Excavations, Surveys and Heritage Management in Victoria

Volume 9

2020

Excavations, Surveys and Heritage Management in Victoria
Volume 9, 2020

Edited by

Elizabeth Foley

David Frankel

Susan Lawrence

Caroline Spry

with the assistance of

Ilya Berelov

Shaun Canning

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

Excavations, Surveys and Heritage Management in Victoria Volume 9, 2020

Melbourne

ISSN 2208-827X

Contents

Abstracts

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.

Going over old ground: modeling historical landscape change in Victoria using GIS

Greg Hil[1], Susan Lawrence[1] and Diana Smith[2]

Abstract

Historical land-use descriptions are an important aspect of cultural heritage management in Victoria. Determining prior uses of a landscape can help archaeologists to predict the presence and condition of prior ground surfaces during the planning stages of a cultural heritage assessment. Unfortunately, prior land-uses are almost universally considered through the lens of ground 'disturbance', which can limit the inferential potential of past activities. This is particularly true for the outcomes of industries such as mining and urbanisation. In this paper, we present a means of reframing prior land-uses by characterising and categorising their possible stratigraphic outcomes. This framework is paired with a GIS-based approach for comparing nineteenth century topographic maps with more recent records of elevation. The potential of this approach is highlighted by its presented use at Ballarat and Melbourne's Hoddle Grid (CBD), where significant increases and decreases in historical elevation levels are identified. When combined with the historical record, this form of modeling could provide archaeologists with a new means of considering historical land-uses as they relate to the current condition of the archaeological record.

Introduction

The nineteenth century was a formative period for much of Victoria's contemporary cultural landscape. From the 1830s, industries such as mining, forestry, and agriculture, combined with urbanisation to reshape Victoria's surface into something akin to the landscape we recognise today. As the state continues to be transformed it is now often the task of archaeologists to interpret how those prior landform changes relate to the archaeological record. And, whilst it may be tempting to assume that activities like historical mining or urban development were uniformly disturbing to cultural heritage, subsurface testing has often found this to be untrue. The movement of large quantities of earth associated with many forms of nineteenth century industry sometimes resulted in the burying and thus protection of prior ground surfaces. This has become particularly apparent in the context of urban fill deposits and gold mining sludge. Examples of the former include urban areas that have been artificially raised through imported earth and the latter a form of gold mining tailings that have been redeposited through fluvial processes (Lane and Gilchrist 2019; Lawrence and Davies 2014). If the presence of these types of landform changes can be anticipated prior to works, this could save time and resources, whilst producing better outcomes for uncovered cultural heritage. In this paper we present a means to model, visualise, and ultimately interpret some of those changes to the landscape through the use of nineteenth century topographic maps and GIS. This project is part of ongoing PhD research jointly funded by Aboriginal Victoria and La Trobe University and associated with the ARC-funded Rivers of Gold project.

Landscape change and Victorian archaeology

Humans have been shaping Victoria's landscape for at least 30,000 years (Canning and Thiele 2010). Prior to the 1830s, the main driver of that change was Aboriginal land management, settlement, and subsistence. European invasion and the industrial activities it transplanted represented a stark turning point. The continent's first hooved animals devoured grasslands and compacted topsoils underfoot (Paterson 2018:5). Entire hillslopes were rapidly denuded of trees, and by the 1850s, inland regions were being ripped open in search of gold (Lawrence and Davies 2018). It has been estimated that in the nineteenth century alone, 800 million cubic metres of sediment were mobilised by Victorian gold miners (equivalent to over 300 Great Pyramids of Giza!) (Davies et al. 2018a, 2018b). The landscape was also remodelled across the colony's emerging urban centres in order to better accommodate European settlement. Near Melbourne, wetlands were filled in, Batmans Hill was levelled, and the Yarra River was redirected and channelised (Giblett 2016; Presland 2008, 2014; Victorian Low-Lands Commission 1873). These large-scale transformations were of course joined by the incremental activities of the wider

[1] Department of Archaeology and History, La Trobe University, Melbourne, Vic. 3086, g.hil@latrobe.edu.au

[2] Aboriginal Victoria, Department of Premier & Cabinet, Bendigo, Vic. 3550

public, including the ploughing of fields, the digging of cellars, and through the continuous rhythm of building construction, renovation, and demolition.

