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Busby's Bore Archaeology Report

**OPTIONS FOR THE PROTECTION AND INTERPRETATION OF
UNDERGROUND ARCHAEOLOGICAL REMAINS FROM BUSBY'S BORE**

11 DRIVER AVE, MOORE PARK

Prepared for
Artefact Heritage and
Environment

Date
08/07/25

ICS Job Reference
#20888

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1. Introduction

International Conservation Services (ICS) was engaged by Artefact Heritage and Environment in June 2025 to provide technical materials conservation advice for the conservation and interpretation of subsoil archaeological items excavated from Busby's Bore, namely the Busby's Bore Spur access shaft 1 (BBS-01), 11 Driver Ave, Moore Park.

2. Scope of work

ICS was engaged to provide the following scope of works:

Preservation of Salvaged Material:

General recommendations for the preservation of the salvaged shaft material once installed and displayed.

- Identifying key considerations that may include ventilation from below and access for ongoing cleaning and maintenance.
- Specifying additional preservation measures that may be relevant.

Reconstruction / Re-imagining of the Shaft:

General recommendations on reconstructing or 'reimagining' the shaft structure, including:

- Type of mortar to be used (if any), noting that minimal original mortar was observed during excavation.
- Correct positioning of bricks and stonework
- General suggestions for a suitable support system to hold the bricks and stones in place.

Use of Surplus Material:

Considerations for the use of leftover material, including:

- Donating remaining materials to heritage stonemasons or conservators for reuse in other heritage projects.
- Retaining some for future maintenance or repair

3. Proposed Interpretation Strategy

- The proposed interpretation of the archaeological remains involves the partial reconstruction of the brick and stone shaft as part of the new construction works on the site. The proposed reconstruction is suspended atop a multilevel carpark and will be able to be viewed from above at plaza level through a weathertight glass cover.
- The proposed reconstruction will utilise the most intact brick and stone elements salvaged from the excavation. The current proposal allows for a single layer of sandstone topping (compared with 5/6 in the original configuration) and approximately 1000-1200mm of brickwork (compared to approximately 2600mm of brickwork).

4. Location

The site is located within Lot 11 DP 2155013, 11 Driver Avenue, Moore Park.



Plate 1: Approximate location of excavation denoted in red within Lot 11 DP 1255013, 11 Driver Ave, Moore Park

Source: SixMaps <https://maps.six.nsw.gov.au/>

5. Heritage Listings

The site is listed on the State Heritage Register as part of the larger listing of the entire Busby's Bore.

Item Name: Busby's Bore
Address: Centennial Park to College Street, Surry Hills
LGA: SYDNEY
LALC: LA PEROUSE
Listing no.: 00568
Gazettal date: 4 February 1999

6. Statement of Significance

"Busby's Bore is a unique engineering achievement which played a crucial role in the development of urban Sydney. As a product of convict labour and a major factor in the establishment of local administration in NSW (in the form of the Sydney Corporation) the bore is associated with the important steps that changed Sydney from penal colony to colonial trading port.

The fabric of the bore and associated archaeological deposits possess research potential relating to substantive historical and scientific questions relating to 19th century work and technology and to changes in the environment. The intactness of the bore and the fact that it is still in use make it a rare survivor from the first half of the 19th century within urban Sydney. (Godden Mackay 1996: 10)."

Source: Heritage NSW State Heritage Register Listing

7. Busby Bore Description

7.1 Busby Bore Description

"Busby's Bore is a tunnel that was constructed through sandstone and varies in size from 4 to 10 feet in height and from 2 to 3 foot 6 inches width. It is lined in some sections with dressed stone slabs to carry water from Lachlan Swamps, Centennial Park at west side, Lang and Cook Roads, beneath the Sydney showground, Victoria Barracks and Oxford Street to the corner of Liverpool and Oxford Streets, Hyde Park - a distance of about 2 miles (Brady 1975)."

Source: Heritage NSW State Heritage Register Listing

7.2 Condition assessment subsoil remains of Busby's Bore Spur access shaft 1 (BBS-01)

The assessment of the condition of the archaeological remains is based on a site inspection by Julian Bickersteth, Richard Silink from ICS and Sabrina Roesner from Artefact, on Tuesday 2 July 2025. These remains are currently being stored underneath the Sydney Football Stadium which is adjacent to the site. Subsequent physical analysis of a sample brick was undertaken by Nicola Ashurst.

