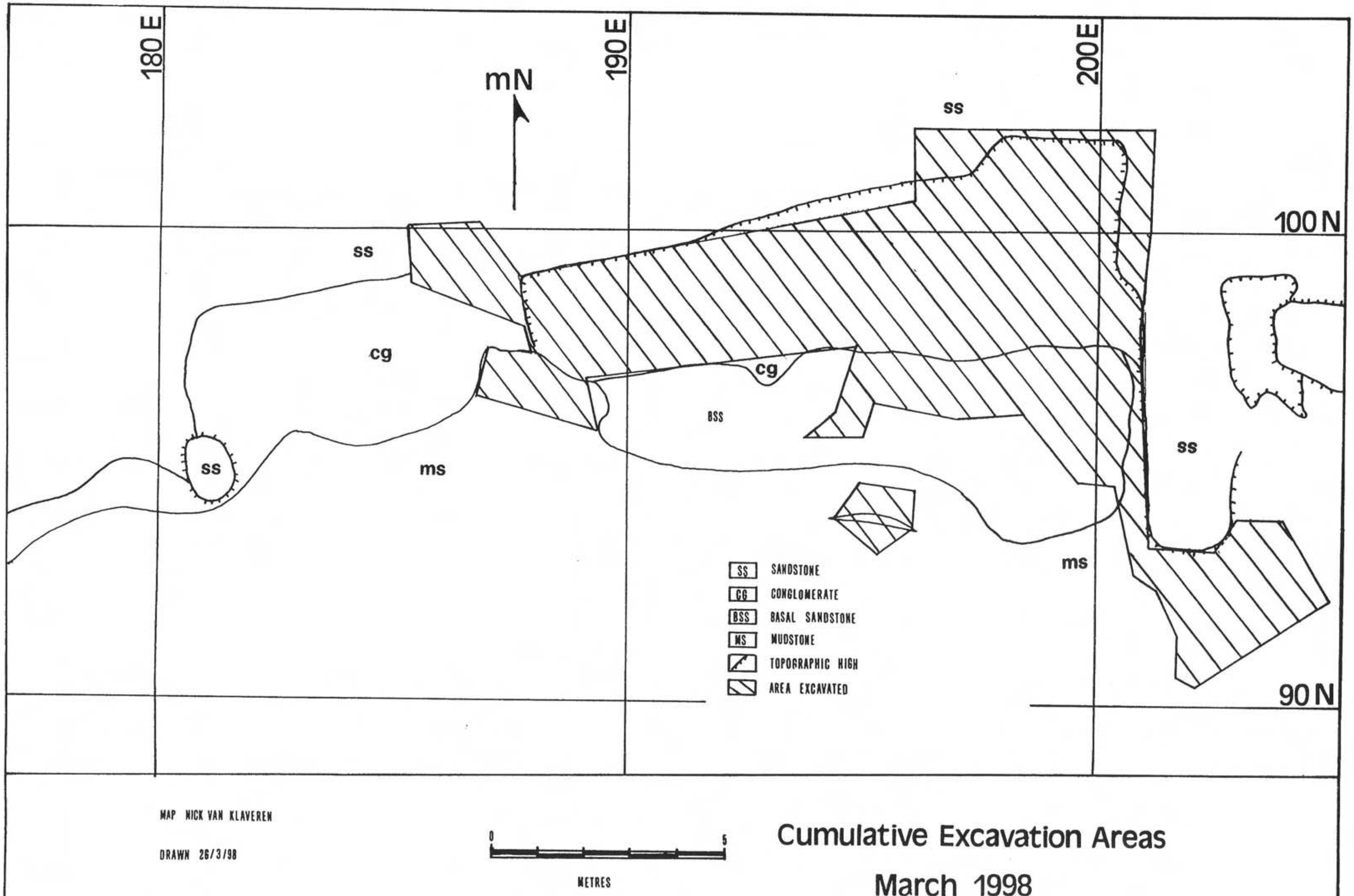
METRES

MAP 1

PROGRESSIVE EXCAVATION AREAS

MARCH 1998



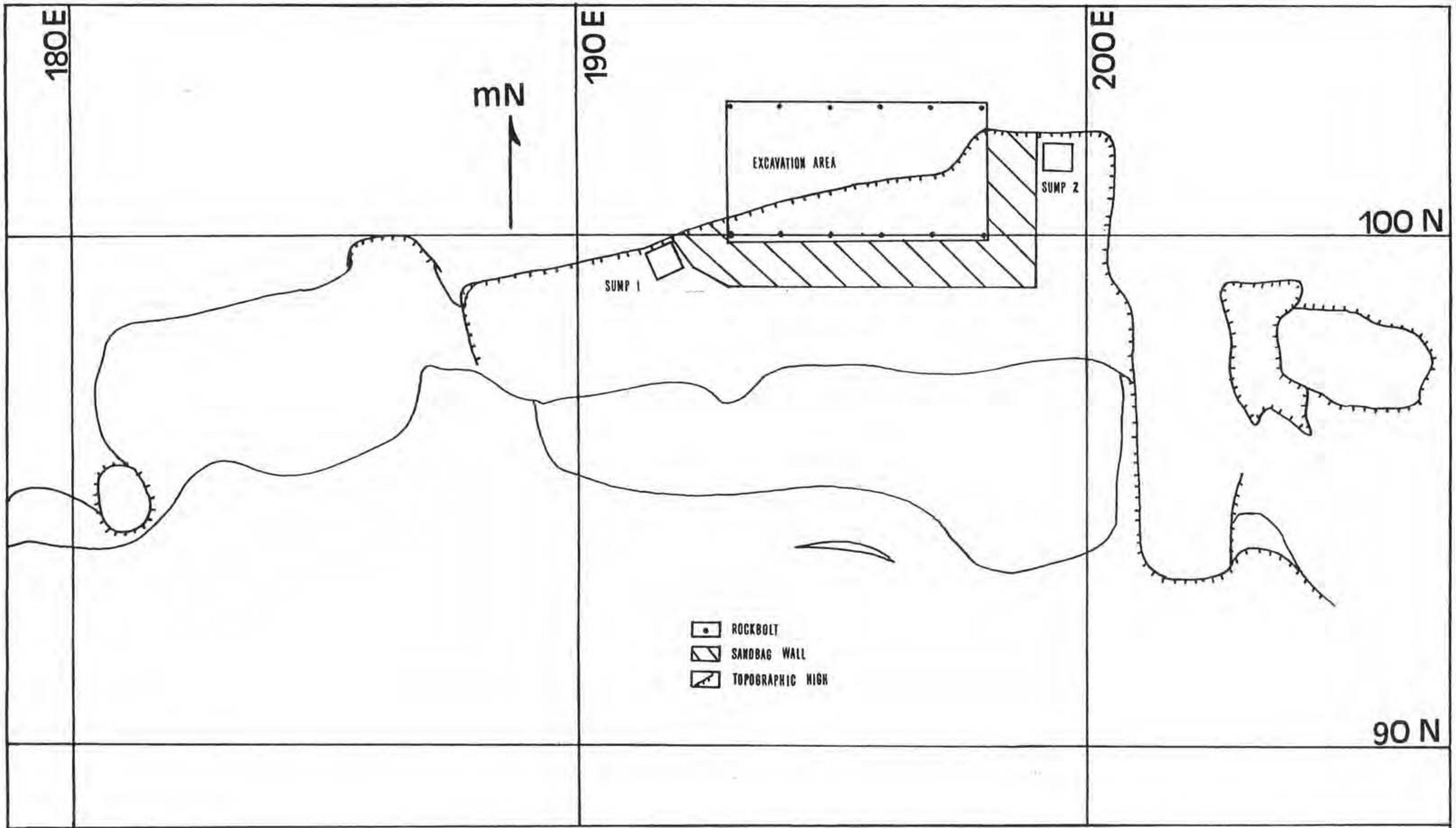
MAP NICK VAN KLAVEREN

DRAWN 26/3/98

MAP 2

Cumulative Excavation Areas

March 1998



MAP NICK VAN KLAVEREN

DRAWN 19/3/98

MAP 3

PROJECTED EXCAVATION

AREA 1999