Given the myriad ways that nineteenth century Victorians shaped the landscape the 'land-use history' section of a Cultural Heritage Management Plan (CHMP) (an investigatory report in Aboriginal cultural heritage management that considers Aboriginal cultural heritage, prior land-uses of an area, and provides contingencies in case Aboriginal cultural heritage is discovered) can only ever scratch the surface of activities that may have taken place in any given area. One of the challenges faced by archaeologists is relating descriptions of land-use to site formation, particularly in the absence of subsurface testing. In Aboriginal cultural heritage management this often results in an implicit association of land-use to degrees of 'disturbance'. This is not unexpected given the primary purpose of most 'desktop assessments' (the preliminary stage of CHMPs) is to determine the necessity for more in-depth archaeological investigation.

Victoria is not unique in its struggle to integrate near-endless forms of landscape change into a standardised planning framework. The British Geological Survey (BGS) has long recognised the need to include anthropogenic deposits into their maps and models of urban stratigraphy (Ford et al. 2014:60). Recognising that geology's most fundamental rules are rarely applicable to anthropogenic deposits, the BGS instead developed a system of classification based on morphogenetics. That is, defining artificial ground by *how* it is formed rather than what it is formed *of*; behaviour rather than composition. What they created was the Classification Scheme of Artificial Ground (McMillan and Powell 1999; Ford et al. 2010). In this system, all forms of anthropogenic landscape change can be split into five categories (**Table 1**).

With minor adjustments, such as relabelling made ground as 'remade ground' to acknowledge pre-colonial land management, changing the ground surface from which forms of artificial ground relate from 'natural ground surface' to 'pre-colonial ground surface', and more accurately referring to 'disturbed ground' as 'collapsed ground', this system is well-suited to Victorian archaeological contexts. Rather than replacing traditional stratigraphic approaches, the BGS system, as used here, instead relates the stratigraphic outcomes of land-uses to former pre-colonial ground surfaces. The approach can be thought of as a means to characterise and categorise the stratigraphic outcomes of anthropogenic activities on landscape-based scales.

Reframing anthropogenic landscape change (land-use) in terms of its physical outcomes could provide increased clarity during planning stages of development. For instance, if a prior land-use activity may have resulted in 'remade ground', development proponents could have increased forewarning about the possibility of nineteenth century structural remains or in situ Aboriginal cultural heritage in their activity area. The converse is also true in cases of 'worked ground'. As areas of excavation are often associated with locally redeposited material, this approach could potentially identify artificial ground patterning across a landscape. However, for such a system to be of value during planning stages, archaeologists need a means of determining the outcomes of historical land-use *prior* to subsurface investigations. Identifying the possible presence or absence of artificial ground and/or prior ground surfaces through non-invasive methods is achievable through methods such as historical research, Ground Penetrating Radar (GPR), and, as we present in this paper, through the use of topographic maps and GIS.

Methods: modeling volumetric landscape change with GIS

The BGS's classification scheme, as used here, categorises artificial landscape change in terms that are relative to pre-colonial ground surfaces. However, this definition is