Further information regarding the remains is taken from the Salvage and Condition Report – Busby Bores, Moore Park Precinct Village & Carpark prepared by the RJC Group, 10 February 2025.

The brick and stonework were carefully excavated and still appear to be damp/wet. Due to being excavated from wet ground, the bricks are very soft, and any associated mortars if present at all would be particularly delicate.

7.2.1 Mortar

There appears to be fragmentary remains of a sandy mixture on the surface, of many of the bricks.

In the sand there is no immediate evidence of shell lime, however it is possible it is there, coloured by silt and clay from the original aggregate. Interestingly, there are several fragments of charcoal, but these are embedded in the clay.

Photos taken during excavation and demolition indicate that some form of bedding was used in between the bricks to level and align them even if this was done in a minimal way. The mortar is probably a shell lime and sandy loam mortar. It appears to be a dark colour and most likely the percentage of lime it contained was minimal.

The mortar would likely to have been soft and an excellent bedding material and one on which the bricks could have been slid and adjusted into the correct level position or alignment.

7.2.2 Brickwork

The excavated bricks are 230mm long, 103mm wide and 58mm high. There is no frog indent however a sample of the bricks have been marked with the Government arrow symbol.

The brickwork was laid in a radial format with the short end forming the inner face of the shaft. Each course consisted of approximately 45 bricks.



Plate 2: Image of shaft during excavation. Note the radial layout of the brickwork with the outward gaps filled with possibly a soft mortar / clay. The horizontal joints are very thin.

Source: Artefact Heritage and Environment, 2025.

7.2.3 Sandstone capping

The upper section of the shaft of some five/six courses was constructed using rough hewn soft sandstone approximately 200mm in height. The sandstone blocks are highly irregular in shape and size and crudely dressed to form the curve of the bore.

The photogrammetry supplied by Artefact shows that the lowest of the five/six courses of stone overlaps the upper courses of the brickwork. This stone also shows clear evidence of the Government issue arrow.



Plate 3: Interior photogrammetry of the shaft. Note the Government arrow on the inside face of the lowest course of the stonework.

Source: Artefact Heritage and Environment, 2025.

8. Issues for the long-term conservation of exposed archaeological remains

"The process of archaeology is essentially destructive.

Excavation irrevocably changes the nature and context of the site and the excavated data, and the resulting exposure of fabric and artifacts can accelerate their deterioration and decay. By its very nature most archaeological investigation gives rise to an inherent conflict between the practice of archaeology, requirements for physical conservation of fabric, and, often, cultural values other than archaeological ones that are associated with particular sites.¹

Deterioration is a continuing process which will accelerate as soon as remains are exposed. After excavation the remains will react to their new environment - changes in the air, sunlight, heat/ cold and moisture.

Typically, there are ten key factors or agents of deterioration for archaeological remains. These factors can influence or affect materials in a variety of ways. The factors being:

1. Water/RH
2. Light
3. Temperature
4. Oxygen
5. Wind/currents
6. Salt
7. Acid/alkali
8. Pollutants
9. Biological growth
10. Human action

The remains from Busby's Bore Spur access shaft 1 (BBS-01) will try to reach equilibrium with the new environment and deterioration occurs during this period. ² The placement of the remains in an above ground dry environment and under the protection of a glass cover will mitigate against many of these agents of deterioration.

¹ Getty Conservation Institute, 2012, *Archaeological Sites: Conservation and Management*, included in the Foreword by Professor Richard Mackay, pxiii.

² International Conservation Services, Heritage Council of NSW, 2012. '*Stabilising Stuff: A Guide for Conserving Archaeological Finds in the Field*', Heritage Council of NSW Publication, p3.

9. Potential issues with exposing the archaeological remains under a glass enclosure

There are several issues to be taken into consideration with exposing the archaeological remains under a glass enclosure.

Advantages:

- Glass provides a protective barrier from environmental fluctuations, weathering and physical damage while still allowing visitors to see the artifacts or structures in their original configuration (albeit in a relocated and reconstructed form).

