

# Kingston and Arthurs Vale Safety Hazard Investigations

50% Concept Design Report - Very High Risk Items



# Kingston and Arthurs Vale Safety Hazard Investigations

## 50% Concept Design Report - Very High Risk Items

Client: Department of Infrastructure, Regional Development and Cities

ABN: 86 267 354 017

Prepared by

**AECOM Australia Pty Ltd**

Level 2, 60 Marcus Clarke Street, Canberra ACT 2600, Australia

T +61 2 6201 3000 F +61 2 6201 3099 www.aecom.com

ABN 20 093 846 925

23-Nov-2018

Job No.: 60576687

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

© AECOM Australia Pty Ltd (AECOM). All rights reserved.

AECOM has prepared this document for the sole use of the Client and for a specific purpose, each as expressly stated in the document. No other party should rely on this document without the prior written consent of AECOM. AECOM undertakes no duty, nor accepts any responsibility, to any third party who may rely upon or use this document. This document has been prepared based on the Client's description of its requirements and AECOM's experience, having regard to assumptions that AECOM can reasonably be expected to make in accordance with sound professional principles. AECOM may also have relied upon information provided by the Client and other third parties to prepare this document, some of which may not have been verified. Subject to the above conditions, this document may be transmitted, reproduced or disseminated only in its entirety.

© AECOM New Zealand Limited (AECOM). All rights reserved.

The Report and the information within it is confidential and may be privileged. If you have received the Report in error please notify AECOM immediately. You should not copy it for any purpose, or disclose its contents to any other person. The Report is qualified in its entirety by and should be considered in the light of AECOM's Terms of Engagement and the following:

- 1) The Report is provided solely for your use and benefit unless expressly permitted and then only in connection with the purpose in respect of which the Report is provided. Unless required by law, you shall not provide the Report to any third party without AECOM's prior written consent, which AECOM may at its discretion grant, withhold or grant subject to conditions. Possession of the Report does not carry with it the right to commercially reproduce, publish, sale, hire, lend, redistribute, abstract, excerpt or summarise the Report or to use the name of AECOM in any manner without first obtaining the prior written consent of AECOM.
- 2) AECOM has used its reasonable endeavours to ensure that the data contained in the Report reflects the most accurate and timely information available to it and is based on information that was current as of the date of the Report.
- 3) The Report is based on estimates, assumptions and other information developed by AECOM from its independent research effort, general knowledge of the industry and consultations with you, your employees and your representatives. No warranty or representation is made by AECOM that any of the projected values or results contained in the Report will actually be achieved. In addition, the Report is based upon information that was obtained on or before the date in which the Report was prepared. Circumstances and events may occur following the date on which such information was obtained that are beyond our control and which may affect the findings or projections contained in the Report. We may not be held responsible for such circumstances or events and specifically disclaim any responsibility therefore.
- 4) AECOM has relied on information provided by you and by third parties (Information Providers) to produce the Report and arrive at its conclusions. AECOM has not verified information provided by Information Providers (unless specifically noted otherwise) and we assume no responsibility and make no representations with respect to the adequacy, accuracy or completeness of such information. No responsibility is assumed for inaccuracies in reporting by Information Providers including, without limitation, by your employees or your representatives or for inaccuracies in any other data source whether provided in writing or orally used in preparing or presenting the Report.
- 5) In no event, regardless of whether AECOM's consent has been provided, shall AECOM assume any liability or responsibility to any third party to whom the Report is disclosed or otherwise made available.
- 6) The conclusions in the Report must be viewed in the context of the entire Report including, without limitation, any assumptions made and disclaimers provided. The conclusions in this Report must not be excised from the body of the Report under any circumstances.
- 7) Without the prior written consent of AECOM, the Report is not to be used in conjunction with any public or private offering of securities or other similar purpose where it might be relied upon to any degree by any person other than you.
- 8) All intellectual property rights (including, but not limited to copyright, database rights and trade marks rights) in the Report including any forecasts, drawings, spreadsheets, plans or other materials provided are the property of AECOM. You may use and copy such materials for your own internal use only.

## Quality Information

Document Kingston and Arthurs Vale Safety Hazard Investigations

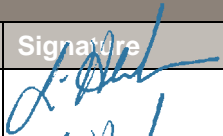
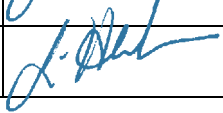
Ref 60576687

Date 23-Nov-2018

Prepared by Alan Schmierer

Reviewed by Ross Armitage

### Revision History

| Rev | Revision Date | Details          | Authorised                      |  |
|-----|---------------|------------------|---------------------------------|--|
|     |               |                  | Name/Position                   | Signature  |
| A   | 08-Oct-2018   | Draft for Review | Liam Hale<br>Associate Director |   |
| 0   | 23-Nov-2018   | Original Issue   | Liam Hale<br>Associate Director |  |

## Table of Contents

|  |    |
|--|----|
| Executive Summary                                      | i  |
| 1.0 Introduction                                       | 1  |
| 1.1 Heritage context                                   | 2  |
| 2.0 Civil Hospital (Northern Gable and Retaining Wall) | 3  |
| 2.1 Description  | 3  |
| 2.2 Scope and Purpose                                  | 3  |
| 2.3 Site Observations                                  | 4  |
| 2.3.1 Observations                                     | 4  |
| 2.4 Structural Assessment                              | 11 |
| 2.4.1 Northern Gable                                   | 11 |
| 2.4.2 Retaining Wall                                   | 12 |
| 2.4.3 Timber Lintel                                    | 12 |
| 2.5 Proposed Solutions                                 | 12 |
| 2.5.1 Northern Gable                                   | 12 |
| 2.5.2 Retaining Wall                                   | 14 |
| 2.5.3 Timber Lintel                                    | 14 |
| 2.6 Cost of Solution                                   | 17 |
| 3.0 Arthur's Vale Retaining Wall                       | 18 |
| 3.1 Description  | 18 |
| 3.2 Scope and Purpose                                  | 18 |
| 3.3 Site Observations                                  | 19 |
| 3.3.1 Observations                                     | 19 |
| 3.4 Structural Assessment                              | 25 |
| 3.5 Proposed Solutions                                 | 25 |
| 3.5.1 Do Nothing                                       | 25 |
| 3.5.2 Earth Bund Upstream and Agricultural Drain       | 26 |
| 3.6 Cost of Solution                                   | 29 |
| 4.0 Bounty Street Bridge                               | 30 |
| 4.1 Descriptions                                       | 30 |
| 4.2 Scope and Purpose                                  | 30 |
| 4.3 Background   | 31 |
| 4.4 Site Observations                                  | 31 |
| 4.4.1 Observations                                     | 31 |
| 4.5 Structural Assessment                              | 35 |
| 4.5.1 Cause  | 36 |
| 4.6 Proposed Solutions                                 | 36 |
| 4.6.1 Do Nothing                                       | 36 |
| 4.6.2 Recommended Solution                             | 36 |
| 4.7 Cost of Solution                                   | 43 |
| 4.8 Draft programme of works                           | 43 |
| 5.0 Longridge Barracks Arches                          | 46 |
| 5.1 Description  | 46 |
| 5.2 Scope and Purpose                                  | 46 |
| 5.3 Site Observations                                  | 47 |
| 5.3.1 Observations                                     | 47 |
| 5.4 Structural Assessment                              | 50 |
| 5.5 Proposed Solutions                                 | 50 |
| 5.5.1 Do Nothing                                       | 50 |
| 5.5.2 Underpin and Brace the Arches                    | 50 |
| 5.6 Cost of Solution                                   | 54 |
| 6.0 Royal Engineer's Office (REO)                      | 55 |
| 6.1 Description  | 55 |
| 6.2 Scope and Purpose                                  | 55 |
| 6.3 Site Observations                                  | 56 |
| 6.3.1 Observations                                     | 56 |



|            |   |    |
|------------|---|----|
| 6.4        | Structural Assessment                           | 60 |
| 6.5        | Proposed Solutions                              | 60 |
| 6.5.1      | Do Nothing                                      | 60 |
| 6.5.2      | Re Build the Portico                            | 60 |
| 7.0        | Planning Approvals Advice                       | 63 |
| 8.0        | Early Works to Address High Risk Safety Hazards | 64 |
| 9.0        | Summary project cost and risk                   | 65 |
| 9.1        | Project Costs                                   | 65 |
| 9.2        | Project Risk                                    | 65 |
| 9.2.1      | Contingencies and Risk Analysis                 | 65 |
| 9.2.2      | Inherent Risks                                  | 66 |
| 9.2.3      | Contingent Risk                                 | 66 |
| 9.2.4      | Total Contingency Allowance                     | 66 |
| 10.0       | References                                      | 67 |
| Appendix A |   |    |
|            | Planning Approvals Advice                       | A  |
| Appendix B |   |    |
|            | 50% Design Stage Cost Estimates                 | B  |
| Appendix C |   |    |
|            | Risk Register                                   | C  |
| Appendix D |   |    |
|            | Concept Sketches                                | D  |

## Executive Summary

Following receipt of the Kingston and Arthur's Vale Historic Area Safety Hazard Scoping Study Draft Report (GML, May, 2018), AECOM Australia Pty Ltd (AECOM) were commissioned by the Department of Infrastructure, Regional Development and Cities (DIRDC) to develop a 50% design report to support a New Policy Proposal (NPP) for the delivery of design work to address a number of the "very high risk" structural hazards identified in the GML Draft Report.

This report outlines AECOM's approach, methodology, and findings including design work to a 50% level of detail accompanied by a P80 level cost estimate. Pending approval and funding, the project is ready to progress to a detailed design phase prior to construction.

Site inspections were undertaken by experienced engineers and recommended mitigation measures for the identified risks are summarised in Table 1.

**Table 1 Recommended mitigation measures**

| Location                             | Issue   | Recommended Mitigation Measures  |
|--------------------------------------|---|--|
| <b>Civil Hospital</b>                | Structural crack on gable   | Install timber or steel braces to the inside face of the wall<br>Investigate condition of the base of the wall   |
| <b>Civil Hospital</b>                | Failure of retaining wall   | Wall assessed as adequate<br>Inspect condition annually or biennially<br>Ensure stormwater drain is operational and maintained   |
| <b>Civil Hospital</b>                | Missing timber lintel and cracking in adjacent wall                                       | Replace the missing and any decayed lintels with new timber lintels that are sympathetic to the heritage requirements  |
| <b>Arthur's Vale Retaining Wall</b>  | Lateral movement, rotation of wall, horizontal cracks                                     | Exclude vehicles from the rear of the wall<br>Install berms to divert stormwater flows<br>Install subsoil drains and maintain existing drains to intercept stormwater and discharge into Watermill Creek   |
| <b>Bounty Street Bridge</b>          | Structural issues such as tilting, cracking, settlement and sedimentation                 | Temporarily close the bridge to vehicular traffic<br>Lower the water level in Watermill Creek to historic levels<br>Rectify contamination of Watermill Creek from septic system discharge<br>Review spillway to Watermill Dam and rectify if required so it can be used to manage flows at the Bounty St bridge<br>Construct coffer dams upstream and downstream of the bridge and desilt the stream at the bridge to allow engineering investigations of the Bridge.<br>Undertake the recommendations of the Hughes Trueman report (2010) |
| <b>Longridge Barracks Arches</b>     | Structural issues (tilting/cracking), foundation overstress                               | Underpin the arches to prevent further rotation<br>Install steel braces to the rear of the arches to resist wind and earthquake forces   |
| <b>Royal Engineer's Office (REO)</b> | Structural cracks, rotation of the Portico to the west (away from the main structure) and | Install vehicle barrier to reduce risk from car impact<br>Deconstruct and rebuild the portico including tying the gable back to the rear of the portico  |

| Location      | Issue   | Recommended Mitigation Measures |
|---------------|---|---------------------------------|
| Entry Portico | decayed northern column capital and stone base of the REO Portico |                                 |

The P80 project costs have been estimated at \$3,140,953 and include a 25% allowance for Client supervision and administration and risk contingency of 31% based on the Inherent and Contingent Risk values determined during the risk analysis process. Costs for the Bounty St Bridge repair are excluded and require completion of the engineering investigation before they can be estimated.

The Bounty St bridge works and engineering investigation are estimated to require up to three years with deliverables being Contract Documentation for repair works. The duration for repair works is unknown and dependent on the engineering investigation.

The remaining works could be completed within two years subject to funding and labour availability.

Priority works aimed at mitigating immediate risks while planning and funding is progressed has been estimated at \$50,000 and is predominantly erection of signage and exclusion zones.

A review of the environmental and heritage approvals pathways has been included in the report because of the heritage status of the precinct and the overlays of local and Commonwealth legislation. Consultation with stakeholders and compliance with the various legislative requirements will be required during detailed documentation and construction of the works.

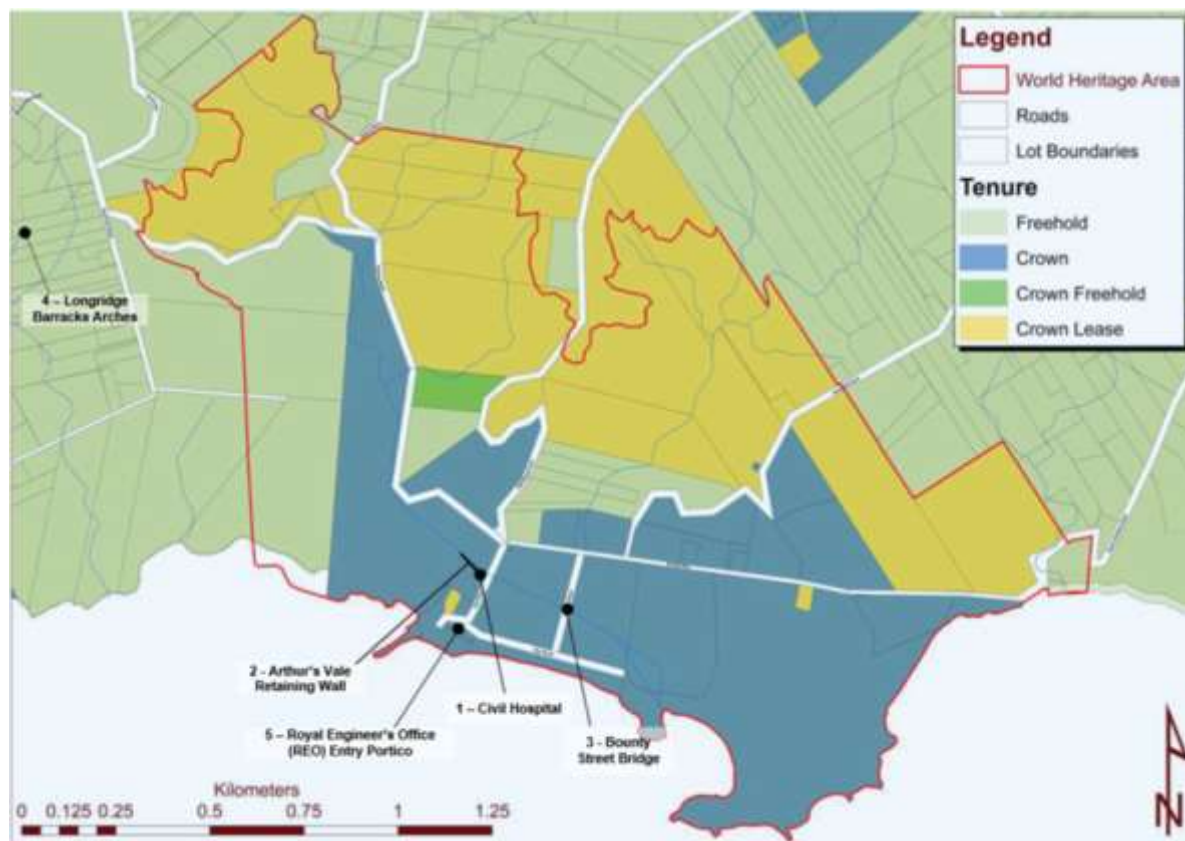
## 1.0 Introduction

The Department of Infrastructure, Regional Development and Cities (DIRDC) commissioned AECOM Australia Pty Ltd (AECOM) to provide 'Asset Management Planning and Advisory Services' that will allow DIRDC to meet its responsibilities across the Territories.

As a variation to the scope, AECOM have been commissioned to assess a number of very high risk structural issues identified in the *KAVHA Safety Hazard Scoping Study Draft Report* (GML, May, 2018). The scope of the work covers delivery of design up to the 50% level of detail with a P80 level cost estimate to address a number of "very high risk" structural hazards identified in the Report. The scope of services covers the following heritage items on Norfolk Island:

- Civil Hospital (Northern Gable and Retaining Wall)
- Arthur's Vale Retaining Wall
- Bounty Street Bridge
- Longridge Barracks Arches
- Royal Engineer's Office (REO) Entry Portico.

This report provides the 50% level of design to address the identified hazards with initial project costings and project risk register. In addition, AECOM has prepared a document summarising the environmental approval pathways that are relevant and preliminary mitigation and management measures associated with the proposed engineering options for rectification work on the heritage items.



**Figure 1 Map of KAVHA showing Commonwealth land, Crown land, Crown Free hold land, and free hold and Crown Lease land. The Commonwealth Heritage Listing applies only to Commonwealth land (Source: KAVHA HMP, 2016)**



## 1.1 Heritage context

The properties assessed as part of the Kingston and Arthur's Vale Safety Hazard Investigations are variously included on the World Heritage List (WHL), National Heritage List (NHL), Commonwealth Heritage List (CHL) and the Norfolk Island Heritage Register (NIHR) (Table 2) (see also Appendix A). WHL, NHL and CHL places are all protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), while the NIHR places are protected under the *Norfolk Island Heritage Act 2002*. As a consequence, works to these heritage properties need to be managed in accordance with national and local legislation.

In Australia, best practice principles for meeting heritage management requirements are provided by the *Australia ICOMOS Charter for Places of Cultural Significance, The Burra Charter*, 2013 (Burra Charter) (ICOMOS (Australia) 2013). Further guidance for the WHL Kingston and Arthur's Vale Historic Area (KAVHA), is provided by the *Kingston and Arthur's Vale Historic Area Heritage Management Plan* (HMP) prepared by Godden Mackay Logan (GML) in 2016 (Godden Mackay Logan Pty Ltd 2016). The *Norfolk Island: Longridge Arches Heritage Management Plan* prepared by Eric Martin and Associates (2005) provides similar guidance for the Longridge Barracks Arches.

In the following sections, these management documents are used to provide a preliminary assessment of the heritage risk posed by the proposed works, and to formulate potential management measures.