BGS Category	Definition
Made Ground	Areas where the ground is known to have been deposited by man on the former, natural ground surface: road, rail, reservoir and screening embankments; flood defences; spoil (waste) heaps; coastal reclamation fill; offshore dumping grounds; constructional fill
Worked Ground	Areas where the ground is known to have been cut away (excavated) by people: quarries, pits, rail and road cuttings, cut-away landscaping, dredged channels
Infilled Ground	Areas where the ground has been cut away (excavated) and then had artificial ground (fill) deposited: partly or wholly back-filled workings such as pits, quarries, opencast sites; landfill sites (except sites where material is dumped or spread over the natural ground surface)
Landscaped Ground	Areas where the original surface has been extensively remodelled, but where it is impractical or impossible to separately delineate areas of worked (excavated) ground and made ground
Disturbed Ground	Areas of surface and near-surface mineral workings where ill-defined excavations, areas of man-induced subsidence caused by the workings and spoil are complexly associated with each other, for example collapsed bell pits and shallow mine workings

Table 1. BGS Classifications and definitions (taken verbatim from McMillan and Powell 1999: 4)

easily adapted to refer to later, historical ground surfaces if required. If an alluvial flat, for example, remains largely unmodified by post-colonial industry until 1860, when it is blanketed by gold mining sludge, it remains 'remade ground' until it is 'worked' deeper than that layer of sludge. In order for it to become 'worked ground' the area must be excavated until 'natural' (a culturally sterile basal horizon) has been uniformly reached. This process is simplified when it is reframed in terms of numerical elevation change. The hypothetical 1860 sludge event increased the elevation at the exampled location by a quantifiable amount. The elevation of a given ground surface can be raised, decreased, or left the same (unless it is reduced then later increased by the same amount). Therefore, to model landscape change, the elevation of a given ground surface must be compared to a later ground surface at the same location. This can be achieved through the comparison of historical Digital Elevation Models (DEMs) produced from nineteenth century topographic maps in GIS. Two case study areas that demonstrate this application are Ballarat and Melbourne's Hoddle Grid (the City of Melbourne's central business district) (**Figure 1**). The prior and later ground surfaces at those two locations date to 1858 and 2012 (Ballarat) and 1853 and 1895 (Hoddle Grid). The dates are dictated by the availability of nineteenth century elevation data for each study area.

First, high resolution digital scans of each historical topographic map were retrieved from online databases and georeferenced within ArcGIS Pro (Version 2.4.1). The georeferencing process aligns each historical map to its real-world location through user-defined control points. In this instance those control points consisted of well-defined street corners and building footprints, which were aligned to LiDAR or modern cadastral maps of each study area. The use of LiDAR to georeference John Phillips' 1858 map of Ballarat was pertinent, as the same LiDAR was later used for surface-to-surface comparisons. Next, all forms of elevation information contained within each historical map (contour lines or survey benchmarks) were manually mouse-traced within ArcGIS Pro. This process, known as vectorisation, allows that elevation data to be integrated into mapping algorithms. Phillips' 1858 map of Ballarat depicts elevation solely through the use of contour lines (intervals of five feet/1.524 m), whereas Clement Hodgkinson's 1853 plan of the Hoddle Grid depicts elevation through contour lines (intervals of four feet/1.219 m) and through 212 elevation benchmarks. From here, Esri's ArcGIS Pro interpolation algorithms were used to create DEMs of both Ballarat and the Hoddle Grid from 1858 and 1853 respectively. The outcome of these steps was the creation of three-dimensional models that can be referred to as each area's 'prior ground surface'.

To quantify elevation change through time a second DEM was created for each study area. For Ballarat, this 'later ground surface' took the form of LiDAR imagery collected of the township in 2012. For Melbourne's Hoddle Grid, a mosaic was created from 22 Melbourne Metropolitan Board of Works (MMBW) plans created