Challenges:

- Reflections - Glass can create glare or reflections that can obscure the view.
 - Condensation below the glass can negatively impact ability to view the remains.
 - Temperature and Humidity Control - While glass enclosures can provide a protective barrier, it typically does not adequately control temperature and humidity levels. This could potentially accelerate the degradation of delicate materials.
 - Lack of Airflow- Insufficient airflow inside glass enclosures can lead to mould and biological growth that may harm artifacts over time.
 - Condensation and Microclimates - In some cases, the glass enclosure can create microclimates that trap moisture or cause condensation and could potentially limit the ability to view the remains.
 - Insect damage - Exposed archaeological remains such as masonry structures are susceptible to damage from insects in particular the mortar joints.
 - Plant and biological growth – Increased humidity can encourage plant growth that can damage the remains
 - Efflorescence – Drying of the bricks may induce efflorescence to the face of the bricks.
 - Ongoing maintenance – Bricks under glass will still require ongoing access for maintenance, conservation works and assessment.
 - Glass invariably scratches when used in a trafficable area and reduces the visibility of the remains below.
 - Lighting of the remains will be a challenge to reduce the contrast between daylight and the darkened reconstructed remains being displayed.
 - Staining from atmospheric pollutants from air within the carpark.
-

10. Recent precedents

This section will highlight three case studies of archaeological remains on open display in the Sydney area. It should be noted that all three relate to remains in situ, ie that are still in their original location with contact with ground water, but they illustrate the challenges of conserving archaeological remains. The three are:

- the Parramatta Hospital site at the Parramatta Justice Precinct;
- the early convict structures beneath the V by Crown development in Parramatta;
- the remains of Australia's first Government House beneath the Museum of Sydney in the CBD.

All these sites date from the first 30 years of the Sydney colony and all contain masonry elements. ICS has been involved with the long-term management of each of these sites and, subsequently, is highly familiar with the degradation implications of open display for archaeological remains.

Images of the sites are included in Appendix A.

10.1 Parramatta Hospital site – Paramatta Justice Precinct

Excavated in 1993, this site is the location of the longest continually used hospital in Australia. Between 1818 and 1848, this was the Colonial Hospital and was a typical hospital of the period. Following construction of the Parramatta Justice Precinct, the archaeological remains have been displayed in two separate pavilions on either side of a large plaza (figs. 4-7). The large pavilion encloses the Hospital site, which also incorporates a function area and a number of artefact display cases, while the smaller pavilion exhibits part of the kitchen/laundry outbuildings.

The major factor that impacts significantly on this site is the proximity of the water table, which means that the archaeological remains continue to draw up water. This has contributed to different issues across the two pavilions.

Due to the combination of moisture build-up and light, the Hospital Pavilion develops excessive biological growth on the archaeological remains (including ferns, moss, and mould, which required ongoing maintenance) as well as mould on interior surfaces of the building. The Kitchen Pavilion also exhibits biological growth but, more significantly, is affected by salt efflorescence, which has resulted in powdering and spalling of the excavated stonework.

While installation of additional passive and mechanical ventilation may slightly reduce the amount of moisture within the spaces, the close proximity of the water table means that the remains will always be wet and will be subject to ongoing deterioration even if interventions are made on the pavilions.

10.2 Early convict settlement – Philip Ruddock Heritage Centre, V by Crown, Parramatta

Excavated in 2005, this site comprises the remains of a convict hut, a wheelwright's workshop and the basement of the Shepherd and Flock Inn. The site was incorporated into the design of the above V by Crown building and forms an open but covered display (figs. 8-11).

While the fully open display allows for increased airflow, it has also led to infestation of the site by a species of native wasps that burrow into the soft mortar between the bricks and jeopardises their structural integrity.

10.3 First Government House – Museums of Sydney

Excavated in 1983, this site contains the foundation of the back wall and part of the western wall of Governor Arthur Phillip's house, and the foundations of the original outbuildings containing the bakehouse and kitchen.

Display of these archaeological remains has since been incorporated into the design of the Museum of Sydney, with glazing in the foyer floor allowing viewing (Plates 4-15).

Extensive trialling was undertaken in the years after opening to establish a stable environment around the remains, including introducing air flow, UV lighting and double-glazing viewing glass.

While not to the same extent as the Parramatta Hospital site, the First Government House remains continue to exhibit algal growth and salt efflorescence degradation associated with the presence of moisture and light. The site is also prone to build-up of detritus, including dead insects, degraded builders' plastic and dust, which requires ongoing maintenance.

These case studies highlight the fact that archaeological remains on open display require continuing maintenance and are subject to ongoing deterioration.

11. Preservation of Salvaged Material

General recommendations for the preservation of the salvaged shaft material once installed and displayed include:

11.1.1 Ventilation

- Ventilation must be provided to the remains to prevent the build up of condensation under the glass resulting from a differential between the temperature and relative humidity on the two sides of the glass. Elevated levels of humidity will encourage biological growth on the brickwork.
- We recommend allowing for ventilation to the remains using clean air ducted from the outside. Air from the carpark will invariably contain elevated levels of pollutants that may impact deleteriously the fragile brick and stonework.

