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Front cover:
Dead standing black box Culturally Modified Tree along Kromelak *(Outlet Creek) (Photo: Darren Griffin)*

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Editorial note

The papers included in this ninth issue of *Excavations, Surveys and Heritage Management in Victoria* were presented at the annual Victorian Archaeology Colloquium held at La Trobe University on 1 February 2020. Once again we had over 150 participants whose attendance testifies to the importance of this fixture within the local archaeological calendar. It continues to be an important opportunity for consultants, academics, managers and Aboriginal community groups to share their common interests in the archaeology and heritage of the State of Victoria.

The papers published here deal with a variety of topics that span Victoria's Aboriginal and European past. While some papers report on the results of specific research projects others focus on aspects of method, approach, education and the social context of our work. and approach.

In addition to the more developed papers, we have continued our practice of publishing the abstracts of other papers given at the Colloquium, illustrated by a selection of the slides taken from the PowerPoint presentations prepared by participants. These demonstrate the range of work being carried out in Victoria, and we hope that many of these will also form the basis of more complete studies in the future. All papers were refereed by the editorial team. This year Elizabeth Foley managed this process and the sub-editing of this volume under the guidance of Caroline Spry. Layout was again undertaken by David Frankel.

Previous volumes of *Excavations, Surveys and Heritage Management in Victoria* are freely available through La Trobe University's institutional repository, Research Online < www.arrow.latrobe.edu.au:8080/vital/access/manager/Repository/latrobe:41999 >. We hope that this will encourage the dissemination of ideas and information in the broader community, both in Australia and internationally.

We grateful to the Colloquium's major sponsors ACHM, Ochre Imprints, Ecology and Heritage Partners and Heritage Insight; sponsors Biosis, ArchLink, Christine Williamson Heritage Consultants and Extent; and to la Trobe University for continuing support. We would like to thank them, and all others involved for their generous contributions towards hosting both the event and this publication. Yafit Dahary of 12 Ovens was, as always, responsible for the catering.

Preparation of this volume was, like so much else in 2020, undertaken during the severe restrictions imposed because of the COVID-19 pandemic. We hope that 2021 will be a better year for all and that even if we are unable to hold our Colloquium at the usual time we will be able to do so later in the year.

The editors and authors acknowledge the Traditional Owners of the lands and heritage discussed at the Colloquium and in this volume, and pay their respects to their Elders, past and present.

Results of recent archaeological investigations at Pejark Marsh in Western Victoria

Asher Ford, Jocelyn DeJong Strickland and Linda Sonego

Abstract

This paper discusses recent archaeological investigations at Pejark Marsh which have re-examined earlier 20th Century archaeological investigations and commentary of the site. A discovery of an Aboriginal stone artefact, interpreted as a millstone and megafauna remains in and directly above nontronite yellow clay, but below volcanic tuff layers at Pejark Marsh, prompted several geological and climatic interpretations of the Pejark Marsh geological sequence . These earlier interpretations have been re-examined in light of recent well-dated pollen sequences revealed from Lake Terang and Pejark Marsh, providing a revised age of between 45 and 51 ka for the tuff layer, and a minimum age estimate for the Aboriginal millstone and megafauna remains.

Recent geotechnical testing indicates that there are likely more variations to the nontronite yellow clay layer than originally uncovered by Gill in 1953 which may reflect that deeper clay profiles are highly localised and represent changes in water levels and outlet locations of the marsh over time. Therefore, while it appears likely that the Aboriginal millstone may be contemporaneous with megafauna remains, the geomorphological processes that formed these deposits requires further investigation. More recent archaeological investigations have identified Indigenous cultural material above the volcanic tuff layer, indicative of later human activity focused on the fresh-water marsh. These recent investigations were limited in depth, not penetrating the tuff layer. Future work should focus on the sequence as a whole, particularly in regards to clarifying the geological and potential archaeological sequence below the tuff horizon.

Introduction

Pejark Marsh is a volcanic maar, a broad low-relief volcanic crater created by magma contacting water-rich sedimentary layers, located on the northeastern outskirts of Terang in Western Victoria. Following the identification of Aboriginal cultural material in 1908 by workers constructing a culvert, Pejark Marsh sparked archaeological interest in the early and mid-20th Century in regards to discussions on the antiquity of man and former climates in Australia (Gill 1953; Keble 1945, 1947; Mahony 1943; Spencer and Walcott 1911). Archaeological investigations have been undertaken in 2019 at Pejark Marsh by GHD on behalf of Acciona, in consultation and with the assistance of the Eastern Maar Aboriginal Corporation. This paper discusses the results of 2019 archaeological investigations, as well as the implications of palynology studies at the marsh (Wagstaff et al .2001) for interpreting the results of earlier studies.