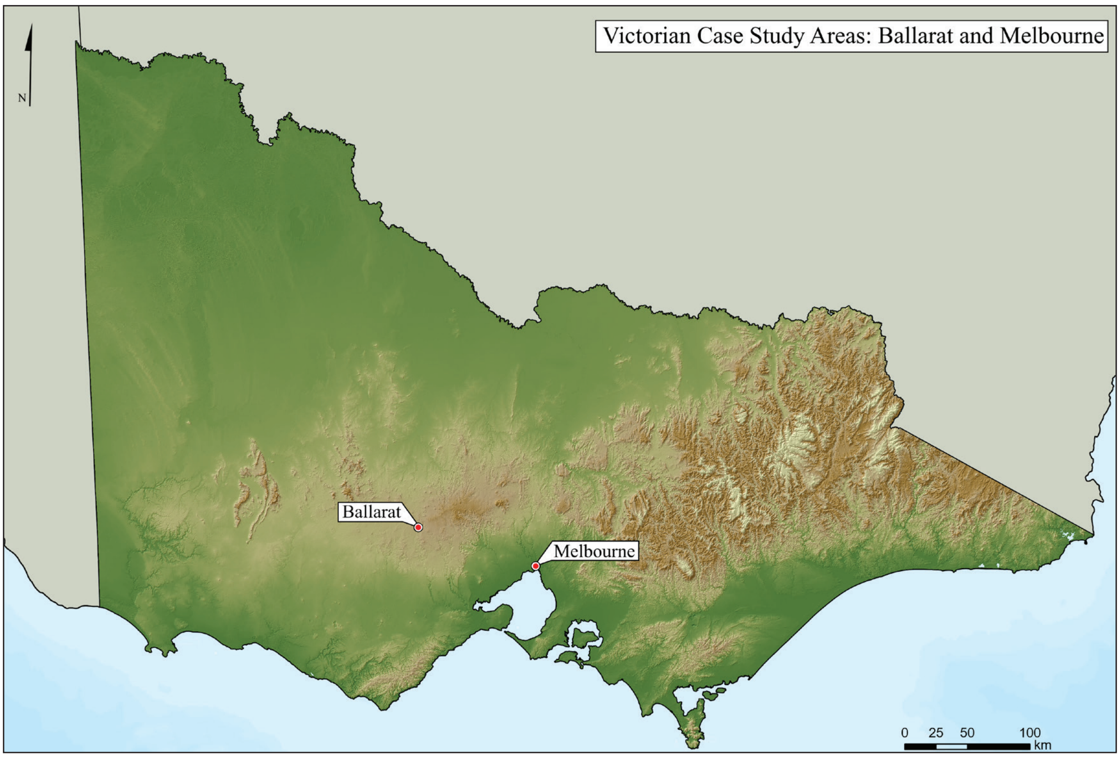

Figure 1. The location of the two Victorian case study areas: Ballarat and Melbourne

in 1895. These plans represent elevation through a combined 11,212 elevation benchmarks. Each 1895 plan also depicts building and cellar footprints, which often contained elevation values. All footprints containing an elevation value were vectorised into polygon shapefiles. This step allowed the elevation values of the 5,404 cellars and buildings to be represented within the 1895 DEM without being averaged against the surrounding landscape.

The final step of the analysis was to calculate the difference in elevation between the historical DEMs. For this, ArcGIS Pro's 'raster calculator' was used. This step produced a new DEM comprised of the differences between the two historical models. So, if one hypothetical area within the Hoddle Grid was four metres above sea level in 1853 and seven metres above sea level in 1895 the value of the new DEM at that location would be three metres (as the area increased by three metres in elevation). Conversely, if an area became lower by 1895, this produced a negative elevation value. These height differences were then classified by colour and then superimposed onto georeferenced historical maps to identify possible sources of elevation change (e.g. land-use).

Results

The historical landscape-change modeling identified widespread changes in elevation across both case study areas. **Figure 2** provides a colourised example of this landscape change in Ballarat. As indicated in the legend, red to orange represents areas that decreased in elevation between 1858 and 2012, whereas green to darker green represent areas of increase (with yellow representing areas within a metre of change). The map highlights how Ballarat's sludge channel (constructed in the early 1860s) cut into the late-1850s ground surface. Also, note the filling in of the waterway across the middle of the map. Along the centre right, parts of Main Street are now two metres higher than their late-1850s levels. These changes in elevation along Main Street are supported by local historical sources (Bate 1978:101; Spielvogel 1981:20).