11.2 Maintenance

- Access should be provided to allow for the periodic cleaning of the display. There is a high likelihood of sand and mortar remains being deposited on the bottom of the shaft as the masonry dries out.
- Access should also provide for the easy ongoing replacement of any lighting contained in the space
- Due to the fragility of the masonry any future regular maintenance should be carefully undertaken by a conservator.

12. Reconstruction / Re-imagining of the Shaft

General recommendations on reconstructing or 'reimagining' the shaft structure, include:

12.1.1 Type of mortar

- We recommend that a very soft shell based traditional lime mortar is used as bedding between the bricks and between the stonework
- Further analysis of the original mortar is required before specifying the appropriate ratio and type of lime and sand to be used in the reconstruction.

12.1.2 Correct positioning of bricks and stonework

- The brickwork should be laid in a radial format to match the diameter of the original shaft, refer to Plate 2. The brick courses should use a comparable number of bricks as the original configuration (app 45 bricks per course).
- The triangular voids to the rear of each course should be filled using a very soft lime mortar to provide stability to each course.
- The lowest part course of the stonework overlaps the upper layers of brickwork (refer Plate 3). The stone displaying the Government Arrow carving should be displayed to enhance the storytelling potential of the reconstructed remains.

12.1.3 Suitable support system to hold the bricks and stones in place.

- We recommend that stainless steel brick ties are discretely inserted to tie the brick cylinder to the surrounding new concrete structure.
- The upper three courses of the brickwork should be rebuilt to accommodate the stone that shows the arrow on the inner face. One or more full courses of stone could be laid above this part course.
- The stone is significantly wider than the brick wall below and may require additional masonry buttressing to provide adequate bearing and support.

13. Use of Surplus Material

The retention or deaccessioning of surplus material must comply with the conditions of consent for the excavation and in accordance with relevant heritage legislation. It would make sense to retain a small number of bricks and stone for future repair and maintenance, a dozen bricks and three sections of stone would practically be appropriate. An option for further retention might include creating a feature wall of bricks within the new development, noting the softness of the brick will require a very soft mortar to ensure the bricks stay bonded.

However it is strongly recommended that a decision about further surplus material is made at the time of completion of this project. Surplus archaeological material from many developments in Sydney continue to languish in stores within the new development, using up storage space and progressively deteriorating until they are often discarded due to their poor condition, dissociation with the original site and change of ownership.

Options for the deaccession of surplus material may include:

- transferring intact bricks to the Museums of History NSW (the brick Hyde Park Barracks is of a similar period)
- transferring the surplus stone to the NSW Government Stone Program

14. Authorship

This report was prepared by Richard Silink (Director Objects and Outdoor and Built Heritage, ICS) and reviewed by Julian Bickersteth AO (CEO, ICS).

Appendix A – Recent precedents



Plate 4: Parramatta Justice Precinct – Hospital Pavilion, showing biological growth obscuring remains