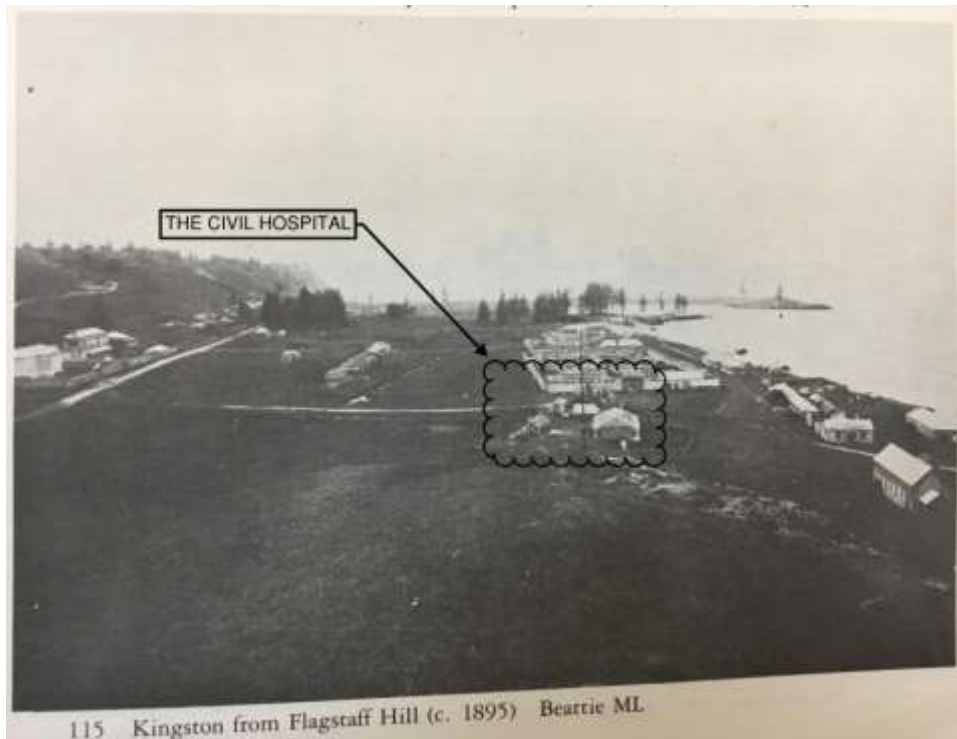
**Table 2 Summary heritage listings**

| Place                         | WHL    | NHL    | CHL    | NIHR |
|-------------------------------|--------|--------|--------|------|
| Civil Hospital                | 106209 | 105962 | 105606 | Yes  |
| Arthur's Vale Retaining Wall  | 106209 | 105962 | 105606 | Yes  |
| Bounty Street Bridge          | 106209 | 105962 | 105606 | Yes  |
| Longridge Barracks Arches     | -      | -      | 105623 | Yes  |
| Royal Engineer's Office (REO) | 106209 | 105962 | 105606 | Yes  |

## 2.0 Civil Hospital (Northern Gable and Retaining Wall)

### 2.1 Description

The Civil/Convict Hospital is a WHL building located in the Kingston and Arthur's Vale Historic Area (KAVHA) of Norfolk Island. The convict hospital was first built in 1829, with extensions added to the building in 1833. The building is made from calcarenite stone and originally had a thatched roof, which was later shingled as part of the 1833 extensions.



**Figure 2 Kingston - Civil Hospital – 1895 (Department of Housing and Construction, Norfolk Island)**

Currently the Civil Hospital is in a state of ruins, with the roof and large portions of the walls missing but it remains a strong visual component of the KAVHA precinct and is integral to the historical interpretation of the site.

### 2.2 Scope and Purpose

The scope of works, as per the Variation to Scope of Asset Management Planning and Advisory Services Version 2, outlines the possible structural safety concerns for the Civil Hospital. The expected scope of works, with regards to the Civil Hospital, includes the following:

- Assessment of the works required to cordon off the building and retaining wall.
- Determination of the extent of defects and the preferred solution to repair/rehabilitate the existing wall. Initial solution should be to provide cross stitching of cracks and temporary steel bracing behind the gables until a long-term strategy can be implemented and replacement of the timber lintel.
- Prepare sketches detailing the recommended solution.
- Prepare a rehabilitation methodology in conjunction with the Senior Heritage Specialist.
- Prepare a P80 level cost estimate for the recommended works.

Based on the GML Draft Report, the following concerns were highlighted as “high risk” or “very high risk” and were investigated during the structural inspection conducted between Monday 20 August 2018 and Friday 24 August 2018. These “high risk” concerns include:

- A structural crack on the gable and cracking between the northern gable and perimeter wall.
- The possible failure of the retaining wall.
- Missing timber lintel and cracking in adjacent unsupported calcarenite blocks.

## 2.3 Site Observations

The outcome of the structural inspection carried out by Alan Schmierer and Jessie Corry (AECOM) from Monday 20 August 2018 to Friday 24 August 2018 was used to address the above outlined scope of works. The inspection was used to identify and validate the identified safety concerns for the Civil Hospital, and to determine an appropriate course of action to resolve these issues.

### 2.3.1 Observations

#### 2.3.1.1 Northern Gable

The main building is in a state of ruin, with the entire roof structure missing, leaving the northern gable unrestrained. This is a safety concern as the gable, which is approximately 5 m high, is left free standing and with no restraint the top of the gable. There is a large crack (>3 mm) running along the eastern corner of the interior face of the gable and a crack on the external face of the gable running down the eastern corner of the gable which appears to be separate to the internal crack. It is possible that a stone became loose due to weathering and hence propagated a crack in the mortar. The walls were extensively pointed with cement-based render in the 1960's due to erosion of the existing mortar. The pointing extended to ground level and on the northern side of the building the ground level has been lowered by erosion and cattle grazing which has left the stone base of the wall exposed. Probing of the northern side of the gable below the render line revealed voids, which extend up to 600 mm into the wall.



Figure 3 Civil Hospital northern gable ruins





**Figure 4 Northern gable interior face**



**Figure 5 Northern gable exterior face**



**Figure 6 Crack in the gable interior face top**



**Figure 7 Crack in the gable interior face bottom**





**Figure 8 Crack in the gable exterior face**



**Figure 9 Crack in the gable exterior face**



**Figure 10 Lowered ground line to the northern exterior of gable**

### 2.3.1.2 Retaining Wall

The retaining wall attached to the Civil Hospital shows a rotation of the base of the wall. The retaining wall steps out and widens in sections, with an offset of approximately 300 mm from the top of the retaining wall, which suggests the top half (balustrade portion) of the retaining wall was installed later. The top half of the balustrade was almost vertical and may have been installed after the base of the retaining wall rotated. This would suggest that no further movement of the retaining wall has occurred since the top half of the wall has been installed. Based on this observation and the proportions of the wall no further works are proposed as required beyond annual inspections of the wall by maintenance staff to check for further rotation or cracking.

A drain is positioned in the centre of the retaining wall which drains rainwater from behind the wall to the lower terrace in front of the wall. It appears to still be functioning, but this needs to be verified and the drain maintained.



Figure 11 Civil Hospital retaining wall interior view



Figure 12 Civil Hospital retaining wall exterior view





**Figure 13 Exterior step out of retaining wall base**



**Figure 14 Interior of the top of the retaining wall**



**Figure 15 Drain below the retaining wall**



**Figure 16 Drain run out below the retaining wall**

### 2.3.1.3 Timber Lintel

One of the doorways to the southern side of the Civil Hospital is missing a timber lintel to the southern face of the doorway. The timber lintel on the northern side was present but appeared to be in a state of decay and completely detached from the top of the doorframe. The doorframe, which is constructed of calcarenite stone, did not show any sign of vertical sagging over the opening and showed no sign of negative impact from the lack of support from the lintel. There are cracks present to the side of the doorframe, which may have propagated from the lintel notch in the wall however, they appeared to be minor with no damage to the integrity of the stonework.



**Figure 17 Missing lintel on southern face of doorframe**





**Figure 18 Northern face of doorframe**



**Figure 19 Southern face of doorframe**



**Figure 20 Space between stone doorframe and existing timber lintel on northern face**



Figure 21 Crack on eastern side of northern face



Figure 22 Crack on western side of northern face

## 2.4 Structural Assessment

Assumptions have been made about the Civil Hospital's structural integrity due to lack of documentation, including capacities of different materials, ground conditions, and types of structure below the surface. Design wind and seismic loads were obtained from relevant Australian standards and used to calculate the adequacy of the structures as part of the risk assessment.

### 2.4.1 Northern Gable

Cracking in the top of the eastern corner was most prominently found on the northern face of the gable and was hence inaccessible from the ground. There may be a loose stone on the northern face of the wall; but due to limited access it was impossible to determine whether the stone was in fact separated from the wall or if the mortar was cracked along only two faces of the stone. The loose stone may be responsible for propagation of further smaller cracks along the eastern corner of the gable. Proper evaluation of the cracking was impaired due to the inaccessibility of the cracks on the northern face and due to additional render/coating applied to the gable. The cracking alone was not of a severe nature and does not pose an immediate threat to the wall.

The stone used for the construction of the gable is locally sourced calcarenite with unknown mechanical properties, so assumptions were made to determine the capacity of the structure. For the purpose of structural calculations, it was assumed that the stone/masonry has no tensile capacity and the wall was properly founded into the ground. The density of the stone was taken to be approximately equivalent to limestone. These assumptions were used to check the gables adequacy as a freestanding wall to withstand both wind and earthquake loading.

It was assumed that the wall will crack about the recess below the top triangular portion of the gable. The calculations revealed that the gable is unable to resist anticipated wind or seismic loads and represents a safety risk. It is recommended that temporary bracing and/or exclusion be installed and a long-term solution for bracing the gable be constructed.



### 2.4.2 Retaining Wall

One of the main concerns with regards to the Civil Hospital retaining wall was the tilt of the wall towards the north. The base half of the retaining wall has rotated, however the top half of the wall remained relatively vertical. It appears that the top half of the retaining wall was added after the base half of the retaining wall had rotated. As the top half of the wall has remained straight, it can be assumed that the rotation of the wall has stopped and been fixed due to this additional wall. Further monitoring and observation would be required to determine if the wall is still rotating and whether further repair is necessary.

### 2.4.3 Timber Lintel

Due to the narrow width of the doorway compared to the proportions of the wall above the main purpose of the timber lintel is be a construction aid and then to prevent individual stones becoming dislodged. The wall above will arch across the opening without a lintel.

The timber lintel still in place on the northern side of the door was showing signs of weathering and had a 20 mm gap between the stone and the timber. Cracks are propagating from the lintel notch in the wall but based on the proportions of the stone wall above and the lack of rotation. These cracks were assessed as minor and not significant to the structural capacity of the wall.

## 2.5 Proposed Solutions

Proposed solutions range from a 'do nothing' approach, do the minimum required for safety, construction of a structural solution that includes heritage interpretation through to full reconstruction. A 'do nothing' solution has been included as a benchmark for costing and planning purposes. Others have been included because they represent a reasonably practical solution.

### 2.5.1 Northern Gable

#### 2.5.1.1 Do Nothing

The 'do nothing' solution for the Civil Hospital northern gable is not considered a viable solution for the wall. The gable wall is unrestrained above the height of the surrounding walls and is not tied back into the remainder of the structure. Calculations indicate that the wall does not have sufficient structural adequacy to resist high winds or foreseeable earthquake loads and hence has a risk of collapse. Collapse during high winds is unlikely to present a reasonable risk to people as it could be expected that area would not be occupied at that time, however the earthquake scenario poses a risk to visitors and workers. Allowing the gable to fail would also contravene HMP Policy 8.3, which states that *'The fabric and layered heritage values attributed to the buildings, structures, ruins, movable items and objects will continue to be conserved, managed and transmitted'*.

It is recommended that exclusion or temporary support be provided to the gable in the short term and until a permanent solution is constructed.

#### 2.5.1.2 Stabilising the Gable

The recommended solution to repair/rehabilitate the Civil Hospital gable is to restrain the gable wall and hence stabilize the structure. A method for the rectification of the gable is to build a structure behind the gable (to the south) to tie the wall back and prevent it overturning. This process is preferable as it will allow for the preservation of the wall, rather than allowing for it to collapse and destroy more of the heritage site. The Civil Hospital will be required to be closed for a period while the construction of the stabilising structure is taking place. It would be best to align the construction with a season of smaller tourism to minimise the impact this closure will have on tourist and guided tours.

One option for this stabilisation is a partial-reconstruction as demonstrated by the works to the Weirs Cove storehouse ruins on King Island. In this case, the bracing mechanism would be a timber structure which is fully attached over the top of the gable and which will tie the top of the wall back into the structure to prevent its separation from the bottom during large winds or earthquake loads. The structure can be arranged to match the shape of the hospital, and hence provide an interpretation of the original building. It is noted, however, that the resulting building form is visually intrusive, and has the potential to conflict with HMP policies regarding preservation of views (Policy 8.2.1), or the management of ruins (Policy 8.3.4) (see also Australian Heritage Council 2013).



**Figure 23 Weir Cove storeroom after restoration and reconstruction (Department of Environment, Water and Natural Resources)**

An alternative approach is that employed for the Darwin Town Hall Ruins, which is listed on the Northern Territory Heritage Register (NTHR 200 04995) and the non-statutory Register of the National Estate (RNE 16356). In this case, more discrete braces have been placed on the interior and exterior of the gables, stabilising the structure while minimising visual impacts, and retaining the structure's ruinous appearance. It is likely that this type of approach is more in keeping with HMP Policy 8.3.4 which states that: 'Reconstruction and restoration of ruins will be avoided unless essential for physical conservation or approved interpretation programs'.

These braces would be fixed to the northern gable wall and the central east west wall.



**Figure 24 Darwin Town Hall Ruins after stabilisation (RNE 6356)**

Either solution will require alterations to the existing structure, potentially impacting original fabric, and also ground disturbing works, potentially impacting on archaeological remains in and around the building. The extent of excavation and fixing to the existing walls is similar in each bracing method.

It is highly recommended that this stabilisation will be implemented as the gable has been deemed unsafe, and as there is no restriction of access to the site, it is a danger to visitors and workers in and around the site. Given the potential for impact on original fabric, archaeological remains and the



appearance of the building, it is further recommended that a heritage impact statement (HIS) be developed to assess the significance of the proposed changes, recommend appropriate mitigations, and support approvals as required.

#### **2.5.1.3 Comparison to GML Recommendations**

The GML Safety Hazard Scoping Study proposed the following potential mitigation strategies to the structural risks:

- Consider installing a new roof structure to laterally brace the northern gable wall and the east to west internal wall. This new structure could interpret the original roof form.
- Investigate the bond between the walls and consider installing concealed stainless steel tie rods between the walls to bridge the cracks.

As discussed above there is consensus on the need to brace the walls so they can adequately resist anticipated wind and seismic loads.

The bracing can take the form of the original roof form and be used to interpret the original building form as recommended by GML. A more discrete bracing form that is similar to that shown in Figure 24 is recommended to reduce the visual impact of the bracing. These braces would be fixed to at least the northern gable and the central east west wall. There is a wall on Quality Row that has been braced in this manner so there is precedent in KAVHA for this form of bracing.

It is probable that the stainless steel tie rods will not be required as the wall bracing will be sufficient to restrain the walls. Alternatively, the eastern wall could be included in the wall bracing works if this was found to be necessary during the detail design phase.

The recommendations provided above address all the GML identified hazards.

### **2.5.2 Retaining Wall**

#### **2.5.2.1 Do Nothing**

With regards to the Civil Hospital retaining wall, the solution to 'do nothing' is a reasonable solution, especially for the immediate future. The retaining wall appears to be in good condition, with the top half of the wall remaining mostly vertical. It would suggest that the wall is no longer rotating and is structurally sound.

It is recommended that annual or biennial monitoring of the wall be implemented to ensure that the wall is not rotating and to inspect for any further damage to the wall. It is recommended that the drain under the retaining wall be inspected and cleared out so that water can be removed from behind the wall. Maintenance of the drain should be done to ensure that the drain remains fully functioning and there is no build-up of water behind the wall, in accordance with HMP Policy 8.3.

#### **2.5.2.2 Comparison to GML Recommendations**

The GML Safety Hazard Scoping Study proposed the following potential mitigation strategies to the structural risks:

- Erect signage and barriers to ensure visitors, staff and residents do not access the area in front of / below the retaining wall on foot or on vehicles
- Investigate the cause of the rotation and undertake remedial works to stabilise the wall

AECOM have investigated the cause of the rotation and believe the wall is no longer rotating and is structurally sound. Recommendations have been made regarding ensuring adequate drainage behind the wall.

The recommendations provided above address the GML identified hazard.

### **2.5.3 Timber Lintel**

#### **2.5.3.1 Do Nothing**

While the lintel does not contribute significantly to the overall stability of the wall it does prevent individual stones from becoming dislodged and falling into the doorway. This is a foreseeable risk and

should be prevented, in accordance with HMP Policy 8.3. Hence a 'do nothing' solution is not recommended.

### 2.5.3.2 Replace the Timber Lintel

The timber lintel should be replaced with a new section of timber which is in keeping with the species, size, form, shape and appearance of the original fabric (see HMP Policy 8.3.1, 8.3.2, 8.3.3). Unsympathetic timbers, such as treated pine, should be avoided and removed where possible (Figure 25) (see HMP Policy 8.3.1). If treatments are required for the longevity of the timber, options should be investigated to ensure minimal visual or physical impact on the original fabric.

Any lintel that is showing excessive signs of decay or is not bearing hard against the stone work along its upper surface or at each end should also be replaced as per above.



Figure 25 Replaced timber lintel on eastern entrance into the Civil Hospital

### 2.5.3.3 Comparison to GML Recommendations

The GML Safety Hazard Scoping Study proposed the following potential mitigation strategies to the structural risks:

- Replace the missing timber lintel and assess the condition of the remaining lintels
- Match the timber lintel detail when replacing lintels and do not use concrete

As discussed above there is consensus on the need to replace missing and aged timber lintels with sympathetic timber species.

The recommendations provided above address the GML identified hazards.

#### 2.5.3.4 Risks

Based on the above solution, several risks and mitigation measures have been identified and are included in Table 3.

These risks should be updated during the project and passed on to the designers of subsequent phases.