Our landscape change modeling also revealed innumerable changes in elevation across Melbourne's Hoddle Grid. An example of this landscape change, and possible occurrences of remade or infilled ground, are shown in **Figure 3**. Areas showing an increase in elevation within the figure (increasing from light to dark green) appear to align-well with recent excavations and

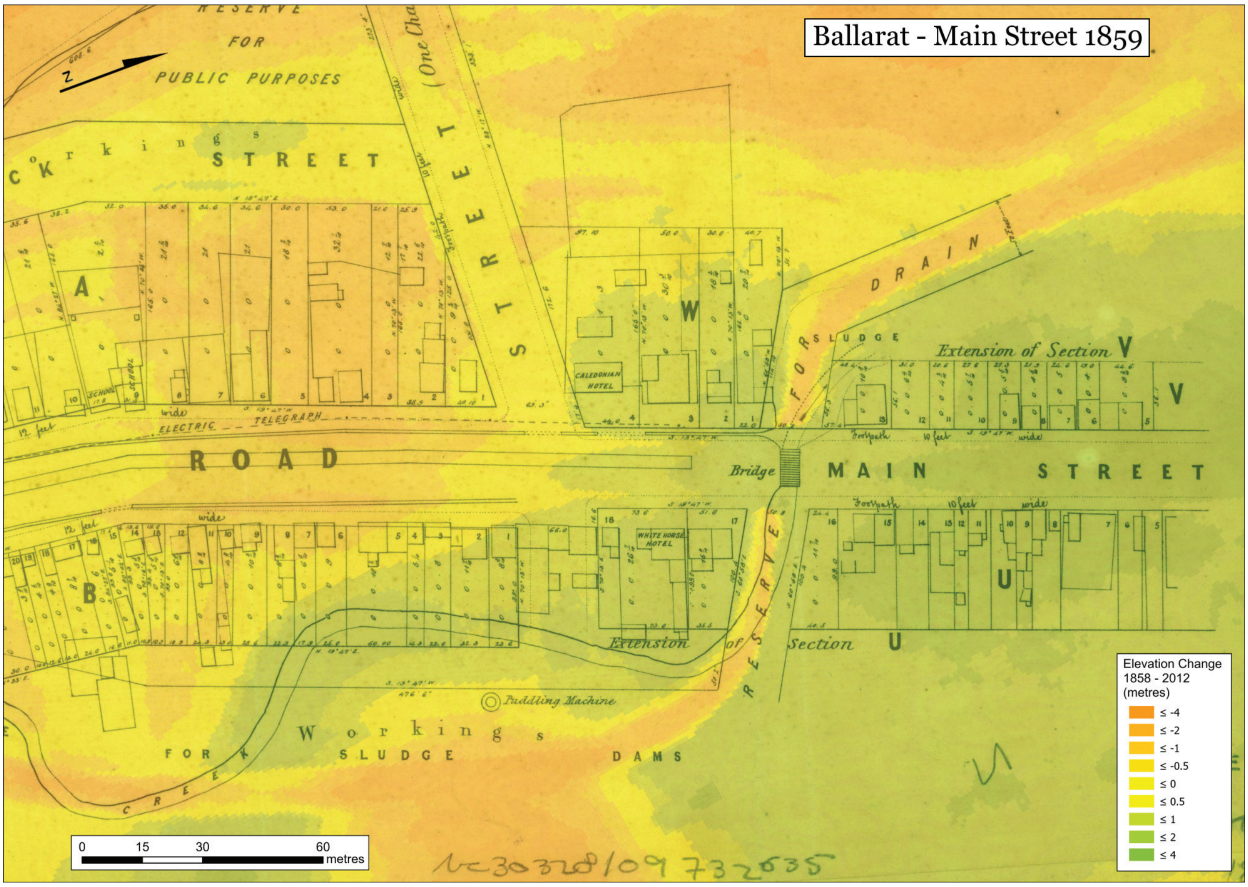

Figure 2. Elevation change modeling (1858-2012) at Ballarat overlying 1859 map of Main Street (Carruthers 1895—full map citation in references)