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Background information and description of Pejark Marsh

Pejark Marsh is one of 40 volcanic maars located on the southern edge of the Western Plains between Colac and Warnambool (Wagstaff et al. 2001:212). Volcanic activity in the area is believed to have started approximately 4.6 ma and has continued up until very recent times. There are few published ages for maars and scoria cones on the Western Plains, but some eruption dates for younger (< 100 ka) maar and scoria cone formations have been bracketed through radiocarbon or optically-stimulated luminescence (OSL) dating of the sediments overlying and underlying volcanic ash or tuff layers (Matchan et al. 2016:176).

Maars are low-relief volcanic craters caused by phreatomagmatic eruptions where rising magma has come into contact with surface water. They are usually surrounded by tuff rings, the result of rapid cooling of volcanic ash by water (Rosengren 1994). The typical bowl-shaped crater with a low rim of maars can be formed within a minute or up to half an hour (Nunn et al. 2019:1619). The majority of maars in the region are complex maar-scoria formations, for example, the scoria cone complexes of Mount Noorat and the Terang Township, located to the north and south of Pejark Marsh respectively (**Figure 1**). Pejark Marsh is rare in that it is a simple volcano, along with nearby Lake Keilambete (Boyce 2013:453, 457).

Pejark Marsh is more or less circular in shape with a northern protrusion and is surrounded by a wide

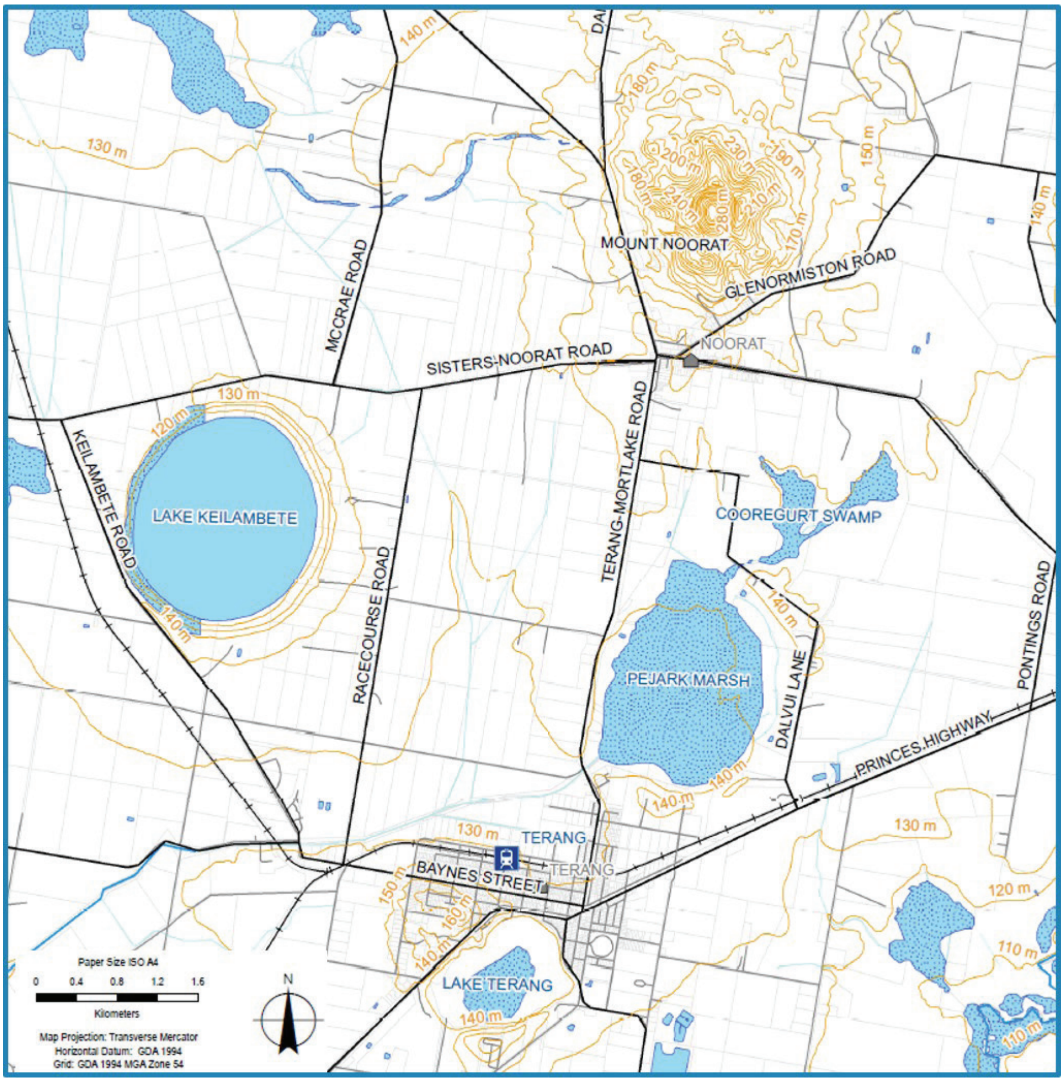

Figure 1. Pejark Marsh and surrounds

but shallow crater that evens out into the surrounding plains. The inside slope of the maar rim is reasonably steep at approximately 30 degrees. There are currently no streams flowing into the maar, but it does join with Cooregurt Swamp to the north and appears to have had an outlet to the southwest. Before European settlement, the marsh was a fresh-water swamp with a dense cover of *Leptospermum* tea tree scrub, surrounded by open eucalypt woodland (Keble 1947: 48; Wagstaff et al. 2001:213). In the early 1890s, vegetation was cleared and the marsh was drained via a series of channels (Spencer and Walcott 1911:93). The present-day vegetation in the area is largely open farmland and pasture for stock grazing (Wagstaff et al. 2001:213).