**Table 3 Risk table**

| Risk event   | Probability    | Consequence  | Mitigation   |
|--|----------------|--|--|
| Gable bracing will alter appearance of building  | Almost certain | Visual impact to WHL landscape                                   | <ul style="list-style-type: none"> <li>Design to consider least intrusive option</li> <li>HIS to identify impacts and mitigations, and support any necessary approvals</li> </ul>  |
| Archaeological artefacts are contained in ground that will be excavated                  | Likely         | Artefacts will be damaged or destroyed during construction works | <ul style="list-style-type: none"> <li>Archaeological assessment to be conducted in accordance with HMP Policy 8.4.1 and suitable mitigations developed as part of HIS. Depending on archaeological sensitivity and extent of ground disturbance, these may include: <ul style="list-style-type: none"> <li>- Test pitting</li> <li>- Controlled archaeological excavation</li> <li>- Archaeological monitoring</li> </ul> </li> </ul> |
| Gable bracing and new lintel works may damage the wall, and introduce intrusive elements | Possible       | Impact on original fabric and appearance                         | <ul style="list-style-type: none"> <li>Appropriate care to be taken around wall</li> <li>Design to identify least intrusive options</li> <li>Suitably qualified engineering specialist to direct construction works</li> <li>Any damage to be repaired in accordance with Burra Charter standards</li> </ul>   |

#### 2.5.3.5 Summary of Works

The following works, in the likely chronological order, are recommended:

- Prepare detailed design and construction documentation to undertake the following works:
  - Excavate the base of the gable wall, inspect by structural engineer to confirm proposed repair works, point stonework and reinstate ground level
  - Timber bracing structure to stabilise gable walls
  - Timber lintels to doorway
  - Detailed design, drawings, specifications
  - Heritage review & approvals
  - Contract documentation.

The recommended construction works are shown on Concept Sketches in Appendix D.

## 2.6 Cost of Solution

The estimated cost to undertake the project is \$474,116. The costs are summarised in Table 4 and a copy of the detailed estimate included in Appendix B.

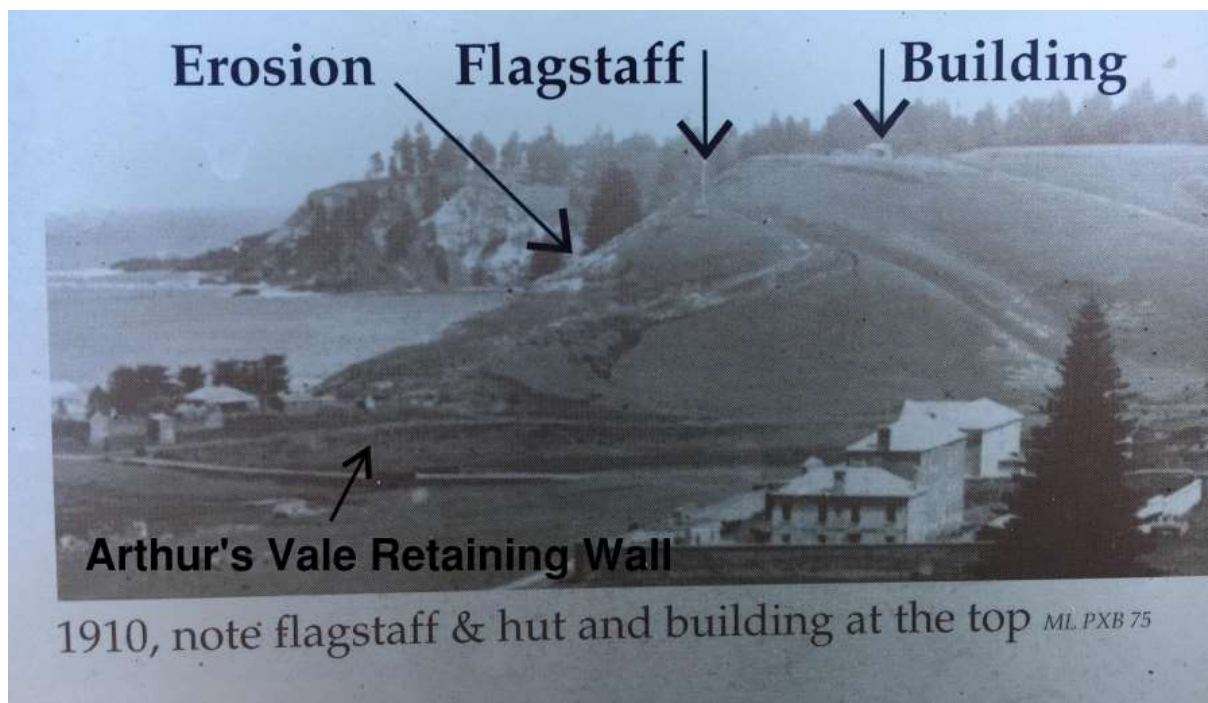
**Table 4 Estimated cost of recommended solution**

| Project element   | Estimated Cost    |
|---|-------------------|
| Detailed design & documentation   | \$ 84,500         |
| Archaeological and heritage impact assessment   |                   |
| Construction Northern Gable: <ul style="list-style-type: none"> <li>- Exclusion zones and signage to full extent of northern gable</li> <li>- Excavation of footings for gable support frame and investigations to base of Northern walls</li> <li>- Construction of new timber bracing frame</li> <li>- Repointing base of northern wall</li> <li>- Reinstatement of earth to northern batter</li> </ul> | \$ 191,611        |
| Construction Civil Hospital retaining wall: <ul style="list-style-type: none"> <li>- Inspection and opening up works if required to the existing drain through the wall</li> <li>- Initiate biennial inspection of the wall with photographic records to be used for comparison purposes at following inspections</li> </ul>  |                   |
| Construction Timber lintel: <ul style="list-style-type: none"> <li>- Insertion of new timber lintels to openings with missing or rotten lintels</li> </ul>  |                   |
| Archaeological mitigations (provisional)  | \$ 12,700         |
| Client supervision & administration (25%)   | \$ 72,203         |
| Contingencies (Inherent and Contingent)   | \$ 113,102        |
| <b>Total Cost</b>   | <b>\$ 474,116</b> |

## 3.0 Arthur's Vale Retaining Wall

### 3.1 Description

The Arthur's Vale retaining wall is a calcarenite stone wall that is located within the Kingston and Arthur's Vale Historic Area (KAVHA) on Norfolk Island. The retaining wall is just one part of the extensive WHL site and is located just north of the Civil Hospital. The retaining wall was a part of the original convict settlement site that was built in 1833. The retaining wall is approximately 60 m long, 2.8 m at the tallest point, and extends east to west from the southern end of Pier Street, Kingston.



**Figure 26 Arthur's Vale Retaining Wall 1910**

The Arthur's Vale retaining wall is a significant part of the KAVHA site and was constructed as part of an access road that continued along Arthur's Vale. The site is open to both pedestrian and vehicular access and "bulging" of the wall has created a safety concern regarding its adequacy. The site needs to be maintained and preserved for both the heritage and historical value but also as a structurally capable retaining wall to restrain the land behind.

### 3.2 Scope and Purpose

The scope of works, as per the Variation to Scope of Asset Management Planning and Advisory Services Version 2, outlines the possible structural safety concerns for the Arthur's Vale Retaining Wall. The expected scope of works, with regards to the Retaining Wall, includes the following:

- Assessment of the works required to cordon off above and below the retaining wall
- Determination of the likely extent of defects and the preferred solution to repair/rehabilitate the existing wall.
- Prepare sketches detailing the recommended solution.
- Prepare a rehabilitation methodology in conjunction with our Senior Heritage Specialist.
- Prepare a P80 level cost estimate for the recommended works.



The GML Draft Report suggests that the retaining wall is at imminent risk of collapse and it has been noted that there is no restriction of both vehicular and pedestrian traffic on or around the wall. Based on the GML Draft Report, the following concerns were highlighted as “high risk” or “very high risk” and were investigated during the structural inspection conducted between Monday 20 August 2018 and Friday 24 August 2018. These “high risk” concerns include:

- Structural “bulging” of the calcarenite wall with horizontal cracking.
- Rotation of the wall.

### 3.3 Site Observations

The outcomes of the structural inspection carried out by Alan Schmierer and Jessie Corry (AECOM) from Monday 20 August 2018 to Friday 24 August 2018 was used to address the above outlined scope of works. The inspection was used to identify and validate safety concerns for the Arthur’s Vale retaining wall, and to determine an appropriate course of action to resolve these issues.

#### 3.3.1 Observations

The Arthur’s Vale retaining wall, while it remained structurally intact, appeared to have some major issues with bulging of the retaining wall and erosion of parts of the retaining wall. Roughly a third of the retaining wall was showing a large bulge towards the north and the top half of the retaining wall appeared to have fallen back in on itself. There was evidence of large cracks throughout the retaining wall, gaps in the mortar between stones, no mortar in stones for portions of the retaining wall and there was evidence of significant cracking (>10 mm) and damage to the top of the retaining wall. There was evidence of three existing vertical drains within the first half of the wall however they appeared to be non-functional and possibly filled in. There was no sign of drainage in the rest of the wall, with no sign of drainage evident where the bulging in the wall was present. The landscape behind the wall was sloped to direct water into the main section of the retaining wall where there are no drains present through the retaining wall.



**Figure 27 Arthur’s Vale Retaining Wall**



**Figure 28 Bulging of retaining wall**



**Figure 29 Bulging of retaining wall**



**Figure 30 Rotation of the top of the wall**



**Figure 31 Collapse of top of wall back on itself**





Figure 32 Arthur's Vale retaining wall drain locations



Figure 33 Drain 1 external view



Figure 34 Drain 1 internal view





**Figure 35 Drain 2**



**Figure 36 Drain 2 aligned with drain in the hospital**



**Figure 37 Drain 3**



**Figure 38 Drain 3 location**





Figure 39 Cracking in top of retaining wall



Figure 40 Cracking in the retaining wall



Figure 41 Damage to top of retaining wall





**Figure 42 Cracking and gaps in the mortar**



**Figure 43 Portion of retaining wall without mortar**



**Figure 44 Slope of land funnelling water down into retaining wall from hill behind**

### 3.4 Structural Assessment

The wall is constructed using calcarenite stones and is of unknown thickness. Its height starts at essentially zero at the western end and increases to over two metres at the eastern end. The wall is configured as three approximately straight segments forming a curve.

The western end is constructed as dry stacked stones covering an earth batter and has a relatively informal pattern of rock stacking. This section of the wall is in relatively fair condition due to its low height.

The eastern end is constructed with rectangular and flat stones laid in a formal pattern with mortared joints. It appears to be engineered and of a mass gravity design. This section of the wall is in relatively good condition due to its better quality of construction. There are three drains in this section of the wall that are intended to collect stormwater from behind the wall and allow it to pass through and be discharged into the creek. One drain is aligned with the drain from the Civil Hospital retaining wall. It is not known if the drains still function and the inlets appear to have been overgrown with kikuyu grass.

The central portion of the wall has been constructed with a form and quality somewhere between the two end walls. Large portions are dry stacked, but areas have been mortared, possibly in response to damage to the wall. One section of mortar repair pointing had the date 1996 scribed into the mortar while it was still wet. This section of wall appears to have been constructed as a dry stone facing one or two stones thick and laid over an earth face. Most of the damage to the wall is located within this central portion. The damage can be categorised into three main types:

- Horizontal movement. Some sections of the wall have moved away from the earth indicating excessive lateral pressure on the wall. This is typically associated with an inadequate wall thickness and possibly excessive water pressure behind the wall. These are either not repaired or repaired by mortaring the stones in their displaced locations.
- Local displacement of stones. This appears to be the result of water passing through the wall and displacing stones locally. Repair has typically involved mortaring the stones in a slightly displaced location.
- Horizontal cracking at approximately mid height of the wall and the top portion of the wall tilting backwards. This sometimes accompanied by slight outward rotation of the bottom half of the wall. It appears that the cause of this damage is rainwater runoff passing through the wall and eroding the earth batter behind the stones. This has left the top half of the wall unsupported laterally and resulted in it falling backwards onto the eroded earth face.

The water that is causing damage to the wall is coming from the terrace behind the wall, the slopes up to the civil hospital, the drain that discharges from the Civil Hospital and runoff from the ridge behind the Civil Hospital via a swale near the gate in the timber fence – refer Figure 44. The low point in the terrace is approximately aligned with the main area of wall damage.

### 3.5 Proposed Solutions

#### 3.5.1 Do Nothing

A 'do nothing' approach to the damage to the retaining wall is not considered to be a suitable solution for the Arthur's Vale retaining wall as it does not address the issue of water passing through the wall and eroding the earth batter behind it. Eventually this erosion is expected to lead to at least collapse of sections of the central part of the wall. Allowing such a failure is inconsistent with HMP Policy 8.3.

While the wall collapse could also pose a threat to pedestrians, as there is no restriction of access above or below the wall the actual risk of injury is not considered high as it would likely occur during an extreme rain event and at this time the area is likely to be unoccupied. The risk to vehicles and occupants is higher as the area behind the wall is accessible to vehicles and the weight from a vehicle could initiate the wall failure during or after a period of prolonged rainfall.

It is recommended that in the short term, vehicular access above the wall is prevented. If this is not feasible then vehicles should not use the area when it is wet and not be within two metres from the rear of the wall. It is also recommended that the existing drains be cleared out to allow for drainage through the wall.





### 3.5.2.1 Comparison to GML Recommendations

The GML Safety Hazard Scoping Study proposed the following potential mitigation strategies to the structural risks:

- Erect signage and barriers to ensure visitors, staff and residents do not access the area in front of / below the retaining wall on foot or on vehicles – area to be closed to the general public
- Adequately scope a remediation program including geotechnical investigation and structural design of a new retaining wall
- Carefully document the wall prior to disassembly to enable its accurate reconstruction

There is consensus on the need to keep vehicles from surcharging the wall and that excluding them from the area behind the wall is recommended. If this is not possible, then AECOM believe keeping vehicles at least 2m away from the rear of the wall is sufficient.

AECOM believe that the risk to pedestrians is confined to periods of heavy rainfall and the following period when the ground is saturated. It is likely that during these times the area immediately below and behind the wall would be unattractive to visitors and unoccupied. If this is not the case, then temporary warning signs could be erected and removed as part of the precinct operations.

AECOM have undertaken an engineering assessment and believe the major cause of damage to the wall is inadequate drainage and have proposed remedial measures.

AECOM believe reconstruction of the wall is not required at present and the preferred heritage outcome is to maintain the wall in its current condition via construction of the proposed drainage measures and ongoing maintenance of the wall.

There is consensus on the need to carefully and comprehensively document the wall if a section needs to be rebuilt.

The recommendations provided above address the GML identified hazards.

### 3.5.2.2 Risks

Based on the above solution, several risks and mitigation measures have been identified and are included in Table 5.

These risks should be updated during the project and passed on to the designers of subsequent phases.

**Table 5 Risk table**

| Risk event  | Probability | Consequence  | Mitigation   |
|---|-------------|--|--|
| Archaeological artefacts are contained in ground that will be excavated | Likely      | <ul style="list-style-type: none"> <li>Artefacts will be damaged or destroyed during construction works</li> </ul> | <ul style="list-style-type: none"> <li>Archaeological assessment to be conducted in accordance with HMP Policy 8.4.1 and suitable mitigations developed as part of HIS. Depending on archaeological sensitivity and extent of ground disturbance, these may include:               <ul style="list-style-type: none"> <li>Test pitting</li> <li>Controlled archaeological excavation</li> <li>Archaeological monitoring</li> </ul> </li> </ul> |
| Excavation works for drains may damage the wall                         | Possible    | <ul style="list-style-type: none"> <li>Impact on original fabric</li> </ul>  | <ul style="list-style-type: none"> <li>Appropriate care to be taken around wall</li> <li>Use appropriate sized machinery</li> <li>Suitably qualified engineering specialist to direct excavation works</li> <li>Any damage to be repaired in accordance with Burra Charter standards</li> </ul>  |

### 3.5.2.3 Summary of Works

The following works, in the likely chronological order, are recommended:

- Prepare detailed design and construction documentation to undertake the following works:
  - Archaeological and heritage assessment
  - Detailed design, drawings, specifications
  - Heritage review & approvals
  - Creation of bund to direct water flows from the ridge to Watermill Creek via an alternative route
  - Agricultural drain to intercept surface and subsurface flows from behind the wall and direct them to Watermill Creek via the three existing drains in the retaining wall
  - Provision of a means for excluding vehicular traffic from the zone of influence at the rear of the wall
  - Contract documentation.

The recommended construction works are shown on Concept Sketches in Appendix D.



### 3.6 Cost of Solution

The estimated cost to undertake the project is \$493,524. The costs are summarised in Table 6 and a copy of the detailed estimate included in Appendix B.

**Table 6 Estimated cost of recommended solution**

| Project element  | Estimated Cost    |
|--|-------------------|
| Detailed design & documentation  | \$ 39,400         |
| Archaeological and heritage assessment   |                   |
| Construction Arthurs Vale Retaining wall:  | \$ 250,982        |
| <ul style="list-style-type: none"> <li>- Vehicle exclusion to rear of wall via signage and barriers</li> <li>- Excavation for new swale and agricultural drain</li> <li>- Construction of new swale and agricultural drain</li> <li>- Inspection and opening up works to three off existing drains through the wall</li> <li>- Connection of new agricultural drain to existing drain points through the wall</li> </ul> |                   |
| Archaeological mitigations (provisional)   | \$ 6,250          |
| Client supervision & administration (25%)  | \$ 74,158         |
| Contingencies (Inherent and Contingent)  | \$ 122,733        |
| <b>Total Cost</b>  | <b>\$ 493,524</b> |

## 4.0 Bounty Street Bridge

### 4.1 Descriptions

The Bounty Street Bridge is a convict-built bridge, constructed circa 1832 (O'Connor, undated) and located within the KAVHA precinct. It has significant cracking and has suffered from non-uniform subsidence leading to concerns regarding the structural integrity of the bridge. The GML Report references a number of previous studies including Hughes Trueman (Apr 2010), Higginbotham & Associates (Apr 2010) and Northrop Report (Dec 2014). However, a number of earlier reports, dating back to Wilson (2002) all report similar findings relating to the bridge condition and associated issues with high water levels, weeds and structural defects. The watercourse is a constructed straight channel and is recorded in various documents as both Watermill Creek and Swamp Creek. This report will refer to Watermill Creek.