the findings of the 'Heritage in Ruins' report regarding the Grid's urban fill deposits (Lane and Gilchrist 2019; Negus Cleary et al. 2019). These fill events correspond to Acts of Parliament passed in the 1850s, which required landowners to raise the ground surface of their property if requested by City Council (Lane and Gilchrist 2019). This was partially a response to a deadly typhoid epidemic, attributed to standing pools of stagnant water, which plagued Melbourne throughout the nineteenth century (Dingle and Rasmussen 1991). In some cases, built structures were buried beneath upwards of two metres of imported earth. The area marked in red in **Figure 3** provides an example of an area where structural remains were discovered at those significant depths (Negus Cleary et al. 2019). Examples of public work 'fill orders' gazetted in local newspapers are also shown within the figure. Other forms of landscape change, not depicted in **Figure 3**, include the removal of Batmans Hill, which was levelled during the 1860s, as well as numerous cellars depicted in the 1895 MMBW plans (Presland 2008). The cellars provide many probable examples of 'worked ground' across the Grid—areas that are much less likely to retain pre-colonial ground surfaces. There also appears to be some spatial patterning in terms of areas that increased in elevation. In some cases, larger areas of increase (remade or infilled ground) correspond to parts of the Grid that are low-lying in relation to their surroundings. Altogether, our elevation change modeling, sheds significant light on the anthropogenic use of both Melbourne and Ballarat's landscapes during the nineteenth century.

Conclusion

Our modeling has the potential to provide invaluable information about historical land-use across urban areas. Its results are a reminder of the ubiquity of nineteenth century industrial landscape change in our contemporary cultural landscape. Rather than being idiosyncratic examples, Ballarat and the Hoddle Grid's 'fill events' are likely to have taken place across much of developed Victoria whether through gold mining, urbanisation, or through the cumulative nature of human agency. Terms such as 'remade', 'worked', or 'infilled' ground could provide an effective means of categorising many different forms of landscape change. For buried Aboriginal cultural heritage, the archaeological