Pejark Marsh Archaeological Site

Pejark Marsh was a location of archaeological, geological and paleontological interest to the National Museum of Victoria (now Museums Victoria) during the early to mid-20th Century (Spencer and Walcott 1911; Keble 1947; Gill 1953), largely focused on the southwest outlet area (**Figure 3**). A review of these twentieth century studies including excavations undertaken by Spencer and Walcott (1911) and geological interpretations for the antiquity of Aboriginals in Australia (Keble 1947; Gill 1953), provides crucial information about the geology and history of settlement in the area.

Archaeological interest was sparked when in 1908, a local Terang resident, A. J. Merry, found what he believed to be an Aboriginal stone artefact in deep clays, while undertaking excavations for a culvert over the southwestern channel outlet at Pejark Marsh. Merry reported the find to the National Museum of Victoria, noting that the artefact was found within a yellow clay layer approximately 2.5 m below ground. He further stated that numerous megafaunal remains were located between the yellow clay and an overlying black clay (Keble 1947). A photograph of the stone artefact published in an article by Mahoney (1943), as shown in

Figure 2, and was characterized as a quartzite millstone.

Subsequent excavations by Spencer and Walcott (1911:93) in 1908 encountered variation in the depth of the stratigraphy, due to variation in the underlying clays and deposits. In one area they reported about 3 ft (0.9 m) of heavy black alluvial soil, 18 inches (0.45 m) of volcanic tuff and 5 ft (1.5 m) of black clay, overlying a yellow clay. Near the culvert that drained the marsh and the location of the millstone, the underlying clay was more like 'a few hardish, brown, ironstone nodules' (Spencer and Walcott 1911:93) rather than yellow clay. Further west there was a thinner layer of black clay and between the black and yellow clays there was a nodular cement. Spencer and Walcott (1911:93) found a few bone fragments in the thin layer of black clay, but all the remaining bones were found where the black and yellow clay layers met. The bones were found to have been modified by large animals, quite possibly by *Thylacoleo,* with no evidence for human involvement (Spencer and Walcott, 1911:103).

Mahony (1943) would later describe Pejark Marsh in a broader review of archaeological sites across Australia, while building an argument for a multi-phased Aboriginal occupation of Australia. He noted that:

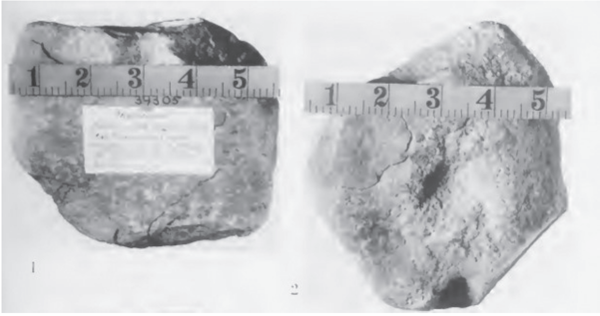

Figure 2. Quartzite millstone from Pejark Swamp top and base views (reproduced from Mahony 1943)

> *... many claims for antiquity of man in Australia have been based on artefacts found, or alleged to have been found, in consolidated dunes, beneath lavas or tuffs of the Newer Volcanic period, in beds containing bones of extinct marsupials, associated with raised shorelines, or buried beneath alluvium (Mahony 1943:23).*

Mahony (1943:23–40) discussed both academic and amateur finds of Aboriginal cultural material in Australia in the context of developing geological and