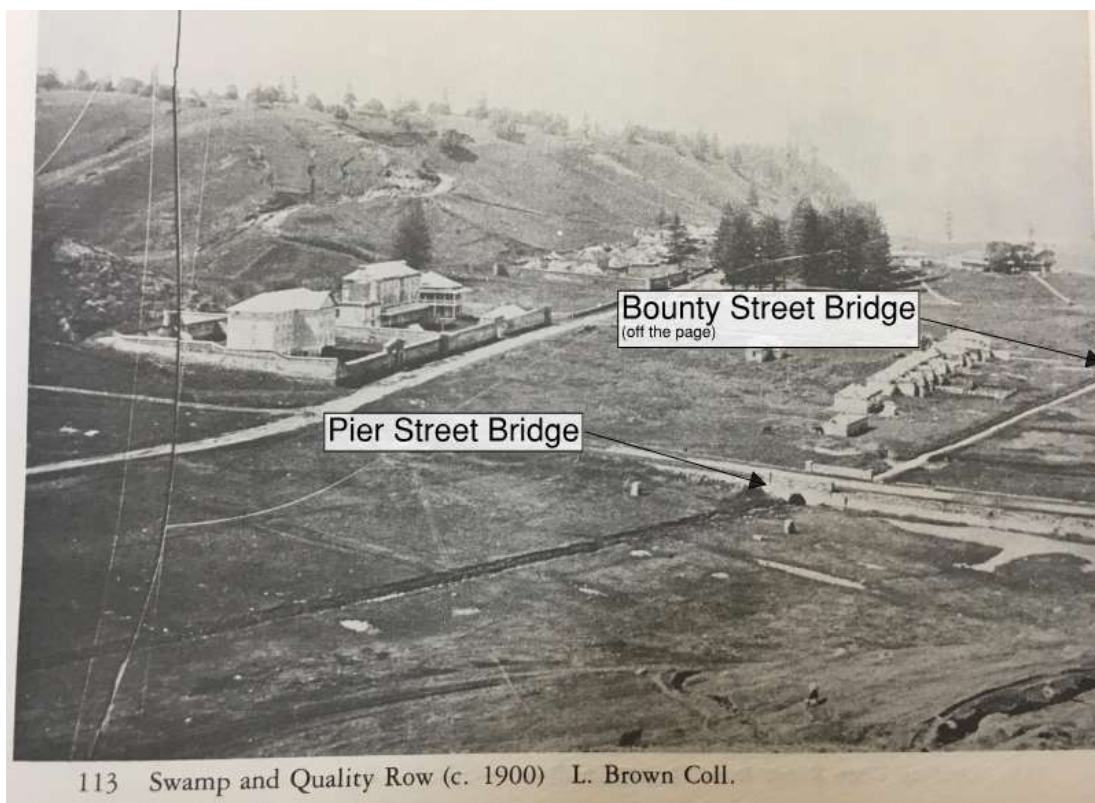


Figure 46 Kingston – Swamp and Quality Row – 1900 (*Department of Housing and Construction, Norfolk Island*)

### 4.2 Scope and Purpose

The scope of works, as per the Variation to Scope of Asset Management Planning and Advisory Services Version 2, outlines the possible structural safety concerns for the Bounty Street Bridge. The expected scope of works, with regards to the bounty street bridge, includes the following:

- Detailed review of the Hughes Trueman report (2010) and other relevant references with consideration to excluding vehicular traffic if considered necessary
- Develop a proposal to remove the vegetation and silt to lower the water level at the bridge. This might include the full length of the drain downstream of the bridge or a localised section on both sides of the coffer dam.
- Prepare sketches detailing possible drain clearing, dewatering solutions.
- Prepare a rehabilitation methodology in conjunction with our Senior Heritage Specialist.
- Prepare a P80 level cost estimate for the recommended works.

Based on the GML Draft Report, the following concerns were highlighted as “high risk” or “very high risk” and were investigated in the structural inspection conducted between Monday 20 August 2018 and Friday 24 August 2018. These “high risk” concerns include:

- Structural crack on the western portal.
- Subsidence of the structure.
- Missing capstones.

### 4.3 Background

Settlement of up to 1,190 mm in the south-west to north-east direction has been reported with commentary around the effect on the hydraulic performance of the waterway with the bridge expected to act as a ‘dam’ during high rainfall events. The bridge is reportedly tilting as a complete unit, as would be expected from an arched structure. The authors of the report contend that based on their assessment, the settlement of the bridge is consistent with inadequate bearing material and the bridge foundations are likely to be settling into the mud. They further contend that the flow from Town Creek at the northern abutment may be a contributory factor in the settlement.

Despite the recommendations from those studies, the only physical measures implemented appear to be the restriction of load and speed limits for traffic using the bridge and measuring of the crack widths.

According to the previous authors there is only minimal fall between the Bounty Street Bridge and the outfall into Emily Bay, so the ability to significantly lower the standing water level and water table may be limited.

A proposal by Norfolk Island Consulting Engineers to undertake an investigation into the stabilisation of the bridge was prepared in November 2017 and submitted to the former Commonwealth Heritage Manager. It is assumed that this work was not completed.

Based on AECOM's site visits in June and August 2018, the standing water levels at the time were high with only the top of the upstream arch visible with reeds and other weeds also visible. The adjacent open drain in Town Creek was also overgrown and high water levels were observed.

### 4.4 Site Observations

The outcomes of the structural inspection carried out by Alan Schmierer and Jessie Corry (AECOM) from Monday 20 August 2018 to Friday 24 August 2018 was used to address the above outlined scope of works. The inspection was used to identify and validate safety concerns for the Bounty Street Bridge, and to determine an appropriate course of action to resolve these issues.

#### 4.4.1 Observations

The northern abutment of the Bounty Street Bridge has subsided. The bridge is located south of the lowest point in the swamp land, and hence the northern end of the bridge would be expected to have poorer foundations. Water and weeds had intruded upon the bridge to the point that the arch of the bridge was no longer visible above the waterline. The stream is filled with weeds and had not been cleared out for a number of years according to members of the KAVHA team. The 1940's channel that had been originally provided as an alternative drainage for the creek was filled in two years ago after the bridge/culvert under the road reached its end of life. The original channel outlet, which runs through a tunnel underneath rock to exit via the beach, has a build-up of sand and debris which has raised the water level at the bridge to a point where it is probably saturating the earth fill over the stone arch. It is currently some 300 mm above the level recorded in the Hughes Trueman report.

There is cracking present in the western wall of the bridge, with cracking up to 30 mm present in the top of the wall. Glass tell-tales had been attached previously to the outside of these cracks, but the glass has come loose from the epoxy in points rendering them ineffective. Measurement of the gap between the glass slide and the epoxy indicates that settlement of the northern abutment is continuing but at a slow pace.





**Figure 47 Bounty Street Bridge**



**Figure 48 Western side of the bridge**



**Figure 49 Eastern side of the bridge**





**Figure 50 Western side of the bridge**



**Figure 51 Eastern side of the bridge**



**Figure 52 Drain channel overrun by weeds**



**Figure 53 Channel exit blocked by weeds**





Figure 54 Drain sand filled exit to beach



Figure 55 Drain tunnel filled with sand and debris



Figure 56 Crack in the western portal



Figure 57 Crack in the western portal





Figure 58 Glass tell-tale on side of crack in the western portal

## 4.5 Structural Assessment

The Bounty Street Bridge is subsiding towards the northern end of the bridge, with minimal change to the southern end. The cracking of the western portal could be seen to align with the assumption that the northern half of the bridge had subsided further than that of the southern side, and hence created cracks at the point of bending in the bridge. It appeared that the crack had widened since the Hughes Trueman Report (2010), despite the intact glass tell-tale. The Hughes Trueman report recorded the crack in the western gable as being a maximum of 17 mm however it was almost 30 mm wide in sections. This could have been due to weathering of the stone around the crack edges, rather than actual widening of the crack.

The water level has risen significantly since that of the Hughes Trueman report, with the arch of the bridge being completely hidden below the water. The channel had also been increasingly overgrown with weeds, with minimal passage for water to move freely. It had been stated in the Hughes Trueman report that the 1940's channel was the main outgoing waterway for the channel, however this has subsequently been filled and the channel was overgrown with weeds.

The Hughes Trueman report recommends detailed engineering investigation works be undertaken to determine appropriate remediation works. These investigations require lowering of the water level at the bridge. The report also indicates that if remediation works are not undertaken the condition of the bridge will deteriorate to the point of collapse.

Currently, Watermill Creek is contaminated with sewerage from septic systems on the island. The contamination will be an issue when trying to drain Watermill Creek into Emily Bay, as this is one of the only safe swimming locations on the island and the contaminated runoff will leak nutrients and contaminants into the water which may cause problems for swimmers and the underwater ecosystem. We understand that the septic systems causing the contamination are due to be repaired or replaced within the next two years. It is assumed the reeds in the creek are currently filtering the sewerage and the increased volume due to the raised water level is increasing the time water spends within the reeds which further aids with removing contaminants. If the contamination issue is resolved within the next two years, then it will become feasible to lower the water level at the bridge and undertake the engineering investigations recommended by Hughes Trueman.

Continued erosion of the stonework will occur while it is submerged and further settlement of the northern abutment may also continue. A timeframe of two years is not likely to be significant given the age of the bridge but delays beyond this are considered excessive from the perspective of the bridges structural adequacy.

The Hughes Trueman report states that “with the amount of differential settlement that this bridge has experienced it is surprising that the bridge still carries load” and “although settlement may have slowed or even stopped the degradation of important structural stonework will continue to the point of collapse. The timing of this cannot be determined from the data currently available.”

In the following eight years the water level has risen and submerged the arch. This will have caused further erosion of the structural stone which cannot be inspected without resorting to dewatering or using underwater methods. Given the following conditions:

- Known extensive settlement and cracking of the bridge structure.
- Inability to undertake detailed inspections of key components of the bridge structure.
- Lack of drawings of the existing structure that could be used to undertake a load capacity assessment.
- Existence of a suitable and nearby alternative bridge (Pier Street bridge).
- Increased risk of damage to or even collapse of the bridge from traffic loads.

It is recommended that the bridge be closed to all but pedestrian traffic until after the detailed site investigation is completed at which time a more rigorous structural assessment may be possible.

#### **4.5.1 Cause**

According to authors of the reports, the primary cause of the settlement at the northern abutment in the south-west to north-east direction is due to inadequate bearing material and the bridge foundations are likely to be settling into the mud. They further contend that the flow from Town Creek at the northern abutment may be a contributory factor in the settlement.

Historical information records the area near Bounty Street as a swamp. There is no record of the likely depth of underlying rock or the bridge foundations constructed. Anecdotal comment from Jim Tavener (Director, Norfolk Industries, June 2018) suggested that during a previous maintenance clearing event the operator may have excavated too close to the abutment but this cannot be confirmed.

## **4.6 Proposed Solutions**

### **4.6.1 Do Nothing**

A ‘do nothing’ solution will eventually allow collapse of the bridge in contravention of HMP Policy 8.3, and hence is not recommended. The bridge appears to have subsided marginally since the Hughes Trueman report in 2010 and the raised water level will be eroding the stonework.

### **4.6.2 Recommended Solution**

#### **4.6.2.1 Implement the 2010 Report Recommendations**

Despite the Bounty Street Bridge being identified as a ‘very high risk’ under the Section 3.4.3 of the Draft KAVHA Safety Hazard Scoping Study (GML, May 2018), it is considered that a proper assessment is not possible without further works to dewater Watermill Creek near the bridge.

Once the blockages are removed it is expected that the water levels can be lowered. This may also include treatment of the water to remove nutrients prior to discharging into Emily Bay.

No recent maintenance of the waterway appears to have been undertaken along Watermill Creek from Arthurs Vale to the tunnel near Emily Bay.

Based on the earlier reports, it is recommended that the initial project should concentrate on the removal of weeds and desilting to allow a proper detailed investigation to proceed either as a component of this work or as a separate, subsequent project. According to Hughes Trueman's recommendations (2010, Section 7.8, p10), "An outcome which best protects heritage fabric would be best achieved by de-watering."

This will allow the detailed engineering investigation recommended in the Hughes Trueman report to be undertaken, including:

- Carry out detailed survey of the bridge and monitor movements.
- Carry out a geotechnical investigation to assess the foundations conditions and feasibility to construct a coffer dam and diversion channel.
- Dewater to carry out inspection works (and any remedial repairs).
- Consider measures to reduce nitrate, phosphate and sewage levels in water runoff entering Emily Bay through cattle and sewerage controls.
- Consider the diversion of the lower end of Town Creek to move the confluence further away from the downstream.
- Consider the archaeological impacts (refer to Higginbotham & Associates (2010)).

Although these works will principally focus on the removal of modern alluvium, there is the potential for impact to archaeological remains within that alluvium, or to archaeological deposits in sediments adjacent to the waterways. There is also the potential for damage to surrounding heritage fabric during desilting, including the bridge, dam and tunnel. Given these risks, it is recommended that a heritage impact statement (HIS) be developed to assess the potential impacts of the works, recommend appropriate mitigations, and support approvals as required.

#### **4.6.2.2 Preparatory Works Required**

##### **4.6.2.2.1 Temporary diversion of traffic**

Currently the bridge is subject to a 2-tonne load limit with no restrictions to parking on the grassed verges. It is recommended that in the interim until any repair or strengthening works are undertaken, all vehicular traffic be restricted from using Bounty Street. An alternative route for vehicles accessing the KAVHA, Emily Bay and Slaughter Bay areas currently exists via Pier Street and it assessed as being in a satisfactory condition for the expected increase in traffic volumes.

Pedestrian usage should be maintained.

The future level of service of the restored bridge will be dependent on the extent of strengthening works undertaken in the ultimate scheme. It is expected that the design process will include a recommendation as to the re-opening of the bridge to vehicular traffic and any load restrictions.

##### **4.6.2.2.2 Septic System Rectifications**

The proposed clean out of the channel would be preceded by rectification of septic systems and reduction of the contamination to acceptable levels. After the septic systems are upgraded it is recommended that an environmental assessment be undertaken to determine if reeds within the creek can be removed without compromising the water quality within Emily Bay to an extent that damages the corals.



#### 4.6.2.2.3 Watermill Creek Water Lowering

It is proposed to lower the water level to match the invert level of the stone channel on the sea side of the tunnel under the ridge when the sewerage contamination has been resolved in two years. This will lower the water to historical levels and allow the site investigation recommended in the Hughes Trueman (2010) report to be undertaken.

Works would include:

- Removing the concrete blockwork weir that is located immediately downstream of the tunnel through the ridge where the Watermill Creek discharges into the stone lined channel at Emily Bay (refer Figure 55).
- Removing sand from the stone lined channel between Emily Bay and the tunnel – and keeping it free from sand build-up.
- Lowering the invert of the tunnel so it aligns with the invert of the stone lined channel.

#### 4.6.2.2.4 Watermill Creek Works

Watermill Creek flows generally from west to east and discharges to Emily Bay via a convict-built tunnel. To facilitate a detailed inspection of Bounty Street Bridge, desilting and removal of vegetation (reeds and water hyacinth) is required to remove blockages, lower the standing water level and provide access for inspecting the bridge.

A draft Water Quality & Sewerage Infrastructure Management Strategy dated 2 May 2014 has been provided as part of the briefing documents for this report. The report states that “drainage channel and wetland maintenance strategies and maintenance action shall be aimed at:

- Maintaining wetland ground levels at an RL that maintains freshwater marsh habitats
- Maximising water quality
- Protecting heritage structures
- Providing data that will inform rational assessment of the effect of drainage channel maintenance on:
  - Water levels
  - Water quality in the public reserve and Emily Bay
  - The conservation of heritage structures, and
  - Wetland habitat and fauna”

It further states that drainage channel maintenance works must be demonstrated to the satisfaction of the Conservator of Public Reserves.

As stated in the previous section, it is proposed to lower the water level in Watermill Creek to match the convict drain into Emily Bay. This will return the water level to levels thought to exist at the time of the Bounty Street Bridge construction.

Additionally, the channel will require desilting and vegetation removal near the Bounty Street Bridge to allow the detailed site investigation. Temporary lowering of the water level at the bridge to the level of the bridge foundations will also be required. This could be via pumping of the creek or construction of local weirs above and below the bridge and dewatering locally. Watermill Dam is likely to be used during this process to reduce flows in the creek. Water quality monitoring will be required to ensure any discharge to Emily Bay is of permitted quality.

Based on available reports, the level of siltation of the creek channel is thought to be in the order of 1.0 m and this has been used in developing the cost estimate. The section adjacent the bridge is overgrown with reeds and free water is visible to above the bridge arch.

The silt and vegetation will need to be disposed of away from the creek banks to maintain grades and flows into the creek.



**Figure 59 Aerial photo of Watermill Creek (Source: RCS Survey Report, Nov 2015)**



**Figure 60 Previous creek profile (Source: Archaeological Assessment of the Proposed Works to the Bridge, Bounty Street, Kingston, Higginbotham, Apr 2010)**

The 1940's concrete lined channel has been partially filled and therefore does not now drain to Emily Bay. The former Commonwealth Heritage Manager (Brian Prince) indicated that he was considering filling in the remnants of that drain. This may provide a source for disposal of some of the excavated material.

It was also noted that former landfill behind the headland to the east of Emily Bay has some subsidence. This site may also provide a potential disposal site, pending confirmation of the presence of coliforms concentrations and suitability for use as surface fill, with or without treatment.

The typical cross section of the creek has been estimated as shown in Figure 61 and this may need to be doubled at the bridge to provide access to the foundations.

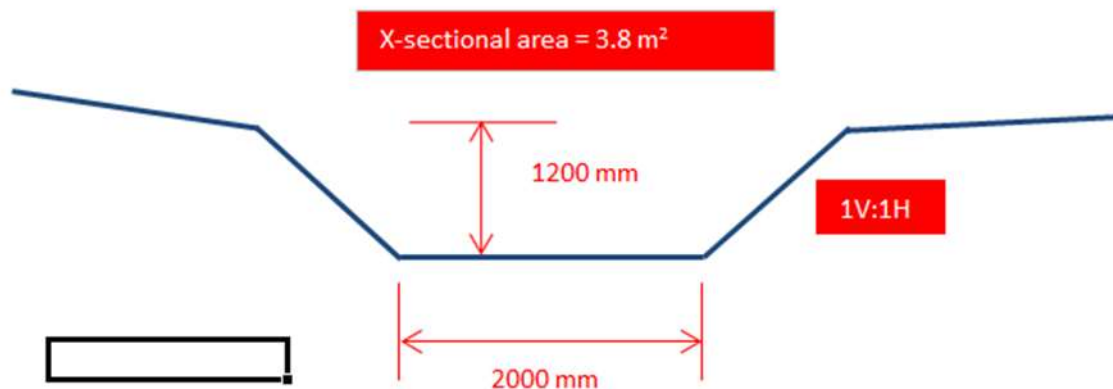


Figure 61 Typical section for estimating purposes

#### 4.6.2.2.5 Watermill Dam Works

Watermill Dam would be used during the dewatering works to store flows from Watermill Creek. Water levels would be lowered prior to the dewatering works and the dam storage volume used to minimise flows at Bounty Street Bridge.