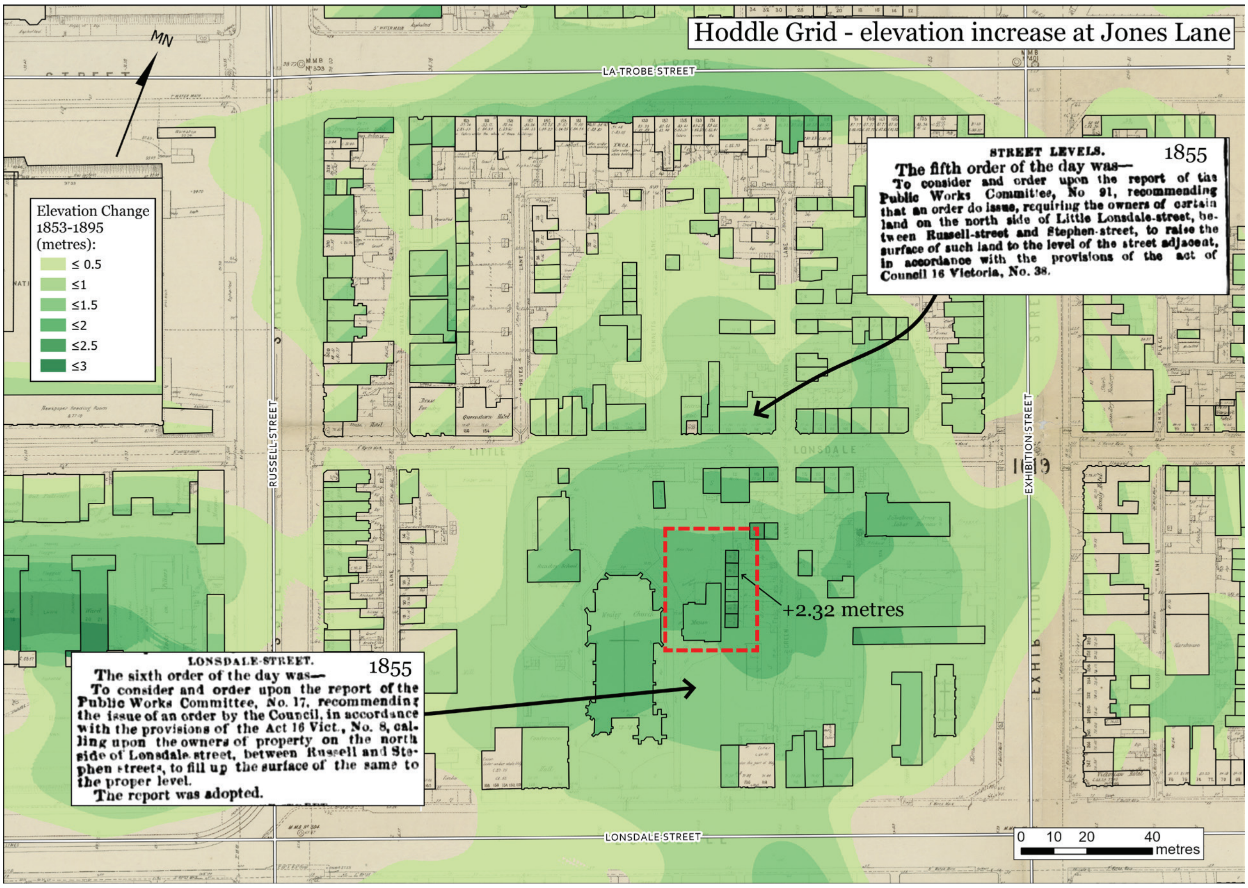

*Figure 3. Elevation increases greater than 0.25 m (1853 to 1895) at Jones Lane/Wesleyan Precinct (Hoddle Grid), overlying 1895 MMBW map, with relevant newspaper articles (*The Argus*, 20th February 1855;* The Argus*, 16th October 1855). The rectangle marked in red provides the approximate location where structural remains were uncovered during a 2017 excavation at Jones Lane*

implications for the presence of a mineshaft is really no different than a deep cellar, or a swimming pool (worked ground). An urban fill deposit has many of the same implications as gold mining sludge (remade/infilled ground). Together, these terms could provide increased clarity, while improving our ability to relate historical landform changes to the archaeological record. From a management perspective, this modeling could enable the production of new predictive models. These could allow cultural heritage resources to be refocused to areas with an increased likelihood of retaining pre-colonial ground surfaces. Whilst this could enable future discoveries to be made, it could also provide the opportunity to preserve archaeological fabric through avoidance. This paper has been a preliminary output of ongoing PhD research and these ideas and the GIS modeling will be the subject of future works (watch this space).

Acknowledgements

We would like to acknowledge Aboriginal peoples, the Traditional Custodians of Ballarat and Melbourne. This paper is a part of ongoing PhD research at La Trobe University and is taking place in accordance with the conditions set forth in Cultural Heritage Permit F20/102. This research is also part of the broader Rivers of Gold project jointly funded by La Trobe University, Aboriginal Victoria, and the Australian Research Council. The authors would also like to acknowledge valuable discussions with Jeremy Smith (Heritage Victoria), Michelle Negus Cleary (Dr Vincent Clark & Associates) and David Thomas (Aboriginal Victoria) and thank our anonymous reviewers for their detailed and insightful comments.