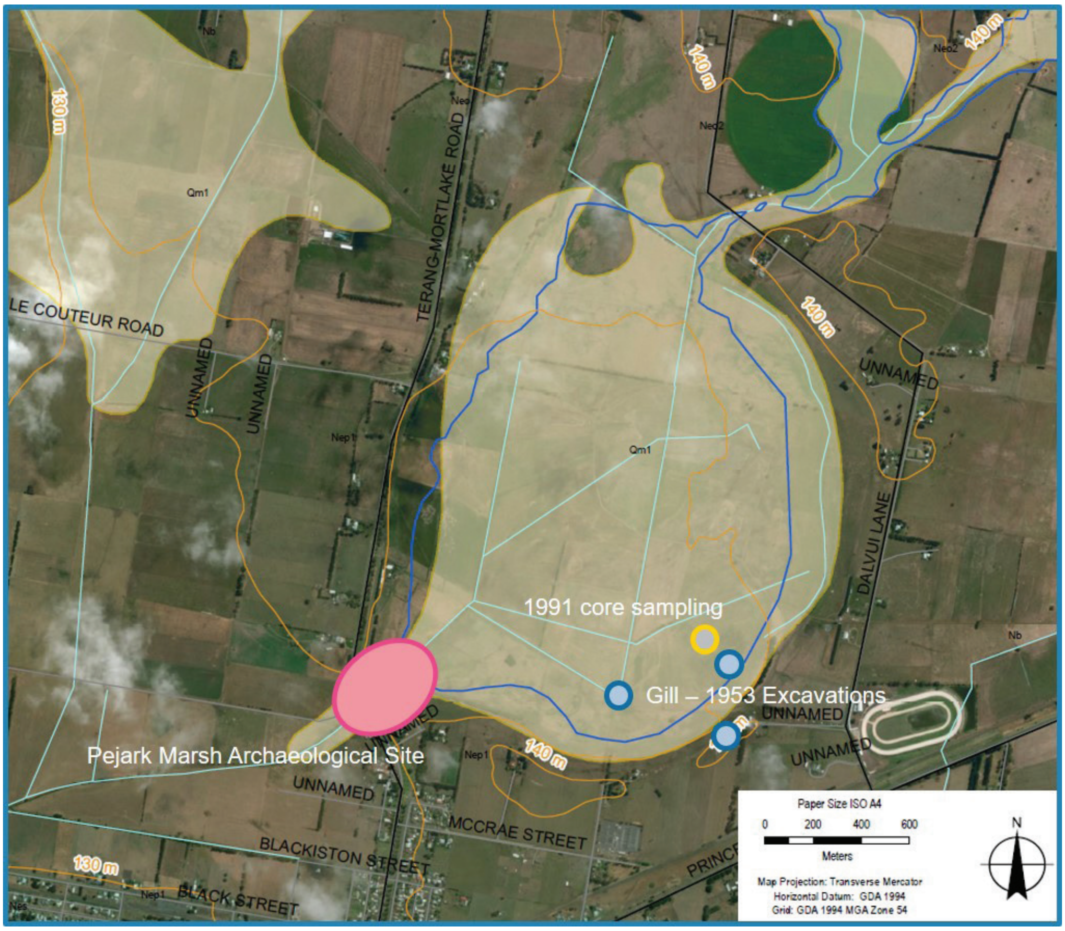

Figure 3. Locations of previous investigations at Pejark Marsh

climate interpretations, including the Wellington, Talgai, Tartanga, Devon Downs, Keilor, Aitape, Tower Hill, Myrniong Creek, Perjark Marsh and others. In the case of Pejark Marsh, Mahony (1943:39–40) described the finds by Merry and the results of the excavations by Spencer and Walcott. Mahony (1943:44) suggested that the Pejark Marsh site required further investigation and broadly concluded that Aboriginal arrival in Australia was likely to date to the Pleistocene and was 'certainly ancient in the historical and almost certainly the geological sense'.

Following Mahony's review, Keble (1947) undertook further archaeological investigation at Pejark Marsh, focused on verifying the original accounts of Merry and another local informant, Harvie, as well as confirming the results of Spencer and Walcott's excavations. In reviewing Merry's account, Keble was most interested in confirming the provenance of the millstone. Merry stated in correspondence to the Museum in 1909 that:

> *The implement was embedded with the bones in the yellow clay, it was impossible for it to have fallen in from the overlying beds and I was very careful with it, as when I struck it with the shovel I thought it was a large bone, and wanted to get it out without breaking it. It was 3 feet in from the bed of the drain, and 2 feet below same in the solid clay under sandstone 3 feet in width which I had cut away (Keble 1947: 47).*

Keble further summarises Merry on earlier finds by Harvie:

> *Mr R. Harvie, one of the men worked in the opening of the drain in the first place, informed Mr Merry that he dug up a stone implement, said to be a grindstone, about a chain below the culvert, 9 feet from the surface, which is about the top of the yellow clay, and 4 feet below the 'sandstone'. (Keble 1947:47).*

Keble also relates another find of a stone axe by Merry while excavating for the culvert:

> *Whilst removing some clay I had previously thrown out from the excavations I came on another broken implement, this time of a dark blue colour ... I missed seeing it when I first threw it out, I think it must have been in a big spit, and the clay all round it hid it from view (Keble 1947:47).*

Merry was unsure of the provenance of this second artefact, only that it was from below the 'sandstone', i.e. the volcanic tuff. Keble concluded that he found no reason to dispute the authenticity of Merry's account, as he was reliable witness and had no personal interest attached to the discovery. However, Keble (1947) dismissed the importance of the stone axe as it was not located in situ.