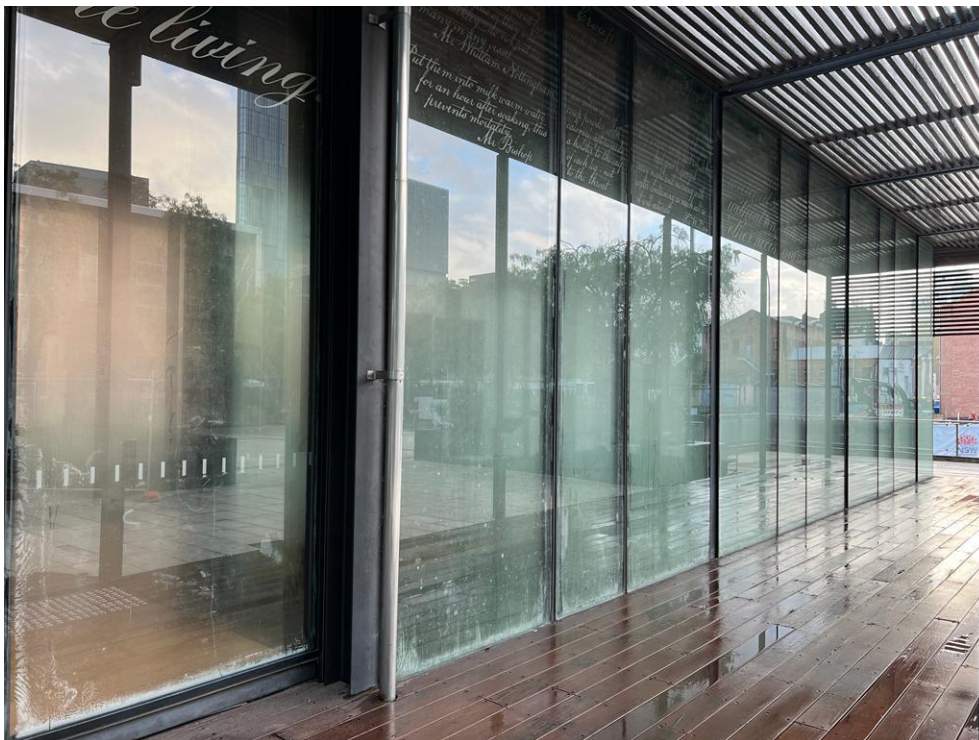


Plate 5: Parramatta Justice Precinct – Hospital Pavilion, showing condensation on glass from high humidity and lack of ventilation



Plate 6: Parramatta Justice Precinct- Kitchen Pavilion, showing biological growth

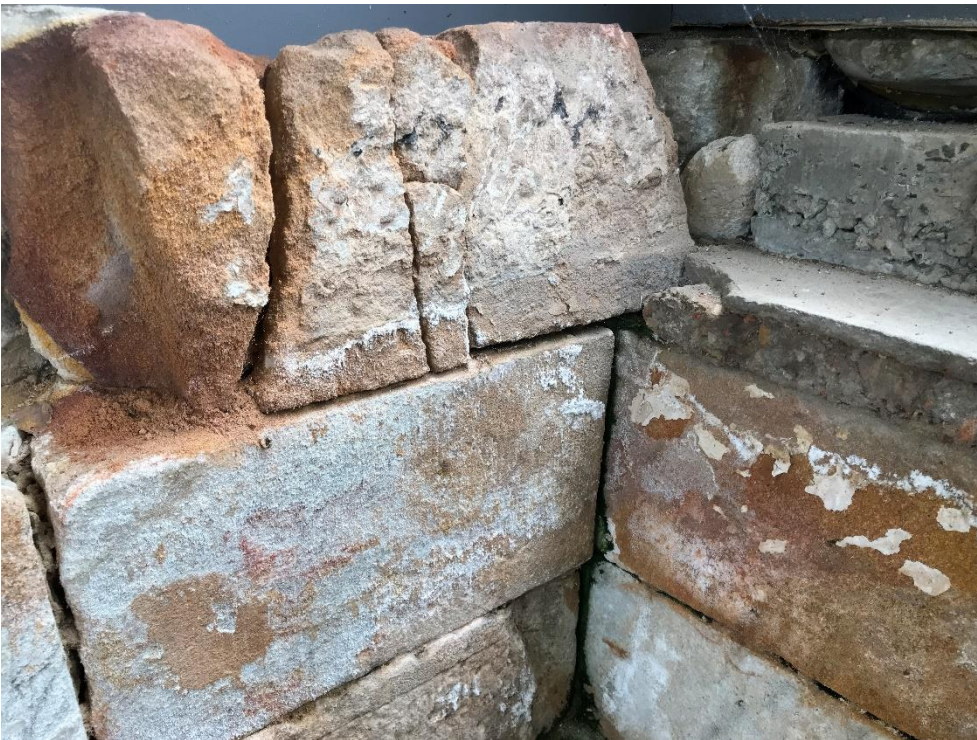


Plate 7: Parramatta Justice Precinct - Kitchen Pavilion, showing damage from soluble salt efflorescence



Plate 8: Early convict settlement at V by Crown, Parramatta – overall view of site showing remains of convict hut and part of wheelwright workshop



Plate 9: Early convict settlement at V by Crown, Parramatta – showing damage to mortar by native wasps



Plate 10: Early convict settlement at V by Crown, Parramatta – showing repair of wasp burrows



Plate 11: Early convict settlement at V by Crown, Parramatta – showing erosion from water ingress



Plate 12: First Government House at Museum of Sydney – overall view showing viewing windows



Plate 13: First Government House at Museum of Sydney – view within one of the windows, showing development of green/grey biological growth along top



Plate 14: First Government House at Museum of Sydney –showing development of salt efflorescence 'crust' and associated damage from detachment



Plate 15: First Government House at Museum of Sydney –showing dripping of water onto archaeological remains and deterioration of building plastics