References

THE ARGUS ‘City Council’, Tuesday 20 February 1855:5

THE ARGUS ‘City Council’, Tuesday 16 October 1855:5

Bate, W. 1978 *Lucky City: The First Generation at Ballarat, 1851-1901*. Carlton South, Vic: Melbourne University Press

Canning, S. and F. Thiele 2010 Indigenous cultural heritage and history within the metropolitan Melbourne investigation area. Unpublished report to the Victorian Environmental Assessment Council

Carruthers, J. 1859 Town Lots, Ballarat East (Plank Road). Retrieved 3 October 2019 from < https://trove.nla.gov.au/version/31574733 >

Davies, P., S. Lawrence, J. Turnbull, I. Rutherfurd, J. Grove, E. Silvester, D. Baldwin and M. Macklin 2018a Reconstruction of historical riverine sediment production on the goldfields of Victoria, Australia. *Anthropocene* 21:1–15

Davies, P., S. Lawrence, J. Turnbull, I. Rutherfurd, J. Grove, E. Silvester, D. Baldwin and M. Macklin 2018b Bucket dredging in south-eastern Australia, 1899-1958. *Australasian Mining History*, 16:59–74

Dingle, A.E. and C. Rasmussen 1991. *Vital Connections: Melbourne and its Board of Works, 1891-1991*. Melbourne, Vic.: McPhee Gribble

Ford, J., H. Kessler, A. Cooper, S.J. Price, and A.J. Humpage 2010 An enhanced classification for artificial ground. British Geological Survey Open Report, OR/10/036

Ford, J., S.J. Price, A. Cooper and C.N. Waters 2014 An assessment of lithostratigraphy for anthropogenic deposits. *Geological Society, London, Special Publications* 395(1):55–89

Giblett, R. 2016 Lost and found wetlands of Melbourne. *Victorian Historical Journal* 87(1):135–156

Hodgkinson, C. 1853 Contour Plan of Melbourne, PROV VPRS 8168/P05 (MELBRL-15-1)

Lane, S. and A. Gilchrist 2019 Heritage in ruins: An investigation into Melbourne’s ‘buried blocks.’ Unpublished report to the Heritage Council Victoria (project PR180502)

Lawrence, S. and P. Davies 2014 The sludge question: the regulation of mine tailings in nineteenth-century Victoria. *Environment and History* 20:385–410

Lawrence, S. and P. Davies 2018 Archaeology and the Anthropocene in the study of settler Australia. In MAT de Souza and D. Menezes (eds), *Historical Archaeology and Environment*, pp. 229–251. Cham: Springer International Publishing

McMillan, A.A. and J.H. Powell 1999 BGS rock classification scheme. Volume 4, classification of artificial (man-made) ground and natural superficial deposits: Applications to geological maps and datasets in the UK. British Geological Survey Research Report, RR 99–04

Melbourne and Metropolitan Board of Works 1895 Melbourne and Metropolitan Board of Works detail plan. 1019. City of Melbourne, Melbourne

Negus Cleary, M., N. Bajzelj, J. Scibilla and M. Haas 2019 Beneath the clay: the mid-nineteenth century raising of street and property levels in Jones Lane and Little Lonsdale Street, Melbourne. *Excavations, Surveys and Heritage Management in Victoria* 8:17–28

Paterson, A. 2018 Once were foragers: the archaeology of agrarian Australia and the fate of Aboriginal land management. *Quaternary International* 489:4–16

Phillips, J. 1858 Geological Survey of Victoria: Ballarat. Department of Public Lands, Melbourne

Presland, G. 2008 *The Place for a Village: How Nature has Shaped the City of Melbourne*. Melbourne, Vic.: Museum of Victoria

Presland, G. 2014 A boggy question: differing views of wetlands in 19th century Melbourne. *The Victorian Naturalist* 131(4):96–105

Spielvogel, N.F. 1981 *Spielvogel Papers: Volume Two*. P.G. Mansfield (ed.), Ballarat, Vic.: Ballarat Historical Society

Victorian Low-Lands Commission, 1873 *Low-Lands Commission: Progress Report*. Melbourne, Vic.: John Ferres, Government Printer