Keble excavated near Merry's original find and encountered stratigraphic profiles and fragmented megafauna remains similar to those described by Merry, Spencer and Walcott. Based on his interpretations of climate and nearby volcanic activity, Keble estimated that the Pejark Marsh upper tuff and underlying black clays, which also contained volcanic materials, likely accumulated 2,000 years ago (Keble 1947:45). Keble further suggested that the texture of the yellow clay suggested that it had accumulated from airborne material during the arid period of the last Postglacial Optimum. These geological and climatic interpretations led Keble to argue that Pejark Marsh millstone probably less than 3,000 years BP in age, relating to the Holocene (1947:50).

Gill (1953:64) also visited Pejark Marsh, building on Keble's investigations to further describe geological evidence in Western Victoria. His investigations at Pejark Marsh focused on further investigations into the extent and age of the volcanic tuff and the underlying yellow clay layer. Gill undertook a further three excavations near the drainage channel in the south-eastern margins of Pejark Marsh (**Figure 3**) and confirmed the presence of what he referred to as 'Terang Tuff' in these areas, however he was uncertain of its northern extent.

The stratigraphy uncovered during excavations in the southeast corner of Pejark Marsh were c. 15 cm (6 inches) of black peaty loam over the same amount of dark grey to black silty clay with pond snails (*Lenameria sp.*). The dark grey to black silty clay was found over a brownish tuff with a type of bacteria (*Coxiella sp.*), but this layer of brownish tuff layer was not penetrated (Gill 1956:66). Gill summarised archaeological investigations prior to 1953 and developed a geological profile that reflected the result of his (1953:63) and earlier excavations (Spencer and Walcott 1911; Keble 1947).

From a depth of 0–0.9 m the soil profile sequence consisted of black alluvium sticky clay. 0.9–1.5 m the soil profile is predominantly 'Terang Tuff'. 1.5–3.3 m a second band of black alluvium sticky clays occurs. 3.3–4.3 m nontronite sulphuric yellow clay is present. 4.3–5.3 m a reddish hard pluvial clay occurs. Lastly, from 5.3 m onwards a soft water baring stratum is present (Gill 1953:63).

In attempting to interpret the geological profile of Pejark Marsh, Gill (1953:66) speculated that both Lake Terang and Pejark Marsh were relatively young because they were fresh-water marshes. This was based on the contemporary understanding that salt accumulates over time and is derived from cyclic salt, that is salt from water that is transported by wind and deposited by rain. Gill (1953:62) further surmised that the tuff encountered at Pejark Marsh was probably associated with the Lake Terang maar eruption, approximately 1.6 km south of Pejark Marsh. The lack of additional sediment mixed in with the tuff layer also suggested to Gill (1953:62) that the tuff remains where it was deposited. He interpreted the upper sedimentary layers, black alluvium and tuff layers as likely dating to the Upper Holocene.

The lack of aeolian deposits at Pejark Marsh was also noted, and Gill (1953:70) interpreted a layer directly above the yellow clay as an eroded layer of the same clay. This theory was informed by laboratory tests of the yellow clay, which indicated that it was nontronite which develops under stagnant water-reducing conditions. Gill (1953:63–68) concluded that the bone fragments of the megafauna formed a cluster from an earlier bed that rested on top of the yellow clay that was deposited after the mid-Holocene arid period. As the millstone had been recovered from the yellow nontronite clay, Gill (1953:63, 69) concluded the millstone was likely to be from either the Early Holocene or late Pleistocene.

It should be noted that both Keble and Gill investigated and wrote about Pejark Marsh in the context of addressing broader research questions of the time, such as the antiquity of Aboriginal Australians using geological information. Walcott, Keble and Gill all held geological positions at the National Museum of Victoria. Interest in Pejark Marsh appears to have diminished with the introduction of direct dating techniques, of which Gill was an earlier adopter and academic interests shifted to other sites in Australia once these technologies become available (Spriggs 2020). While testimony from Merry and Harvie suggest that Aboriginal people were contemporary with megafauna at Pejark Marsh, the lack of overlap between megafauna and cultural material in any of the subsequent excavations by Spencer and Walcott, Keble or Gill, is likely to have dampened interest in Pejark Marsh as a potential research site (Gill 1953:25).

Geological and palynological investigations

Investigations into the geology and palynology of western Victoria continued outside of archaeological concerns in the 20th Century. Studies into the geological age of Pejark Marsh occurred as part of palynological research, with the aim of extending 'the Quaternary record of vegetation and climate within the Western Plains region and to contribute towards the establishment of a Quaternary biostratigraphy for southeastern Australia' (Wagstaff et al. 2001: 211).

The palynological sequence of Pejark Marsh suggests that it was originally an open un-vegetated water basin that was quite deep. It then became shallower with some vegetation, transforming into a swamp with peat deposits followed by a later larger infilling of the crater and an increase in the amount and variation of taxa (Wagstaff et al. 2001:228).

Core samples were taken from Pejark Marsh in 1991 (**Figure 3**) with some sample dated using radiocarbon dating, uranium/thorium (U/Th) disequilibrium dating and zircon fission-track dating. The core sample is significant because it was the first core sample to reach to the bottom of a volcanic crater sequence in Australia (Wagstaff et al. 2001:228).