Based on AECOM's site visit, the dam was noted to be leaking with water heard flowing underneath the concrete overflow spillway. The open drain at the outlet is overgrown with bamboo impeding access. Whilst hard to quantify, based on the noise, the flow is considered to be moderate in that that it is more than a trickle, but the dam remains quite full, estimated at 70% when visited in June 2018.

It is unclear as to the last time that Watermill Dam was drained and desilted. It is understood that the dam was routinely cleaned out every two or three years with the silt removed used as a construction material (Puss Anderson, June 2018). It is also understood that the upstream face of the wall was re-rendered at approximately 10-year intervals, but this has not been done for some time.

It may be prudent to undertake an initial review of any available construction documentation in order to ascertain the location of the dam gate and method of emptying the dam. An initial inspection is then recommended to confirm if there is a leak as reported and if there is damage to the structure..

Pending further structural investigation and heritage assessment, rectification is expected to involve:

- Emptying the dam
- Removal of the existing spillway and restoring or reconstructing the dam wall
- Replacing eroded fill material
- Reinstatement of the spillway and rendering the upstream dam face with appropriate materials.

It is recommended that it be determined if this is the original Watermill Dam and if so, consideration given to the presence of and possible removal of later elements.

#### 4.6.2.3 Comparison to GML Recommendations

The GML Safety Hazard Scoping Study proposed the following potential mitigation strategies to the structural risks:

- Recommendations of the Hughes Trueman report should be carried out without significant delay to ensure the structural integrity of the bridge is restored.

There is consensus on this hazard.

The recommendations provided above address the GML identified hazards.



#### 4.6.2.4 Risks

Based on the above solution, several risks and mitigation measures have been identified and are included in Table 7.

These risks should be updated during the project and passed on to the designers of subsequent phases.

**Table 7 Risk table**

| Risk event  | Probability | Consequence   | Mitigation   |
|---|-------------|---|--|
| Vehicle traffic causing damage or even collapse of the bridge                               | Possible    | <ul style="list-style-type: none"> <li>Injury to vehicle occupants and loss of bridge</li> </ul>                | <ul style="list-style-type: none"> <li>Restrict traffic to pedestrian only. It is considered very unlikely that a full or even partial collapse would occur under pedestrian loads prior to the detailed site investigation works outlined below are completed.</li> </ul>   |
| Archaeological artefacts are contained in sediments that have washed into the creek and dam | Possible    | <ul style="list-style-type: none"> <li>Artefacts will be damaged or destroyed during desilting works</li> </ul> | <ul style="list-style-type: none"> <li>Archaeological assessment to be conducted in accordance with HMP Policy 8.4.1 and suitable mitigations developed as part of HIS. Depending on archaeological sensitivity, these may include: <ul style="list-style-type: none"> <li>Test pitting</li> <li>Controlled archaeological excavation</li> <li>Archaeological monitoring of desilting works</li> </ul> </li> </ul> |
| Desilting works will impact ground around the creek or dam                                  | Possible    | <ul style="list-style-type: none"> <li>Intact archaeological deposits may be damaged or destroyed</li> </ul>    | <ul style="list-style-type: none"> <li>As above</li> <li>Maintain existing (straight) alignment</li> </ul>   |
| Coffer dam or other construction will impact ground around the creek                        | Possible    | <ul style="list-style-type: none"> <li>Intact archaeological deposits may be damaged or destroyed</li> </ul>    | <ul style="list-style-type: none"> <li>As above</li> </ul>   |
| Excavation works for desilting or other purposes undermine bridge structure                 | Possible    | <ul style="list-style-type: none"> <li>Bridge structure will be further compromised</li> </ul>                  | <ul style="list-style-type: none"> <li>Appropriate care to be taken around bridge</li> <li>Suitably qualified engineering specialist to direct excavation works, based on existing survey data</li> <li>Any damage to be repaired in accordance with Burra Charter standards</li> </ul>  |

| Risk event   | Probability   | Consequence  | Mitigation   |
|--|---------------|--|--|
| Extensive works required at Watermill Dam                            | Possible      | <ul style="list-style-type: none"> <li>Damage to original fabric</li> </ul>  | <ul style="list-style-type: none"> <li>Appropriate care to be taken around dam structure</li> <li>Suitably qualified engineering specialist to direct works</li> <li>Any repairs to be completed in accordance with Burra Charter standards</li> </ul> |
| Water level may not be lowered sufficiently by clearing the waterway | Probable      | <ul style="list-style-type: none"> <li>Detailed inspection of bridge will not be possible</li> </ul>   | <ul style="list-style-type: none"> <li>Include allowance for investigation into coffer dam above and below Bounty Street</li> </ul>  |
| Discharge of contaminated water into Emily Bay                       | Highly likely | <ul style="list-style-type: none"> <li>The reported levels of contaminants are due to a malfunctioning sewerage system in the Town Creek catchment and from cattle grazing on the Kingston Common</li> </ul> | <ul style="list-style-type: none"> <li>Include allowance for water quality testing and for in situ water treatment (if rectification by NIRC has not been completed)</li> </ul>  |

#### 4.6.2.5 Summary of Works

The following works, in the likely chronological order, are recommended:

- Install signage and traffic control measures to limit traffic on bridge to pedestrian only.
- Identify and rectify septic systems that are contaminating Watermill Creek.
- Undertake environmental testing to confirm water quality in the creek and confirm methodology for desilting Watermill Creek.
- Prepare detailed design and construction documentation to undertake the following works:
  - Archaeological and heritage assessment
  - Heritage review & approvals
  - Empty, desilt and repair dam wall and spillway
  - Lower Watermill Creek level at the tunnel
  - Excavate Watermill Creek Channel and remove reeds near the Bounty St bridge
  - Design and construct a temporary coffer dam (if required)
  - Undertake a detailed investigation into Bounty Street Bridge including:
    - Survey
    - Geotechnical Investigation
    - Detailed site investigation
    - Detailed design, drawings, specifications
    - Contract documentation.
- The recommended construction works are shown on Concept Sketches in Appendix D.

It is recommended until repairs are completed the bridge be closed for all vehicular traffic, with traffic directed to the Pier Street Bridge to remove the additional loading from Bounty Street Bridge.

It is expected that the final decision regarding the project scope may be based on the level of available funding and the relevant priority of competing projects.

#### 4.7 Cost of Solution

The estimated cost to undertake the project is \$1,043,424. The costs are summarised in Table 8 and a copy of the detailed estimate included in Appendix B.

**Table 8 Estimated cost of recommended solution**

| Project element  | Estimated Cost      |
|--|---------------------|
| Detailed design & documentation  | \$ 76,000           |
| Archaeological and heritage assessment   |                     |
| Preliminary Works:   | \$ 15,000           |
| - Install traffic control devices & signage to divert vehicles and limit bridge to pedestrian traffic only |                     |
| Construction:  | \$ 420,417          |
| - Empty, desilt and repair dam wall and spillway   |                     |
| - Excavate Watermill Creek Channel in the immediate vicinity of Bounty Street Bridge                       |                     |
| - Design and construct a temporary coffer dams on the upstream and downstream of the bridge                |                     |
| Detailed investigation of Bounty Street Bridge including structural, survey and geotechnical               | \$ 130,000          |
| Archaeological mitigations (provisional)   | \$ 18,000           |
| Client supervision & administration (25%)  | \$ 164,854          |
| Contingencies (Inherent and Contingent)  | \$ 219,153          |
| <b>Total Cost</b>  | <b>\$ 1,043,424</b> |

#### 4.8 Draft programme of works

Due to the unique circumstances surrounding Bounty Street Bridge, a number of preliminary works are required to be completed before a detailed investigation into the bridge subsidence can be undertaken. As listed in Table 7, the following risks have been identified which will need to be mitigated to allow the water level to be reduced in the vicinity of Bounty Street:

- Need to avoid works during the wet season.
- Contamination due to defected septic systems and cattle grazing on Kingston Common.
- Watermill Creek infested by weeds and siltation.
- Damage to the dam wall and spillway.

As a result, the works are expected to be required to be completed over two financial years and this will need to be considered in accordance with the Department's budgeting processes. A draft indicative programme has been developed and is shown in



| Bounty Street Bridge Draft Programme                  |  |                    | Jul-19                  | Aug-19 | Sep-19 | Oct-19 | Nov-19 | Dec-19 | Jan-20 | Feb-20 | Mar-20 | Apr-20 | May-20 | Jun-20 |
|---|--|--------------------|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|   |  |                    | 1                       | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     |
|   |  |                    | Draft Monthly Programme |        |        |        |        |        |        |        |        |        |        |        |
| <b>Preliminary Works</b>                              |  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Install signage and traffic control measures             |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
| <b>Detailed Design &amp; Documentation</b>            |  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Survey   |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Detailed design, drawings, specifications                |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Heritage review & approvals                              |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Contract documentation                                   |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Watermill Dam investigation                              |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
| <b>Construction</b>                                   |  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Site establishment                                       |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Implement Environmental Management Plan                  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Empty, desilt and repair dam wall and spillway           |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Excavate Watermill Creek Channel at Bounty Street Bridge |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Construction of coffer dam                               |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
| <b>Detailed Investigation of Bounty Street Bridge</b> |  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Survey   |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Geotechnical Investigation                               |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Detailed site investigation                              |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Detailed design, drawings, specifications                |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Heritage review & approvals                              |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | Contract documentation                                   |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
| <b>Cash Flow</b>                                      |  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | FY 2019/2020   | \$837,719          |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | FY2020/2021  | \$205,705          |                         |        |        |        |        |        |        |        |        |        |        |        |
|   | <b>Total</b>   | <b>\$1,043,424</b> |                         |        |        |        |        |        |        |        |        |        |        |        |

**Figure 62.** Based on an assumed start date of 1 July 2019, the cash flow for the preliminary works and investigation are shown in Table 9.

**Table 9** Bounty Street Bridge indicative cash flow

| Financial Year           | Estimated cost (incl. markups) |
|--------------------------|--------------------------------|
| <b>2019/2020</b>         | \$ 837,719                     |
| <b>2020/2021</b>         | \$ 205,705                     |
| <b>Total (all years)</b> | <b>\$ 1,043,424</b>            |

It is acknowledged that any rectification works will need to be funded as part of the Department's FY2021/2022 budget and the level of funding required will need to be determined prior to the likely completion of the detailed investigation (currently June 2021).

| Bounty Street Bridge Draft Programme                  |  |                    | Jul-19                  | Aug-19 | Sep-19 | Oct-19 | Nov-19 | Dec-19 | Jan-20 | Feb-20 | Mar-20 | Apr-20 | May-20 | Jun-20 | Jul-20 | Aug-20 | Sep-20 | Oct-20 | Nov-20 | Dec-20 | Jan-21 |
|---|--|--------------------|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|   |  |                    | 1                       | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     | 11     | 12     | 13     | 14     | 15     | 16     | 17     | 18     | 19     |
|   |  |                    | Draft Monthly Programme |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <b>Preliminary Works</b>                              |  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Install signage and traffic control measures             |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <b>Detailed Design &amp; Documentation</b>            |  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Survey   |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Detailed design, drawings, specifications                |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Heritage review & approvals                              |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Contract documentation                                   |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Watermill Dam investigation                              |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <b>Construction</b>                                   |  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Site establishment                                       |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Implement Environmental Management Plan                  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Empty, desilt and repair dam wall and spillway           |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Excavate Watermill Creek Channel at Bounty Street Bridge |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Construction of coffer dam                               |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <b>Detailed Investigation of Bounty Street Bridge</b> |  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Survey   |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Geotechnical Investigation                               |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Detailed site investigation                              |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Detailed design, drawings, specifications                |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Heritage review & approvals                              |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | Contract documentation                                   |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <b>Cash Flow</b>                                      |  |                    |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | FY 2019/2020   | \$837,719          |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | FY2020/2021  | \$205,705          |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|   | <b>Total</b>   | <b>\$1,043,424</b> |                         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |

Figure 62: Bounty Street Bridge draft programme of works

## 5.0 Longridge Barracks Arches

### 5.1 Description

The Longridge Barracks Arches are part of the convict heritage found on Norfolk Island. The arches are not located within the Kingston precinct but on a ridge to the west of KAVHA. The arches are part of the military barracks which was constructed during the late 1800s and are listed on the CHL. The arches are approximately 2.5 m tall with the above wall reaching up to approximately 5 m above the ground.

The Longridge Barracks Arches are currently in a state of ruin with the face of the arches leaning to the south by up to 200mm. The barracks structure has significantly decayed and has left the arches wall unrestrained.

### 5.2 Scope and Purpose

The scope of works, which was outlined in the Variation to Scope of Asset Management Planning and Advisory Services Version 2, outlines the possible structural safety concerns for the Longridge Barracks Arches. The expected scope of works, with regards to the Longridge Barracks Arches, includes the following:

- Assessment of the works required to cordon off the site from pedestrians and for vehicles on the verge, close to the building foundations.
- Determination of the likely extent of defects and the preferred solution to repair/rehabilitate the existing wall, likely to be temporary bracing behind the arches, pending a long-term solution such as a new roof and/or floor structure.
- Prepare sketches detailing possible drain clearing, dewatering solutions.
- Prepare a rehabilitation methodology in conjunction with our Senior Heritage Specialist.
- Prepare a P80 level cost estimate for the recommended works.

Based on the GML Draft Report, the following concerns were highlighted as “high risk” or “very high risk” and were investigated in the structural inspection conducted between Monday 20 August 2018 and Friday 24 August 2018. These “high risk” works include:

- Structural Cracks.
- Rotation of the structure and the loss of lateral stability.



## 5.3 Site Observations

The outcomes of the structural inspection carried out by Alan Schmierer and Jessie Corry (AECOM) from Monday 20 August 2018 to Friday 24 August 2018 was used to address the above outlined scope of works. The inspection was used to identify and validate all safety concerns for the Longridge Barracks Arches, and to determine an appropriate course of action to resolve these issues.

### 5.3.1 Observations

The Longridge Barracks Arches are part of the remnants of a two-storey barracks building and are located west of the KAVHA precinct. There are ten arches within what was the southern wall of the barracks with a section of solid wall at each end. Behind the arches are two rows of lower walls that formed the interior and rear wall of the barracks. All timber and other elements of the buildings are absent and only the stone walls and arches remain. The arches to the centre portion of the wall have a significant lean towards the south (away from the barracks ruins). The arches are supported by 600 mm square columns on a 700 mm square plinth. It is not known whether this plinth widens below the ground level. The arches were recorded to be showing a tilt of at least 2-3 degrees toward the south, resultant in a displacement of approximately 250 mm at the top of the 5 m wall. This is a large offset, which was easily discernible to the naked eye and is sufficient to cause an increase in pressure on the foundations from the additional eccentricity.

The stone of the arches appeared to be in a relatively good condition, with minor cracking to the walls and columns. There seemed to be an overall pitting of the stone on the columns, however the wall appeared to be in better condition, possibly due to being rendered or a different type of stone. The plinth at the base of the column was showing the same tilt as that of the wall. There was a lack of structure behind the wall to restrain the wall, hence leaving the wall unsupported against lateral loading.



Figure 63 Longridge Barracks Arches



**Figure 64 Tilt from the front of the Arches**



**Figure 65 Tilt from the back of the Arches**



**Figure 66 Single arch view**



**Figure 67 Single column view**





**Figure 68 Longridge Barracks lack of structure behind wall**



**Figure 69 Longridge Barracks lack of structure behind wall from rear of wall**



## 5.4 Structural Assessment

Due to the lack of documentation of the structure it was not possible to check the adequacy of the arch foundations. The stonework was assumed to have no tensile capacity and was therefore reliant on the self-weight of the wall for resistance to overturning. The self-weight of the wall was assumed to be approximately equivalent to that of a medium density limestone as the actual density of the stone used was unknown. Utilising these assumptions, it was determined that the arches have insufficient capacity to withstand wind loads that can be expected to occur at the site.

Given the rotation of the wall it is likely that the footings are undersized for the applied pressure from the wall. In addition, the lean in the wall will be increasing the pressure. This means the lean is likely to increase over time.

There is little structure of the barracks left behind the arches, with the rest of the barracks being of a single storey height. This limits the opportunity to brace the arches back to the remaining barrack walls.

## 5.5 Proposed Solutions

### 5.5.1 Do Nothing

The solution to 'do nothing' for the Longridge Barracks Arches is not considered a viable solution because the walls are not structurally adequate to resist expected wind or seismic loads and the wall rotation is likely to continue due to the overloaded footings. The arches were already showing a visible lean, with the wall having a 200 mm displacement at the top. The tilt of the wall seen on the arches, although it is only approximately 2-3 degrees to the south, poses a problem as it has induced an eccentric load from the top of the wall. This eccentric load will continue to increase as the wall tilts further to the south and will ultimately cause the failure of the wall. Allowing such a failure is inconsistent with the EPBC Act's management aims for CHL places (EPBC Act Regulations, Schedule 7B) and Policy 2(a) of the Longridge Arches HMP (Eric Martin & Associates 2005).

In the short term, it is recommended that the area immediately to the south of the arches be closed off to both pedestrian and vehicular traffic as this represents the likely zone where the arches would collapse into. The area would need to be closed off to an extent equal to the zone that would be affected if the arches fell. The exclusion zone could be removed following completion of the underpinning and bracing works.

### 5.5.2 Underpin and Brace the Arches

The recommended solution for the rectification of the overturning for the Longridge Barracks Arches is twofold. The initial phase is to underpin the footings to the arches to prevent further rotation. The wall will need to be temporarily braced on both sides of the wall to prevent collapse of the wall during the works and vertical propping installed to transfer load from the footings to allow underpinning to proceed.

The second phase would involve the top of the wall above the arches being braced to resist wind and seismic forces. The wall may be braced in a similar fashion to that of the Civil Hospital Gable, with a timber framed structure constructed behind the wall. Alternatively, the structure could be something slightly more discrete as to have less intrusion on the aesthetic of the arches, refer to Figure 70 for a similar solution at Port Arthur, where large steel sections are bolted to the blockwork and used to restrain the wall. These can be installed behind the arches and will provide a much less obtrusive solution to the Longridge Barracks Arches.

As with the Civil Hospital, it is likely that the latter, less intrusive option for the stabilisation of the Arches will be most in keeping with the conservation aims of the EPBC Act and the Burra Charter. However, either solution will require alterations to the existing structure, potentially impacting original fabric, and also ground disturbing works, potentially impacting on archaeological remains in and around the building. Given the potential for impact on original fabric, archaeological remains and the appearance of the building, it is recommended that a heritage impact statement (HIS) be developed to assess the significance of the proposed changes, recommend appropriate mitigations, and support approvals as required.



Figure 70 Bracing for walls at Port Arthur Penitentiary (Mercury, 2014)

#### 5.5.2.1 Comparison to GML Recommendations

The GML Safety Hazard Scoping Study proposed the following potential mitigation strategies to the structural risks:

- In the immediate term cordon off the area to prohibit access to ensure that the risk to the public safety from a potential wall collapse is mitigated
- Adequately scope a remediation program including geotechnical investigation and structural design of a new heritage interpretation of roof/floor structure that can brace the walls

There is consensus on both items above.

The recommendations provided above address the GML identified hazards.

#### 5.5.2.2 Risks

Based on the above solution, several risks and mitigation measures have been identified and are included in Table 10

These risks should be updated during the project and passed on to the designers of subsequent phases.

Table 10: Risk table

| Risk event   | Probability    | Consequence  | Mitigation   |
|--|----------------|--|--|
| Bracing will alter appearance of building                                      | Almost certain | <ul style="list-style-type: none"> <li>Visual impact to CHL place</li> </ul>                                       | <ul style="list-style-type: none"> <li>Design to consider least intrusive option</li> <li>HIS to identify impacts and mitigations, and support any necessary approvals</li> </ul>  |
| Bracing may damage the walls, introduce intrusive elements                     | Possible       | <ul style="list-style-type: none"> <li>Impact on original fabric and appearance</li> </ul>                         | <ul style="list-style-type: none"> <li>Appropriate care to be taken around wall</li> <li>Design to identify least intrusive options</li> <li>Suitably qualified engineering specialist to direct construction works</li> <li>Any damage to be repaired in accordance with Burra Charter standards</li> </ul>   |
| Archaeological artefacts are contained in ground that will be excavated        | Likely         | <ul style="list-style-type: none"> <li>Artefacts will be damaged or destroyed during construction works</li> </ul> | <ul style="list-style-type: none"> <li>Archaeological assessment to be conducted in accordance with HMP Policy 8.4.1 and suitable mitigations developed as part of HIS. Depending on archaeological sensitivity, and extent of disturbance, these may include: <ul style="list-style-type: none"> <li>Test pitting</li> <li>Controlled archaeological excavation</li> </ul> </li> <li>Archaeological monitoring</li> </ul> |
| Excavation works for underpinning the arch structure may damage the arches     | Possible       | <ul style="list-style-type: none"> <li>Arches may be damaged or collapse</li> </ul>                                | <ul style="list-style-type: none"> <li>Appropriate care to be taken around arches</li> <li>Suitably qualified engineering specialist to direct excavation works, based on existing survey data</li> <li>Any damage to be repaired in accordance with Burra Charter standards</li> </ul>  |
| Earthquake may cause collapse of arches outside of the proposed exclusion zone | Possible       | <ul style="list-style-type: none"> <li>Death or injury to tourists or workers</li> </ul>                           | <ul style="list-style-type: none"> <li>Exclude all access to site if risk deemed excessive</li> </ul>  |



### 5.5.2.3 Summary of Works

The following works, in the likely chronological order, are recommended:

- Undertake supervised excavation around arch footings to determine footing extent, depth and type. This to facilitate underpinning and steel brace column footing design.
- Undertake supervised geotechnical field investigation to determine depth to rock and rock quality to enable completion of underpinning design and steel brace column footings.
- Prepare detailed design and construction documentation to undertake the following works:
  - Temporary propping of arches
  - Underpinning design
  - Steel bracing columns to the rear of the arches. This will require architectural, heritage and structural input
  - Footings for the steel bracing columns
  - Detailed design, drawings, specifications
  - Heritage review & approvals
  - Contract documentation.
- The recommended construction works are shown on Concept Sketches in Appendix D.

## 5.6 Cost of Solution

The estimated cost to undertake the project is \$781,517. The costs are summarised in Table 11 and a copy of the detailed estimate included in Appendix B.

**Table 11 Estimated cost of recommended solution**

| Project element  | Estimated Cost    |
|--|-------------------|
| Installation of temporary exclusion zone around the arches   | \$ 10,000         |
| Archaeological and heritage assessment   |                   |
| Detailed and supervised site investigation to base of arches to determine existing footing size, depth and extent  | \$ 21,000         |
| Geotechnical field investigation to determine depth to rock, quality of rock and other parameters require for the underpinning design  | \$ 15,000         |
| Detailed design & documentation  | \$ 54,400         |
| Construction:  | \$ 359,475        |
| <ul style="list-style-type: none"> <li>- Temporary propping and bracing of the arches</li> <li>- Excavation and underpinning of the arches</li> <li>- Excavation and construction of footings for the permanent steel braces</li> <li>- Fabrication and erection of the permanent steel braces</li> <li>- Removal of the temporary exclusion zone</li> </ul> |                   |
| Archaeological mitigations (provisional)   | \$ 9,500          |
| Client supervision & administration (25%)  | \$ 117,343        |
| Contingencies (Inherent and Contingent)  | \$ 194,798        |
| <b>Total Cost</b>  | <b>\$ 781,517</b> |

## 6.0 Royal Engineer's Office (REO)

### 6.1 Description

The Royal Engineer's Office (REO) is a WHL structure located in the Kingston and Arthur's Vale Historic Area (KAVHA) of Norfolk Island. The REO was constructed in 1851, made from stone and built by convicts who were brought over to the settlement in 1830s. The REO is one of the restored buildings found within KAVHA, with major repair work done to the roof structure during the twentieth century.



**Figure 71 View Royal Engineer Office – 1935** (*Department of Housing and Construction, Norfolk Island*)

The REO is a significant building within KAVHA and is currently a working building. The REO is now used as a book store and tourist shop on Norfolk Island, and is a tourist attraction for the site.

### 6.2 Scope and Purpose

The scope of works, which was outlined in the Variation to Scope of Asset Management Planning and Advisory Services Version 2, outlines the possible structural safety concerns for the Royal Engineer's Office. The expected scope of works, with regards to the Royal Engineer's Office, includes the following:

- Determination of the likely extent of defects and the preferred solution to repair/rehabilitate the entry portico, likely to be removal of the temporary bracing and deconstruction of the portico, remedy the settlement of the foundation material, remedy decay of the northern column capital and stone base, reconstruction of the portico and possible installation of tie rods from the portico to the building façade.
- Prepare a rehabilitation methodology in conjunction with our Senior Heritage Specialist.
- Prepare a P80 level cost estimate for the recommended works.
- Prepare a costed Asset Management Plan for the KAVHA site to inform the development of the Department's New Policy Proposal.



Based on the GML Draft Report, the following concerns were highlighted as “high risk” and were investigated in the structural inspection conducted between Monday 20 August 2018 and Friday 24 August 2018. These “high risk” works include:

- Structural Cracks.
- Rotation of the Portico to the west (away from the main structure).
- Decayed northern column capital and stone base of the REO Portico.

### 6.3 Site Observations

The outcomes of the structural inspection carried out by Alan Schmierer and Jessie Corry (AECOM) from Monday 20 August 2018 to Friday 24 August 2018 was used to address the above outlined scope of works. The inspection was used to identify and validate safety concerns for the Royal Engineer’s Office, and to determine an appropriate course of action to resolve these issues.

#### 6.3.1 Observations

The main concern structurally was the front Portico to the office. The portico has two timber props inserted beside and behind the southern column at the front of the portico. The southern column was found to have some large grooves which may be cracks; however the extent was indiscernible due to the layers of paint on the column. The northern column appeared to be a new replica column, designed to replace the original heritage column. According to locals, the northern column was destroyed in a car accident and hence was replaced. The column capital and stone base of the northern column showed signs of decay, with the capital being eroded by wind and salt action.

The roof of the portico appeared to be in good condition although there is a lean to the north of approximately 10 mm in the gable face. The replica column was measured to be slightly longer than that of the original column, which may have contributed to the lean in the top of the portico. There appeared to be some slight decay of the base stone of the portico, but this was minor and there was little to no evidence of settlement of the foundation below the portico.



**Figure 72 Royal Engineers Office**



Figure 73 Royal Engineer's Office Portico



Figure 74 Timber Props on southern column



Figure 75 Single Front View of southern column



**Figure 76 Possible cracking in top of southern column**



**Figure 77 Possible cracking in bottom of southern column**



**Figure 78 Top of the northern column**



**Figure 79 Bottom of the northern column**





**Figure 80 Roof of the Portico**



**Figure 81 Base Slab of the Portico**

## 6.4 Structural Assessment

During the inspection, a local heritage maintenance staff member mentioned that the northern column was destroyed by a car colliding with it. The replacement for the northern column did not match the southern column, with different stone features evident particularly at the base. It was assumed the timber props were installed during the replacement of the northern column. The props were then left in place as a cautionary support, so that the southern column could remain essentially non-load bearing. This may suggest that the southern column suffered some serious damage, i.e. the large cracks which are covered by paint, but rather than destroy and replace the column it was decided to prop the portico using the timber props. It was not possible to determine the state of the southern column without stripping back the layers of paint and inspecting the bare column.

The replica column was measured to be slightly taller than that of the original column. This may suggest that the lean in the portico was due to the extended column to the north, as opposed to the subsiding foundation which was suggested in the GML report. Despite the lean in the portico, the roof structure appeared to be in good condition, with minimal visible defects to the stone.

The lean to the gable face and the amount by which the face protrudes from the supporting columns indicates that the face may be unstable under seismic loads and not sufficiently tied back to the roof of the portico. It may also be that the lean was caused by the collision.

## 6.5 Proposed Solutions

### 6.5.1 Do Nothing

In relation to the Royal Engineer's Office Portico, the proposed solution to 'do nothing' may be a viable option for the structure in the short to medium term. The portico appeared to be in a stable condition, with only a minor lean in the portico overall. The ground conditions and base stone appeared to be stable and showed little sign decay.

The southern column will require further investigation into the extent of the cracking of the column if the timber props are proposed to be removed. A heritage specialist and archaeologist would need to be present for the stripping of the paint. Once the state of the original column is determined, possible repair to the column could be suggested.

The decay of the column cap on the northern column can be expected to gradually continue to the point that it will require replacement. Annual inspection of the stone decay would be sufficient to determine when it would be appropriate to replace these stones.

In order to prevent another car collision to the portico, it is suggested that vehicular access to the grassed area in front of the REO be restricted. This could be achieved by installing a barrier or kerb that is visually discrete but provides a warning to drivers as they near the REO.

Given that the portico appears to be structurally stable in the short term, the 'do nothing' approach is likely to be the most in keeping with the conservation aims of the HMP. Efforts could be made to confirm the soundness of the southern column, and thus remove the somewhat intrusive timber braces, but this is an aesthetic rather than structural issue, and so is unnecessary at this stage.

### 6.5.2 Re Build the Portico

The proposed long-term solution for the Royal Engineer's Office portico is to deconstruct and rebuild the portico structure. The option to rebuild the portico would be used to straighten the roof of the portico and replace the decayed sections of stone. The front face of the portico would be tied back to the back face to prevent the roof from rotating again after the re build. It is not recommended to tie the portico back into the main building as this may induce added stress onto the walls of the main building and cause further damage. The replacement column would need to be reduced height slightly so that it will match the original column and to prevent additional tilt of the portico roof. This may be done by reducing the thickness of the capstone above the column when replacing it.

While the option to 'do nothing' is viable for the portico, it does not correct the tilt of the portico or replace the decayed capstone above the northern column. The option to deconstruct the portico and re build the structure level would allow for these errors to be corrected and to also identify any other errors which were not identified for the roof of the portico. The solution will require the front of the Royal Engineer's Office to be closed off for the extent of the re build. Access to the office may be redirected through the side door during the deconstruction and reconstruction however it is not known how this will affect the business inside. It may be possible that the business inside the REO be temporarily relocated or closed until the construction works have been completed. Therefore, it is suggested that the construction works be conducted during a slow tourist season for Norfolk Island as to cause minimal impact to the tourism for the heritage site.

As noted above, the 'do nothing' approach is likely to be the most in keeping with the conservation aims of the HMP for the time being. However, the possibility of rebuilding the portico should be revisited when the condition of the northern column cap significantly deteriorates, or if other structural issues emerge.

#### 6.5.2.1 Comparison to GML Recommendations

The GML Safety Hazard Scoping Study proposed the following potential mitigation strategies to the structural risks:

- Undertake a forensic investigation of the entry portico and install stainless steel rods to tie the entry portico structure back to the main building walls
- Undertake geotechnical investigations of the foundations to the support columns and underpin if required.
- Replace the northern column headstock with a more durable stone
- Investigate the condition of the original column and if stable then remove the timber posts

There is consensus on the need to investigate the condition of the original column and if it is stable then remove the timber posts. In addition, AECOM recommend addition of barriers or kerbs to prevent cars from impacting the portico.

There is consensus on the need to eventually replace the headstock / cap stone on the northern column.

AECOM have undertaken a visual engineering assessment of the portico and believe that the foundations are adequate and geotechnical investigations are not required.

There is consensus on the need to understand fully if the portico roof is leaning because of an inherent construction issue or if it is from the car impact. AECOM recommends that it be disassembled and reconstructed, perhaps with ties from the gable face back to the rear of the portico.

The recommendations provided above address the GML identified hazards.

#### 6.5.2.2 Risks

Based on the above solution, risks and mitigation measures have been identified and are included in **Table 12**

These risks should be updated during the project and passed on to the designers of subsequent phases.

**Table 12 Risk table**

| Risk event                               | Probability  | Consequence  | Mitigation  |
|--|--|--|---|
| Asbestos contained within roof structure | Possible (ACM were identified in the ceiling space of the REO) | <ul style="list-style-type: none"> <li>• Confirm via existing records or undertake specific testing</li> </ul> | <ul style="list-style-type: none"> <li>• Include allowance testing</li> </ul> |



### 6.5.2.3 Summary of Works

The following works are recommended:

- Prepare detailed design and construction documentation to undertake the following works:
  - Investigate the adequacy of the southern column with the view to removing the timber posts
  - Investigate the adequacy of the gable face with the aim of determining if tie backs to the rear of the portico are required
- This will involve
  - Detailed investigations
  - Detailed design, drawings, specifications
  - Heritage review & approvals
  - Contract documentation.

#### Cost of Solution

The estimated cost to undertake the project is \$348,372. The costs are summarised in Table 13 and a copy of the detailed estimate included in Appendix B.

**Table 13 Estimated cost of recommended solution**

| Project element  | Estimated Cost    |
|--|-------------------|
| Short term – install vehicle barrier / kerb ('Do nothing')   | \$ 5,000          |
| <b>Long term – reconstruction of the portico</b>   |                   |
| Detailed design & documentation  | \$ 21,800         |
| Construction: <ul style="list-style-type: none"> <li>- Detailed documentation of existing construction details</li> <li>- Dismantling of existing portico</li> <li>- Reconstruction using existing materials / segments</li> <li>- Installation of stainless steel tie backs from the front of the portico to the rear lintels to prevent rotation of the front gable</li> </ul> | \$ 172,354        |
| Heritage supervision   | \$ 5,200          |
| Client supervision & administration (25%)  | \$ 51,089         |
| Contingencies (Inherent and Contingent)  | \$ 92,929         |
| <b>Total Cost</b>  | <b>\$ 348,372</b> |

## 7.0 Planning Approvals Advice

In accordance with the scope of works, which was outlined in the Variation to Scope of Asset Management Planning and Advisory Services Version 2, AECOM conducted an environmental and heritage review of the current proposal options, a desktop review of environmental approval pathways and a preliminary discussion with NIRC. Based on the outcomes of those reviews and discussions the following is recommended to progress the Proposal:

- Initiate consultation with Norfolk Island authorities early to confirm the environmental approval pathway and refine the scale and scope of the heritage and environmental assessment as required. This should be carried out early in project design.
- Design should take into account the requirements of:
  - *The Burra Charter* (2013)
  - Eric Martin & Assoc. (2005) *Norfolk Island: Longridge Arches Heritage Management Plan*
  - GML (2016) *Kingston and Arthur's Vale Historic Area Heritage Management Plan*
  - GML (2018) *KAVHA Cultural Landscape Management Plan Preliminary Draft Report*.
- Where practicable, select design options that:
  - Have minimal impact on original fabric
  - Are visually recessive
  - Minimise ground disturbing works.
- Conduct a HIS by a competent Senior Heritage Specialist for each proposal option to support the building Approval submission.
- The Proposal options should be reviewed/ assessed by a competent Senior Heritage Specialist early to advise design and facilitate selection of rectification options that do not result in a significant impact on heritage. The Proposal options shall be in compliance with the KAVHA HMP for items within the KAVHA and the CHL and NIHR heritage requirements for the Longridge Barracks Arches.
- Depending on outcomes of the HIS, proactively submit an EPBC Act referral to the Commonwealth for the proposed rectification options for each heritage item. This would allow for an independent verification of the conclusions of the HIS to ensure all requirements of the World Heritage Convention and Operational Guidelines are fully complied with and the heritage items are safeguarded with no risk to World heritage listing status.
- For the Bounty Street Bridge, plan the work to commence after completion of sewerage treatment improvement works being carried out upstream. Provide mitigation measures for potential impacts of pollution from Windmill Creek desilting works to safeguard against sewage from upstream of the KAVHA impacting the marine water quality and coral reefs in Emily Bay. Desilting of Windmill Creek shall be carried out in accordance to the measures specified in the Commonwealth referral decision (EPBC 2008/4238). Any waste, including sediment from desilting/desludging Windmill Creek below the Bounty Street Bridge should be managed in compliance to the *Norfolk Island Waste Management Strategy*.
- Conduct an environmental impact assessment for the proposed Bounty Street Bridge rectification work and formulate site specific mitigation and management measures to minimise the impacts on the environment. The scope shall include but not be limited to water quality, waste management (material removed as part of desilting works), ecology, erosion and sedimentation and heritage.
- Consider the potential impact to tourism during construction. This is to prevent a sense of feeling 'short changed' for tourists that have chosen to visit KAVHA only to find that parts of the site are not open to public due to repair works and views of the site are adversely impacted. Negative comments on social media could adversely impact the historical tourism industry of Norfolk Island.

Detail on this planning approvals advice can be found in Appendix A.

## 8.0 Early Works to Address High Risk Safety Hazards

The following works are recommended to be undertaken as priority works while planning and funding approval is progressing.