Analysis of sediment core samples from a depth of seventy metres from the maar surface found that the basal 10 m of sediments were made up of Gellibrand Marl spanning from the Oligocene to Middle Miocene period (Wagstaff et al. 2001:214–215). Directly overlying this layer are 20 m of volcanic sands, which were deposited during volcanic activity in the area when material collapsed from the inner rim of the maar into carbonated shallow water. Above this is a layer consistent with lake deposits ranging from 6.9 to 0.36 m. These deposits are comprised of sandstone and mudstone, peppered with volcanic sands and bands of peat between 24.9 to 24 m and 4.3 m to 3.6 m. A layer of tuff follows the topmost band of peat deposits, the 'Terang tuff' identified by Gill.

Zircon fission-track dating has shown promise for estimating the age of tuffaceous layers that are considered to be geologically young (Wagstaff et al. 2001:213). It was applied to samples at a depth of 63.3 m yielding a date of 980 ± 9 ka. One sample from a depth of 3.1–3.5 m within the capping tuff, the 'Terang Tuff', yielded a date of 740 ± 11 ka (Wagstaff et al. 2001:229). Only one sample from 3.63–3.65 m was datable by U/Th. This layer is just under the Terang tuff layer and was dated to 15 ± 5 ka. Radiocarbon dating of a slightly higher layer, 3.5–3.6 m, yielded results of 45 ka (Wagstaff et al. 2001:215).

Palynological studies have also been used to establish a chronological record of Lake Terang, the eruption point cited as the likely source of the capping tuff at Pejark Marsh (Keble 1947, Gill 1953). While contamination of potential samples has limited radiocarbon dating, D'Costa and Kershaw (1995) correlated the pollen sequence of Lake Terang with the Lake Wangoon, which has a similar regional setting and more continuous pollen sequence that has been reliably dated. D'Costa and Kershaw (1995:65) suggest that the Lake Terang sequence has a basal age of 51,000 BP.

While the zircon fission-track and U/Th samples offer wildly different date ranges, the radiocarbon dating at Pejark Marsh correlated with pollen sequences from Lake Terang and Lake Wangoon suggest a date range somewhere between 45 and 51 ka for the Terang Tuff. This estimation would suggest that the geological interpretations made by Keble (1957) and Gill (1953) that the Lake Terang eruption was very recent (i.e. Upper Holocene) are incorrect and that the Terang Tuff and underlying layers likely date to the Late Pleistocene. The yellow clay in which the millstone was located does not correlate to a Holocene arid period as interpreted by Gill.

Recent CHMP investigations undertaken at Pejark Marsh

More recent archaeological investigations in the area of Pejark Marsh mostly consist of assessments for cultural heritage management plans (CHMPs) (Carr 2017, 2018; Ford and Macklin 2019) and salvage excavations (Sonego et al. 2020) (**Figure 4**). Investigations by Carr included archaeological survey and targeted archaeological hand excavation on the maar crest and rim, which had been identified as areas of potential for Aboriginal cultural material (Carr 2017, 2018). Excavations encountered shallow silty clays over a clay base (< 0.4 m), with no Aboriginal cultural material encountered.

Geotechnical testing in the area of the millstone discovery at Pejark Marsh was undertaken by Jacobs (Carr 2018). Testing was executed using push-tube bore holes at five locations searching for the yellow nontronite clay layer described by Gill (1953). Testing identified a high degree of disturbance in the upper stratigraphic layers and a pale brown silty clay layer that Carr suggested correlates to the yellow nontronite clay layer described earlier by Gill. The study recorded the pale brown silty clay being reached at depths varying between 3.5 m and 8 m (Carr 2018).

Ford and Macklin (2019) undertook an archaeological survey on the southern maar crest, inner slopes and maar base. As a result of greater surface visibility, surface artefacts were identified on the lower slopes of the maar and the maar base. A sample 1 x 1 m test pit was excavated near surface artefacts on the lower slopes of maar to 450 mm silty cracking clays, with seven quartz artefacts being recovered. Reflecting on the results of previous CHMP testing (Carr 2017, 2018), difficulties of hand excavation and relevant densities of artefacts being encountered, it was decided to undertake a mechanical test excavation program across the landforms of the maar.

A total of 15 mechanical test trenches (MTTs), 3 x 1.2 m in size, were excavated across the maar. MTTs were situated on the maar rim upper slopes (MTT1 and MTT6), maar rim lower slopes (MTT2 and MTT3), maar base (MTT4, MTT5, MTT10, MTT11, MTT12, MTT13, MTT14, MTT15), maar rim crest (MTT7) and sedimentary plains west of Pejark Marsh (MTT16 and MTT17). Excavations were limited to 2 m in depth, matching the proposed activities being investigated by the CHMP (Ford and Macklin 2019).