**Table 14 Summary of priority works**

| Project Element   | Works   | Cost Estimate    |
|---|---|------------------|
| Civil Hospital (Northern gable, retaining wall, lintels)        | Exclusion zones to fall extent of northern gable and signage explaining the danger. | \$ 10,000        |
| Arthur's Vale Retaining Wall                                    | Vehicle exclusion to rear of wall via signage and barriers                          | \$ 10,000        |
| Bounty Street Bridge (Watermill Creek, dam repairs, coffer dam) | Close bridge to vehicular traffic via signage and barriers                          | \$ 15,000        |
| Longridge Barracks Arches (underpinning, bracing)               | Exclusion zones to fall extent of arches and signage explaining the danger.         | \$ 10,000        |
| Royal Engineer's Office Portico                                 | Erect temporary barriers or kerbs to prevent vehicle impact                         | \$ 5,000         |
| <b>Total Costs (excl. risk)</b>                                 |   | <b>\$ 50,000</b> |



## 9.0 Summary project cost and risk

### 9.1 Project Costs

Project costs have been developed for each project based on the premise that the current workforce on the island is already at capacity (undertaking works under the current Service Delivery Agreement (SDA) between DIRDC and the Norfolk Island Regional Council (NIRC). The labour rates used in the estimate include a 'locality allowance' of 90% to cover the additional costs of importing labour to Norfolk Island. Where works require experience and plant that is not considered to be available, higher rates have also been used to bring those skills and specialist plant. Examples include allowance for specialised equipment and machinery for works such as underpinning and construction of coffer dams.

The estimate project costs for each element are summarised in Table 15 with a total project cost of \$3,357,529. The estimates include inherent risk and contingent risks are discussed in Section 9.2.

**Table 15 Summary of project element costs**

| Project Element   | Cost Estimate      |
|---|--------------------|
| Civil Hospital (Northern gable, retaining wall, lintels)        | \$ 474,116         |
| Arthur's Vale Retaining Wall                                    | \$ 493,524         |
| Bounty Street Bridge (Watermill Creek, dam repairs, coffer dam) | \$1,043,424        |
| Longridge Barracks Arches (underpinning, bracing)               | \$ 781,517         |
| Royal Engineer's Office Portico                                 | \$ 348,372         |
| <b>Total Costs (excl. risk)</b>                                 | <b>\$3,140,953</b> |

Allowances have been included for Client supervision and administration (25%) and risk for all project elements.

A copy of the 50% Design Stage cost estimates is included in Appendix B.

### 9.2 Project Risk

Based on AECOM's initial assessment of project risks, a Project Risk Register has been prepared based on the project scope as currently defined and is included in Appendix C.

Risks identified include:

- Approvals (DIRDC, NIRC, Environment)
- Scope definition
- Commercial issues
- Construction delays - heritage find, reliance on other projects
- Weather impacts.

#### 9.2.1 Contingencies and Risk Analysis

As part of the cost estimating process a quantitative analysis using @Risk software was undertaken to calculate the contingency

The process undertaken is categorised into inherent and contingent risks.

##### a. Inherent Risks

Inherent risks relate to the potential variability in the quantities and rates used in an estimate due to design growth, minor omissions and changes in detailed functional requirements (but not project design criteria). This is modelled from the cost estimate at a detailed level with a

confidence range applied to each quantity and each rate depending on the reliability of the source information e.g, measured from SD drawings or an allowance only.

#### b. Contingent Risks

Contingent risks that may or may not occur, e.g. natural events causing loss of power or access to the project site, industrial issues, unavailability of trained construction resources, contamination removal, external influences etc. which have been excluded from the estimate. These are extracted from the project risk register and modelled on the likelihood of occurrence for each risk.

### 9.2.2 Inherent Risks

On completion of the evaluation and final update of estimate a combined quantitative risk analysis was undertaken. The P80 exceedance probability value less the base estimate was used to calculate the inherent risk contingency for the project at \$520,060.

### 9.2.3 Contingent Risk

The Contingent Risk register was analysed and likelihoods and financial consequences were applied to each risk item. The P80 exceedance probability value was calculated at \$222,653 as per the dark red component in Figure 82.

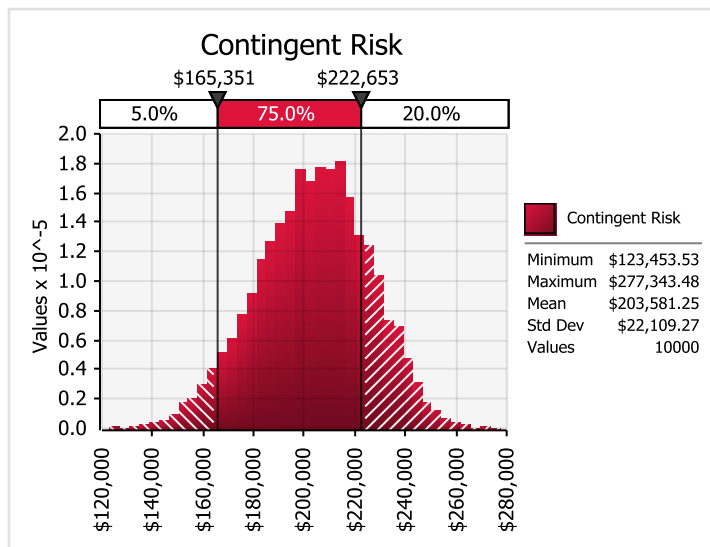


Figure 82: Contingent risk

### 9.2.4 Total Contingency Allowance

These combined P80 Inherent and Contingent risk values indicate the level of contingency required for a P80 level of certainty based on the input and ranges defined in the risk analysis process.

The selected level P80 contingency is \$742,715 or 31% of the project value.

## 10.0 References

- Australian Heritage Council. 2013. *Ruins: A Guide to Conservation and Management*. Canberra, ACT.
- Department of Environment, Water and Natural Resources, the Government of South Australia, *Restoring the store*, Sourced on 18 September 2018, <https://www.naturalresources.sa.gov.au/kangarooisland/news/15-01-12-Store-restored-nws>
- Department of Housing and Construction, *The archaeological survey of Kingston and Arthur's Vale, Volume II., Norfolk Island*, sourced on 21 august 2018.
- Eric Martin & Associates. 2005. *Norfolk Island: Longridge Arches Heritage Management Plan*. Unpublished report to Department of Transport and Regional Services.
- Godden Mackay Logan Pty Ltd. 2016. *Kingston and Arthur's Vale Historic Area Heritage Management Plan*. Report to the Australian Government.
- ICOMOS (Australia). 2013. *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*. Burwood, Victoria: Australia ICOMOS.
- Kempton. H., 2014, 'Reno rescues Port Arthur's penitentiary from ravages of time', *Mercury*, sourced on 19 September 2018, <https://www.themercury.com.au/news/tasmania/reno-rescues-port-arthurs-penitentiary-from-ravages-of-time/news-story/ebd8c6700ced29208a71195dd09696fc>



# Appendix A

## Planning Approvals Advice

# Planning Approvals Advice

KAVHA Asset Management Plan and Advisory Services

28 September 2018

Department of Infrastructure Regional Development and Cities (DIRDC)

Dear Sir/ Madam

RE: Asset Management Planning and Advisory Services for Kingston and Arthur's Vale Safety Hazard Investigation – Environmental Approvals Pathways

## 1.0 Introduction

The Department of Infrastructure, Regional Development and Cities (DIRDC) commissioned AECOM Australia Pty Ltd (AECOM) to provide 'Asset Management Planning and Advisory Services' that will allow DIRDC to meet its responsibilities across the Territories. The scope of services covers the following heritage items on Norfolk Island:

1. Civil Hospital (Northern Gable and Retaining Wall)
2. Arthur's Vale Retaining Wall
3. Bounty Street Bridge
4. Longridge Barracks Arches
5. Royal Engineer's Office (REO) Entry Portico

Except for Longridge Barracks Arches, all the heritage items are located within the Kingston and Arthur's Vale Historic Area (KAVHA) which is included on the World Heritage List (WHL) as a part of the Australian Convict Sites (WHL#106209)..

The scope of the Proposal of work covers delivery of design up to the 50% level of detail with a P80 level cost estimate to address a number of "very high risk" structural hazards identified in the *KAVHA Safety Hazard Scoping Study Draft Report* (GML, May, 2018) (the "Proposal").

This letter report provides advice on the environmental approval pathways that are relevant to the Proposal and preliminary mitigation and management measures associated with the proposed engineering options for rectification work on the heritage items. It is intended that this report is read in conjunction with the *Kingston and Arthur's Vale Safety Hazard Investigation Concept Design Report – Very High Risk Items (Draft)* (AECOM, 2018) which provides further details on the Proposal design.

## 1.1 Background

Norfolk Island is an external territory of Australia, governed locally by the Norfolk Island Regional Council. The Australian Government is responsible for the provision of Federal and State level services, and the Norfolk Island Regional Council is responsible for all aspects of local government operations.

KAVHA is a heritage site that is listed on the following heritage registers:

- World Heritage List (WHL#106209)
- National Heritage List (NHL#105962)
- Commonwealth Heritage List (CHL#105606)
- Norfolk Island Heritage Register.

The Longridge Barracks Arches is also a recognised heritage site, and is listed on the:

- Commonwealth Heritage List (CHL#105623)
- Norfolk Island Heritage Register

WHL, NHL and CHL places are all protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), while the NIHR places are protected under the *Norfolk Island Heritage Act 2002*. As a consequence, works to these heritage properties need to be managed in accordance with national and local legislation.

In Australia, best practice principles for meeting heritage management requirements are provided by the *Australia ICOMOS Charter for Places of Cultural Significance, The Burra Charter*, 2013 (Burra Charter) (ICOMOS (Australia) 2013). Further guidance for the WHL Kingston and Arthur's Vale Historic Area (KAVHA), is provided by the *Kingston and Arthur's Vale Historic Area Heritage Management Plan* (HMP) prepared by Godden Mackay Logan (GML) in 2016 (Godden Mackay Logan Pty Ltd 2016). The *Norfolk Island: Longridge Arches Heritage Management Plan* prepared by Eric Martin and Associates (2005) provides similar guidance for the Longridge Barracks Arches.

## 1.2 Proposal Description

A description of the Proposal options for rectification work of the five heritage items is summarised in Table 1 with details provided in the *Kingston and Arthur's Vale Safety Hazard Investigation Concept Design Report – Very High Risk Items (Draft)* (AECOM, 2018).

**Table 1 Proposed rectification work**

| No | Heritage Item                                      | Rectification work*   |
|----|--|---|
| 1  | Civil Hospital (Northern Gable and Retaining Wall) | <ul style="list-style-type: none"> <li>• Civil Hospital: Build a bracing mechanism of timber structure to tie the wall back</li> <li>• Retaining wall: do nothing</li> <li>• Timber lintel: reinstatement of the timber lintel</li> </ul>   |
| 2  | Arthur's Vale Retaining Wall                       | <ul style="list-style-type: none"> <li>• Install earth bund uphill to direct water away from the wall</li> <li>• Install agricultural drain behind the wall to divert surface runoff</li> </ul>   |
| 3  | Bounty Street Bridge                               | <ul style="list-style-type: none"> <li>• Identify and rectify septic systems that are contaminating Watermill Creek</li> <li>• Undertake environmental testing to confirm water quality in Watermill Creek and confirm methodology for desilting Watermill Creek</li> <li>• Prepare detailed design and construction documentation to undertake the following works: <ul style="list-style-type: none"> <li>- Empty, desilt and repair dam wall and spillway</li> <li>- Excavate Watermill Creek Channel</li> <li>- Design and construct a temporary coffer dam (if required)</li> </ul> </li> <li>• Undertake a detailed investigation into Bounty Street Bridge including: <ul style="list-style-type: none"> <li>- Geotechnical investigation</li> <li>- Detailed site investigation</li> <li>- Detailed design, drawings, specifications</li> </ul> </li> </ul> |
| 4  | Longridge Barracks Arches                          | <ul style="list-style-type: none"> <li>• Underpinning footings <ul style="list-style-type: none"> <li>- Install temporary bracing on both sides of the arch, jack up wall and supported by underpinning</li> </ul> </li> <li>• Provide bracing behind arches</li> </ul>   |
| 5  | Royal Engineer's Office (REO) Entry Portico        | <ul style="list-style-type: none"> <li>• Detailed documentation of existing construction details</li> <li>• Dismantling of existing portico</li> <li>• Reconstruction using existing materials / segments</li> </ul>  |



| No | Heritage Item | Rectification work*  |
|----|---------------|--|
|    |               | <ul style="list-style-type: none"> <li>Installation of stainless steel tie backs from the front of the portico to the rear lintels to prevent rotation of the front gable</li> </ul> |

\*Note:

1. Items 1,2,3 and 5 are within KAVHA

The Proposal options are designed to minimise heritage and environmental impacts, and are subject to further refinement during detailed design.

### 1.3 Initial environmental constraints

The key environmental/heritage constraints of the Proposal include:

- The Proposal design or construction impacts on the WHL values of the KAVHA places (Civil Hospital, Arthur's Vale Retaining Wall, Bounty Street Bridge and REO Entry Portico) and the CHL values of the Longridge Barracks Arches. This is the key environmental/heritage issue of concern.
- The desilting of the Windmill Creek beneath the Bounty Street Bridge for rectification works resulting in cleared pathway which allows sewage originating upstream of the bridge (not generated as part of the Proposal) flowing directly into Emily Bay and exacerbating water pollution that has already been reported as occurring and adversely impacting the coral reefs in the bay (URS Australia Pty Ltd 2013).
- A referral has been previously submitted to the Australian Government by the Norfolk Island Administration for the proposed action to manage the Kingston waterways including weed removal, rehabilitation of banks and monitoring of water quality. The referral decision (EPBC 2008/4238) specified that the proposed works was not a controlled action if undertaken in a particular manner. Specific mitigation measures specified which would be applicable to the proposed works at the Bounty Street Bridge include:
  - Restrict access of machinery to the works area and machinery will not be driven across the Boundary Street Bridge
  - A temporary fence will be constructed 20 metres on both sides of the waterway, be temporary in nature and be stock proof.
  - The fence posts (steel picket) will not impact on archaeological resources below ground.
  - Fencing will be erected before the work begins and will remain in place until the action is complete
- The works causing erosion and sedimentation that adversely impacts downstream receiving waterbodies.
- Noise, dust and temporary closures or restriction on access causing inconvenience and nuisance to local residents and tourists visiting the heritage sites and possibly adversely impacting tourism during the construction phase.

In addition to applicable Commonwealth and Norfolk Island legislation, the following environmental investigations and documentation have been reviewed for consideration in the environmental approval requirements for the Proposal:

- APC Waste Consultants and Econorfolk Foundation Inc Ltd (2015) *The Administration of Norfolk Island Waste Management Strategy Plan*
- Department of Environment, Water, Heritage and Arts (2008) Referral Decision for the Management of Kingston Waterways, Kingston, Norfolk Island (EPBC 2008/ 4238)
- GML (2016) *Kingston and Arthur's Vale Historic Area Heritage Management Plan*
- Eric Martin and Associates (2005) *Norfolk Island: Longridge Arches Heritage Management Plan*

- GML Heritage Pty Ltd (2018) *Kingston Arthur's Vale Historic Area Cultural Landscape Management Plan Preliminary Draft Report*
- Norfolk Island Regional Council (2016) *Norfolk Island Community Strategic Plan 2016-2026*
- Norfolk Island Regional Council (2017) *Water Quality in the KAVHA Catchment*, Norfolk Island Regional Council
- Norfolk Island Regional Council (2018) *Norfolk Island Operational Plan 2018-2019*. Accessed on the internet at: <http://www.norfolkisland.gov.nf/operational-plan-2018-2019>
- URS Australia Pty Ltd (2013) *Norfolk Island Water Quality Study Emily Bay & Upper Cascade Creek Catchments*, Administration of Norfolk Island

## 2.0 Planning Context Overview

The *Norfolk Island Legislation Amendment Act 2015* (Commonwealth) came into force on the 18th June 2015. The Act re-delineated the responsibility of the Australian Government with regard to Norfolk Island and provided for the establishment of the Norfolk Island Regional Council (NIRC) that administers Norfolk Island. The implementation of Act did not result in significant changes in the land tenure within the KAVHA.

The ensuing sections describe the statutory and non-statutory planning context applicable to the KAVHA and the Proposal.

### 2.1 World Heritage Convention

Australia is a signatory of the Convention Concerning the Protection of the World Cultural and Natural Heritage that was adopted in General Conference of UNESCO 1972 (i.e. the World Heritage Convention). Australia ratified the convention in August 1974. The Australian Convict Sites properties, which includes the KAVHA, was added onto the World Heritage List on 31 July 2010 (WHL#106209). The Proposal, with the exception of the Longridge Barracks Arches, is located within the KAVHA and is managed by the KAVHA Management Committee through the KAVHA HMP.

The Australian Government is the 'state party' to the World Heritage Convention and under Article 4 of the Convention has a duty to ensure the identification, protection, conservation, presentation and transmission to future generations of natural and cultural heritage of outstanding universal value. As a party to the Convention, the Australian Government is required to manage listed world heritage items in accordance to the Operational Guidelines prepared by the World Heritage Centre.

At the operational level, the Australian Government's obligations with regard to the Operational Guidelines are addressed through implementing the Environmental Protection and Biodiversity Act 1999 (EPBC Act). The legislative framework set out by the EPBC Act needs to be considered for the Proposal to ensure compliance to the Operational Guidelines and all obligations under the World Heritage Convention. Any works that are found to be a significant impact to World Heritage values under this process may need to be referred to the UNESCO World Heritage Committee for final consideration and approval.

### 2.2 Commonwealth legislation

#### 2.2.1 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's central environmental legislation providing a legal framework to protect and manage nationally and internationally important flora, fauna, Threatened Ecological Communities (TECs) and Heritage places (under Matters of National Environmental Significance (NES)).

Under the EPBC Act, approval from the Commonwealth Minister for Environment and Energy is required for an action that is:

- Likely to have a significant impact on a Matter of NES

- Carried out on Commonwealth Land and/or likely to have a significant impact on the environment of Commonwealth Land
- Undertaken by the Commonwealth and likely to have a significant impact on the environment.

Matters of NES include:

- World Heritage Properties
- National Heritage Places
- Listed migratory species
- Wetlands of International Importance
- Commonwealth Marine Areas
- TECs and threatened species
- Nuclear actions.

If the Proposal is likely, or potentially likely, to have a significant impact on any of the above triggers, the Proposal must be referred. Referral of an action involves providing relevant information on a referral form and submitting it to the Commonwealth Department of the Environment and Energy (the Department). This process is discussed further in Section 2.2.3.

Based on a review of the referral, the Departmental delegate (on the Minister's behalf) will decide whether the proposed action is likely to have a significant impact on matters protected by the EPBC Act and would therefore become a 'controlled action'. If the proposed action is a controlled action, the Proposal will need to undergo a formal assessment and approval process under the EPBC Act before it can proceed. This ranges from provision of preliminary information through to an Environmental Impact Statement (EIS).

## 2.2.2 Potential for a Significant Impact under the EPBC Act

This Section reviews the potential for a significant impact on matters protected by the EPBC Act, based on desktop investigations undertaken for the Proposal. The proposed rectification options for all five heritage items were considered.