In total, 138 flaked artefacts were identified during the surface and subsurface investigations (three surface and 135 subsurface). All artefacts were found in the cracking silty clay layer of the Pejark Marsh maar rim and base, and were found at depths between 0 to 0.7 m. The majority of artefacts were found in the first 0.4 m and no artefacts were found in the tuff layer, which was considered to be a culturally sterile layer. It should be noted that the depth of volcanic tuff deposits underlying cracking silty clays varied across Pejark Marsh (between 0.6 and 1.5 m), with tuff on the slopes having a higher moisture and clay component, compared to tuff deposits on the maar base which are drier and characterised locally as 'Pejark Sandstone'. At no point was the tuff penetrated as excavations were limited to 2 m.

In particular, the previous borehole excavations identified significant variation in the depths (between 3.4 m and 8 m) of Gill's nontronite sulphuric yellow clay around the maar (Carr 2018). A likely explanation for this is that the borehole excavations as well as the discovery of the megafauna and Aboriginal artefacts were located on or near an outlet of Pejark Marsh. The deeper clay profiles may be highly localised and represent changes in water levels and outlet locations of the marsh over time. More definitive research would be required to confirm the age of the yellow clay and potential variations in the sequence.

Higher artefact densities and deeper deposits of silty clay were located on the lower slopes of the maar rim (between 7 and 11.6 artefacts per m^2), which is a sheltered location. Lower artefact densities were encountered on the base (between 2.5 and 3.8 artefacts per m^2) and upper slopes (between 1.1 and 6.9 artefacts per m^2) of the maar rim, which then appear to transition into low density artefact scatters north towards Pejark Marsh and south towards Terang. The low density of artefacts (0.3 artefacts per m^2) recorded on the crest of the maar are consistent with the absence of Aboriginal cultural heritage material encountered by Carr (2017, 2018) who concentrated on testing the upper maar landform.

It was concluded that the places around Pejark Marsh probably represent a low density scatter from movement of Aboriginal people around the marsh and the large artefact scatter found across the crest, upper and slower slope of the southern Pejark Marsh maar rim most likely represents repeat visitation to a sheltered location in close proximity to the marsh. These landforms would have been an ideal location for sheltering as the maar rim is both elevated and in close proximity to food and water resources (Ford and Macklin 2019). Broader testing of the landforms and other inner maar rim locations around Pejark Marsh are recommended in order to test this assumption.

A number of limitations were noted during the CHMP process. These limitations related to difficulties in dry sieving the cracking silty clay layer and the sticky tuff layer. Salvage excavation therefore offered opportunities to further assess the effectiveness of wet sieving versus dry sieving of the cracking silty clay and tuff layers of the marsh rim. It also offered opportunities to gather additional information regarding the stratigraphic deposition of the artefact scatter.

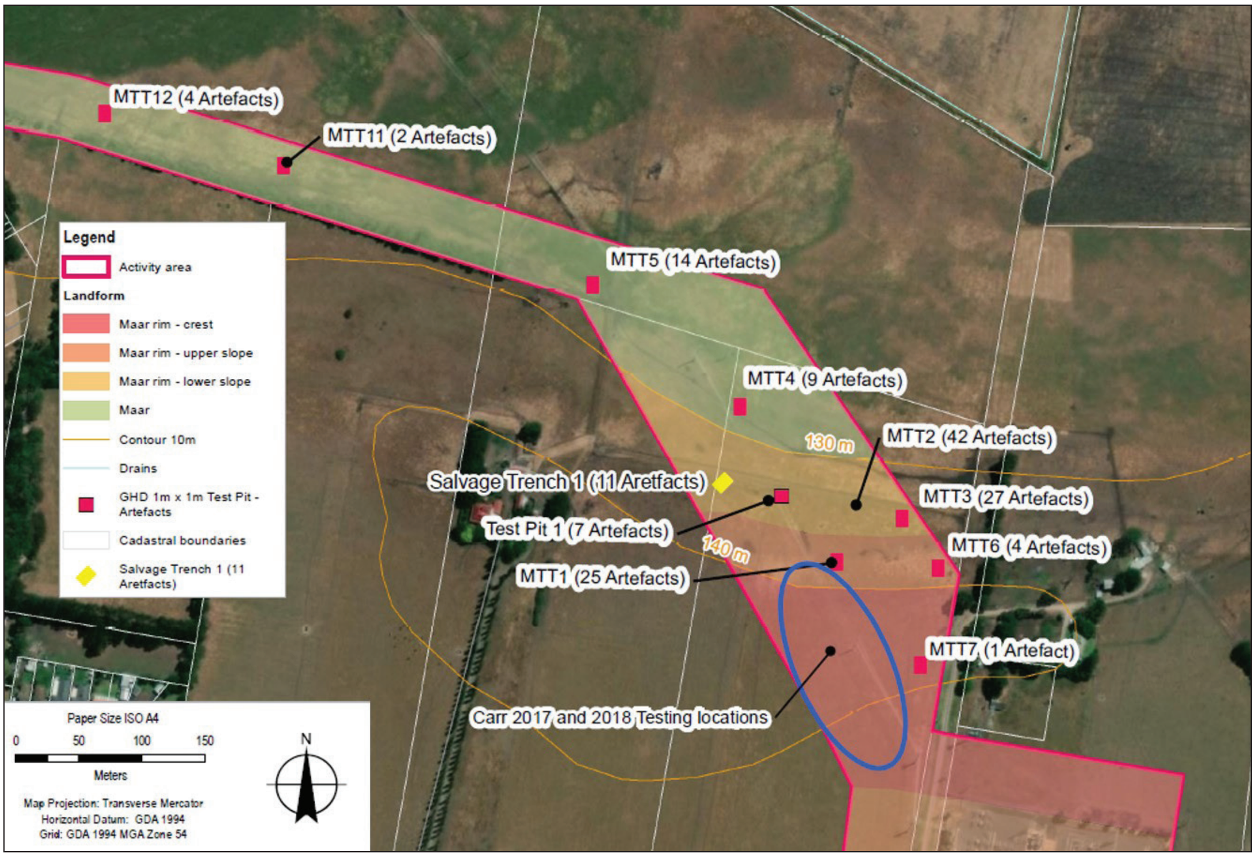

Figure 4. Recent CHMP investigations

A 1.2 x 3 m mechanical test trench was excavated to a depth of 1.5 m on the lower maar rim slope and wet sieved as part of salvage excavations (Sonego et al. 2020). The compact silty clays were very difficult to wet sieve and required high quantities of water; approximately 1000 l for each mud bucket of silty clay and 500 l for each mud bucket of tuff. Despite these limitations, wet sieving was found to be effective at establishing the presence/absence of Aboriginal cultural material, as all excavated material was able to be sieved. Eleven artefacts were found during excavation; all within the cracking silty clay layer between 0.1 and 0.8 m with the majority found in the first 0.4 m. No artefacts were located in the sticky tuff layers, supporting the findings of the complex assessment that this is a culturally sterile layer (Sonego et al. 2020:41).

CHMP (Carr 2017, 2018; Ford and Macklin 2019) and salvage excavations (Sonego et al. 2020) were limited to upper cracking silty clay and tuff layers dating from the present to the Upper Pleistocene (D'Costa and Kershaw 1995; Wagstaff et al. 2001). These limitations were largely a result of negative test results, i.e. artefacts were not encountered, or as a result of the limited depth of the activity (i.e .2 m) for which CHMPs were being prepared. However, the historical evidence indicates that there is further potential for Aboriginal cultural material to be present below tuff layers. Deeper geotechnical testing in the area of the millstone discovery at Pejark Marsh, suggests that soil profiles below the tuff are not uniform across the marsh or its outlet, particularly in regards to the yellow nontronite clay layer described by Gill (1953). This may be the result of highly localized changes in water levels and outlet locations of the marsh over time.

Conclusions

Recent investigations (Carr 2018; Ford and Macklin 2019) largely confirm the upper stratigraphic profile of Pejark Marsh as established in the mid-20th Century (Gill 1953; Keble 1947) but palynological investigations (Wagstaff et all 2001) significantly revise the chronological estimates made by Keble and Gill. The upper capping tuff layer is not as recent as first thought, with a probable date range of 45 to 51 ka (D'Costa and Kershaw 1995; Wagstaff et al. 2001). This also indicates that Gill's nontronite yellow clay deposit, and therefore the Aboriginal millstone excavated by Merry, situated below the tuff, likely date to the Upper Pleistocene.

Recent geotechnical investigations have documented that deeper clay profiles are not uniform. In particular, borehole excavations have identified significant variations in the depths (between 3.4 and 8 m) of Gill's nontronite yellow clay around the maar (Carr

2018). A likely explanation for this is that the borehole excavations, as well as the deeper clays where the megafauna and Aboriginal artefacts were found, are on or near an outlet of Pejark Marsh. The deeper clay profiles may be highly localised and represent changes in water levels and outlet locations of the marsh over time. More definitive research would be required to confirm the age of the yellow clay and potential variations in the sequence.

More recent archaeological investigations have also identified Indigenous cultural material above the volcanic tuff layer (Ford and Macklin 2019; Sonego et al. 2020), while Merry was confirmed to have located an Aboriginal millstone below it (Keble 1947; Gill 1953). The updated chronology for the tuff layer suggests that it separates a Pleistocene sequence, with any underlying deposits of considerable antiquity. Recent archaeological investigations have been limited in depth, not penetrating the tuff layer, and earlier archaeological investigations did not encounter any Aboriginal cultural material (Gill 1953; Keble 1947; Spencer and Walcott 1908). As a result, the geological and archaeological sequence below the tuff layer need further investigation, particularly in regards to teasing out the nature of the deeper nontronite yellow clay and its context.

Acknowledgments

GHD would like to acknowledge that these investigations took place on the traditional lands of the Eastern Maar and would like to thank the Eastern Maar Aboriginal Corporation and field representatives for their knowledge and input. GHD would also like to thank Eastern Maar Aboriginal Corporation and Acciona for permission to publish the material in this paper.

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