### 2.2.2.1 Matters of National Environmental Significance

Matters of NES with the potential to be affected by the Proposal were identified using the EPBC Act Protected Matters Search Tool (PMST), administered by the Department. A one kilometre buffer was applied to the search. A copy of the PMST report is provided in Annex A.

Table 2 lists the Matters of NES and their potential applicability to the development as identified using the PMST.

**Table 2 Matters of NES**

| Matter of NES             | Comment   | Potential for Significant Impact  |
|---------------------------|---|---|
| World Heritage Properties | KAVHA is listed as a World Heritage Property (WHL#106209). This includes the Proposal heritage items: <ul style="list-style-type: none"> <li>• Civil Hospital</li> <li>• Arthur's Vale Retaining Wall</li> <li>• Bounty Street Bridge</li> <li>• REO Entry Portico</li> </ul> | Yes - If the proposed methodology results in a significant impact on the heritage values of the KAVHA and/or is not in carried out accordance to the KAVHA HMP. |
| National Heritage places  | KAVHA is listed as a National Heritage Place (NHL#105962): This includes the Proposal heritage items: <ul style="list-style-type: none"> <li>• Civil Hospital</li> <li>• Arthur's Vale Retaining Wall</li> <li>• Bounty Street Bridge</li> </ul>                              | Yes - If the proposed methodology results in a significant impact on the heritage values of the KAVHA and/or is not in carried out accordance to the KAVHA HMP. |

| Matter of NES                        | Comment   | Potential for Significant Impact   |
|--------------------------------------|---|--|
|                                      | <ul style="list-style-type: none"> <li>REO Entry Portico</li> </ul>   |  |
| Wetlands of International Importance | Not applicable – none identified within 1 km of the Proposal site.  | No.  |
| Listed TECs                          | There are no TEC within 1 km of the Proposal site.  | No. There are no TEC within 1 km of the Proposal site.   |
| Listed threatened species            | <p>69 threatened species identified as potentially occurring within 1 km of the site. This includes:</p> <ul style="list-style-type: none"> <li>24 bird species</li> <li>One fish</li> <li>Five mammals</li> <li>Three invertebrates</li> <li>Five reptiles</li> <li>One shark</li> <li>30 flora species</li> </ul> <p>(see Annex A for a full list).</p> | No. It is unlikely that the Proposal would impact threatened species. The desilting of Windmill Creek beneath Bounty Street Bridge may result in a more effective pathway for sewage from upstream of the site (not generated from the proposal) to flow into the sea. However the impact of sewage on marine water quality and the coral reefs in Emily Bay has already been occurring for a considerable period.   |
| Migratory species                    | <p>40 migratory species identified as potentially occurring within 1 km of the site. This includes:</p> <ul style="list-style-type: none"> <li>18 bird species</li> <li>16 marine species</li> <li>Six wetland species</li> </ul> <p>(see Annex A for a full list).</p>   | No. It is unlikely that the Proposal site would contain critical habitat for migratory bird species or impact on critical habitat and therefore it is unlikely that there is potential for a significant impact.   |
| Commonwealth Marine Areas            | The sea surrounding Norfolk Island is listed as a Special Purpose Zone (Norfolk) (IUCN VI)  | No. It is unlikely the Proposal would impact Commonwealth marine areas. The desilting of Windmill Creek beneath Bounty Street Bridge may result in a more effective pathway for sewage from upstream of the site (not generated from the proposal) to flow into the sea. However the impact of sewage on marine water quality and the coral reefs in Emily Bay has already been occurring for a considerable period. |
| The Great Barrier Reef Marine Park   | Not applicable.   | No.  |
| Nuclear actions                      | Not applicable.   | No.  |



### 2.2.2.2 Other Matters Protected by the EPBC Act

Table 3 lists the Other Matters protected by the EPBC Act for which the Proposal may present a potential significant impact.

**Table 3 Other Matters Protected by the EPBC Act**

| Other Matter                      | Comment  | Potential for Significant Impact  |
|-----------------------------------|--|---|
| Commonwealth Land                 | All Proposal heritage items are located on Commonwealth Land   | Yes - If the proposed methodology results in a significant impact on the heritage values of the areas and/or is not in carried out accordance with the relevant HMP.  |
| Actions by the Commonwealth       | All Proposal works will be undertaken by the Commonwealth  | Yes - If the proposed methodology results in a significant impact on the heritage values of the areas and/or is not in carried out accordance with the relevant HMP.  |
| Listed Marine Species             | 32 listed marine species identified as potentially occurring within 1 km of the site (see Annex A for a full list).  | No. it is unlikely that the proposal would impact listed marine species.  |
| Whales and Other Cetaceans        | 28 whales and cetaceans were identified as potentially occurring within 1 km of the site (see Annex A for a full list). Whales and dolphins are known to frequent the waters of Norfolk island and whale watching is an ecotourism activity. | No. The proposal would not impact whales or dolphins that occur in the waters off Norfolk Island.   |
| Critical Habitats                 | Not applicable – none identified within 1 km of the Proposal site.   | No.   |
| Commonwealth Reserves Terrestrial | Not applicable – none identified within 1 km of the Proposal site.   | No.   |
| Commonwealth Reserves Marine      | The sea surrounding Norfolk Island is listed as a Special Purpose Zone (Norfolk) (IUCN VI)   | No. It is unlikely the proposal would impact Commonwealth marine reserves.<br>The clearing of the Windmill Creek beneath Bounty Street Bridge may result in a more effective pathway for sewage from upstream of the site (not generated from the proposal) to flow into the sea. However the impact of sewage on marine water quality and the coral reefs in Emily Bay has already been occurring for a considerable period. |

Sixty-nine threatened species and 40 migrant species (Matters of NES), 40 listed marine species and 28 whales and cetaceans (other matters) were identified as potentially occurring within a 1 km radius of the Proposal area. It is unlikely that the Proposal would result in a significant impact on these species.

The Proposal could potentially result in a significant impact on MNES related to heritage (i.e. World Heritage Properties and National Heritage Places) and other matters protected under the EPBC Act

(Commonwealth Land, actions by the Commonwealth). The Proposal must be carried out in accordance with the EPBC Act, the KAVHA HMP (Civil Hospital, Arthur's Vale Retaining Wall, Bounty Street Bridge and REO Entry Portico), and the Longridge Arches HMP (Longridge Barracks Arches).

A Heritage Impact Statement (HIS) should be undertaken for each heritage item by a qualified Heritage Specialist. The HIS will determine if the Proposal conforms to the relevant legislative and policy requirements, and whether it causes a significant impact to the heritage values of these places.

It is crucial that the proposed engineering methodology for rectification of each heritage item be reviewed/ assessed by a competent Heritage Specialist. This should be done at the early design stages to facilitate selection of options that minimise the potential for significant impact on heritage values. However, based on the initial Proposal options that include ground disturbing works at a number of sites, and the addition of bracing to the Civil Hospital and the Longridge Barracks Arches, an EPBC Act referral is likely to be triggered.

Even if the Proposal is modified to select engineering options that will not have a significant heritage impact, it may be strategic to submit a referral for a number of reasons:

- It would allow the Commonwealth to independently review the Proposal design, methodology and proposed mitigation and management measures to verify conformance to the World Heritage Operational Guidelines and best management practices to safeguard the world heritage listing status of KAVHA.
- It would allow proper project planning (budgeting and schedule) to assess the impacts and obtain the necessary EPBC Act approval. This would avoid the risk of proceeding with the Proposal and possibly triggering an EPBC Act referral at a later stage (assuming the scope of works does not change).
- It would provide the Department's decision that the Proposal options are not a controlled action, providing some legal protection to the commencement of the works against potential injunctive relief by third parties.

### **2.2.3 Referral Process**

The purpose of a referral is to obtain a decision from the Commonwealth Minister of the Environment and Energy on whether the Proposal will need formal assessment and approval under the EPBC Act (a controlled action). A referral is made by submission of a referral form. Since October 2014, the Department commenced cost recovery arrangements for environmental assessments, and as such, there are fees associated with the assessment of projects, including referrals.

On receipt of the referral, a decision is made within 20 business days, provided sufficient information is provided in the referral. Within this period, there is a 10 day period for public comment.

If the Proposal is deemed to be a controlled action, it will be subject to a formal assessment and approval process. The type of assessment would depend on the complexity of the Proposal and potential impacts. The assessment may be in the form of an EIS which would be submitted to and approved by the Minister for the Environment and Energy.

## **2.3 Protection of Movable Cultural Heritage Act 1986**

The *Protection of Movable Cultural Heritage Act 1986* protects Australia's movable cultural heritage and provides for the return of foreign cultural property which has been illegally exported from its country of origin and imported into Australia. This Act protects against the removal of any heritage items found on or below ground during construction work.

With regard to the Proposal, a chance find procedure that addresses the requirements of this Act should be developed in the CMP and/or CEMP and implemented during construction. The contractor's personnel should be made aware of the requirements through appropriate training.

## 2.4 Norfolk Island Legislation

### 2.4.1 Planning Act 2002 (Norfolk Island)

The *Norfolk Island Planning Act 2002* aims to promote the conservation and preservation of the natural environment, landscape, unique cultural and built heritage as well as the proper management, development and conservation of the natural and man-made resources of Norfolk Island.

The Act sets out the requirements that govern the permitted developments and development approval process. Land use, planning and development control via development approvals in Norfolk Island is currently determined by the responsible Federal minister based on advice from the Norfolk Island Planning and Environment Board. The term 'development' includes the use of any land or the erection of any building or other structure or carrying out building, engineering, mining, or other operations in, on, or under the land, or making any material change to the use of any premises. The term covers: construction, alteration, demolition, subdivision, relocation and signs and hoardings.

The Act requires that development approval submissions be made available for public inspection for a period of 28 days. The submission would be subject to review by the Norfolk Island Planning and Environment Board, who advises the Minister (or representative) for approval.

Section 45 of the Act stipulates the requirement for an Environmental Impact Assessment (EIA) or Environmental Impact Statement (EIS) when development proposals that are likely to have a significant environmental impact. In the case of the Proposal, it is likely that any such EIA or EIS would be combined with the Heritage Impact Statement (HIS) required under the Heritage Act 2002 (see below).

Given that the Proposal involves excavation, installation of drainage, and the construction of wall bracing, it would ordinarily require development approval under the Act. However, as the works are all intended to conserve heritage places, an exemption may be applicable under the s74.1 of the Heritage Overlay of the *Norfolk Island Plan 2002* (see below). It is assumed that some level of heritage assessment, such as a HIS, would be required to demonstrate eligibility for this exemption. Confirmation of the exemption/approval and supporting documentation would be sought from Council as the Proposal is further refined.

The Norfolk Island Regional Council working with the Commonwealth has drafted amendments to strengthen the *Norfolk Island Planning Act 2002* and produced a Significant Development Assessment Strategy which covers '*new infrastructure or the upgrading of existing infrastructure that support economic growth and community welfare on Norfolk Island*'. Projects such as the winning of rock, waste management, electricity infrastructure and sewer treatment infrastructure fit into the category that can be assessed as significant development under the new procedure. The Proposal is not a 'significant development' and therefore the Significant Development Assessment Strategy does not apply. It is noted, however, that the sewerage upgrades required ahead of the Bounty Street Bridge works would likely constitute 'significant development'.

### 2.4.2 Norfolk Island Plan 2002

The *Norfolk Island Plan 2002* sets out the strategic planning framework for the future land use, development and management of land in Norfolk Island. It consists of two components:

- Part A - Strategic Plan:
  - KAVHA is within the High Rural/ Conservation Value Preferred Dominant Land Use. The objectives cover conservation and preservation of these areas that have very high natural and/ or cultural heritage conservation values, allows for complimentary low intensity and low impact use or development and provide land that may buffer certain incompatible uses. The KAVHA HMP is the key instrument to ensure that development within the KAVHA conforms to the objectives of the strategic plan.
  - The Longridge Arches is within the Semi-Rural Preferred Dominant Land Use. The objectives for this area are to preserve rural character while providing 'a limited range of low intensity and low impact use or development opportunities within areas that have natural, cultural and heritage values'.
- Part B – Zoning scheme, overlay and general provisions:
  - Some of the land within KAVHA is zoned Rural (privately owned and Crown leasehold land) while the Crown land is zoned Conservation, Special Use and Open Space

- The land at the Longridge Barracks Arches is zoned rural residential
- Both KAVHA and the Longridge Barracks are included on the heritage overlay.

The aims of the Heritage Overlay are:

- To conserve the environmental heritage of Norfolk Island
- To integrate heritage conservation into the planning and development control processes
- To provide for public involvement in the conservation of environmental heritage
- To ensure that any use or development does not adversely affect the heritage significance of land subject to the Heritage Overlay.

The Heritage Overlay (s74.1) requires approval be obtained for all development on identified land unless the development is completed under an approved conservation management plan, or the executive member is satisfied that the proposed development would contribute to the conservation of heritage significance. Given that the Proposal seeks to conserve several heritage listed structures, it may be exempt from development approval under this section of the Heritage Overlay. It is assumed, however, that some level of heritage assessment would be required to demonstrate eligibility for this exemption. This exemption and supporting documentation would be confirmed with the Council when the preferred engineering design options for the Proposal are selected.

#### **2.4.3 Building Act 2002 (Norfolk Island) and Norfolk Island Building Codes & Standards**

All building activity on Norfolk Island, is controlled by the *Building Act 2002* and the Norfolk Island Building Code. "Building work" is defined by Section 5 of the Building Act as: "the actual physical work for or in connection with the construction, erection, alteration, demolition or removal of a building or structure or services". The Norfolk Island *Building Regulations 2004* lists (among other items): details which shall accompany a building application, the Norfolk Island Building Code, compulsory inspection stages of building work (i.e. covers inspection of foundations works); and activities for which building approval is not required (Schedule 1).

The Proposal would likely involve:

- Installation of temporary and permanent external support/ bracing structures.
- Masonry work to patch up cracks and sections of the outer façade of buildings and structures within KAVHA and the Longridge Barrack Arches. Note that the original masonry would be analysed and a similar composition recreated for the work.
- Improving foundation works of the structures of some heritage items.
- Erection of temporary scaffolding and/ or support structures for a period of more than 6 months.

Based on the current Proposal, the works are not exempted activities as specified in Schedule 1 of the *Norfolk Island Building Regulations 2004* and therefore a Building Approval would likely be required from the Norfolk Island Regional Council. The requirement for a Building Approval for each of the five heritage items would be confirmed with the Council as the Proposal is progressed with further refinement of the preferred engineering design option.

#### **2.4.4 Heritage Act 2002 (NI)**

The *Heritage Act 2002* sets out the criteria, management framework and procedures for establishing the Norfolk Island Heritage Register as well as specifies requirements for Heritage Impact Statement (HIS) and Conservation Management Plans (CMP).

Development applications that are likely to impact a heritage item require a HIS to be prepared and submitted to the Minister. Depending on the significance of the impact, the Minister may require a Conservation Management Plan to be prepared for the proposal to safeguard the heritage item during development.

KAVHA (Civil Hospital, Arthur's Vale Retaining Wall, Bounty Street Bridge and REO Entry Portico) and the Longridge Barracks Arches are all listed on the Norfolk Island Heritage Register. As discussed above, it is likely that the Proposal works would be exempt from development approval under the



Heritage Overlay (s74.1). However, some level of heritage assessment will be required to demonstrate eligibility for this exemption. Consequently a HIS will likely be required for each site.

If the Proposal is determined to have a potentially significant impact, a CMP would likely be required before proposed works can commence. In the case of KAVHA, some of these works may be able to be conducted under the overarching KAVHA HMP. However, the more extensive works, such as the bracing of the Civil Hospital, may require a site-specific HMP/CMP be produced in accordance with Policy 8.3.6 and Recommendation 10.4 of the KAVHA HMP.

A HMP also exists for the Longridge Barracks Arches, but the document is more than 10 years old, and does not appear to provide sufficient detail to effectively manage the site. Consequently, the Minister may also require the completion of an updated HMP before major works at the Longridge site can commence.

The current Proposal includes preparation of a HIS for the selected rectification option for each heritage item by a Senior Heritage Specialist in consultation with the Norfolk Island Regional Council, Norfolk Island Planning and Environment Board and the KAVHA Management Committee. The HIS would support the approval submission required for the Proposal. No allowance has currently been made for the production of separate CMP/HMP.

#### **2.4.5 Public Reserve Land Act 1997 (NI)**

Several areas of Crown land within the KAVHA are designated as public reserves under the *Public Reserves Act 1997* and are managed and protected in accordance to provisions of the Act. These public reserves are: Kingston Common, Kingston recreation, Government House, Point Hunter, the cemetery and the war memorial.

Depending on the extent of the work sites, a permit may be required for the Arthur's Vale Retaining Wall and the Bounty Street Bridge works.

#### **2.4.6 Norfolk Island Trees Act 1999 (NI)**

The *Norfolk Island Trees Act 1999* protects trees that are listed in the *Trees Regulations 1999*. A permit is required prior to removal of a protected tree. Within the KAVHA, there are several Norfolk Island Pines and White Oakes that are protected under this Act.

The Proposal does not involve removal of trees and therefore a permit would not be required.

#### **2.4.7 Protection of Moveable Cultural Heritage Act 1987 (NI)**

The *Protection of Moveable Cultural Heritage Act 1987* (NI) protects Norfolk Island's movable heritage items as well as other Australian and protected items. This Act protects against the removal of any heritage items found on or below ground during construction work.

With regard to the Proposal, a chance find procedure that addresses the requirements of this Act should be developed in the CMP and/or CEMP and implemented during construction. The contractor's personnel should be made aware of the requirements through appropriate training.

### **3.0 Development assessment pathway**

Based on the current Proposal options for the five heritage items, the development assessment pathways for the proposal are summarised in Table 4.

#### **3.1 Commonwealth**

##### **3.1.1 EPBC Act referral**

The Proposal would trigger an EPBC referral if a HIS (conducted by a competent Heritage Specialist) concludes that the proposal might result in a significant impact on heritage values of WHL, NHL or CHL places.

## **3.2 Norfolk Island**

### **3.2.1 Development approval under the Norfolk Island Planning Act 2002**

The works of the Proposal, including installation of drainage, and the construction of wall bracing, would usually require a development approval under the Act. However, as all works are intended to conserve heritage places, an exemption may be applicable under s74.1 of the Heritage Overlay of the *Norfolk Island Plan 2002*. It is assumed that some level of heritage assessment would be required to demonstrate eligibility for this exemption. Confirmation of the exemption/approval would be sought from Council as the Proposal is further refined.

### **3.2.2 Building approval under the Norfolk Island Building Act 2002**

A building approval would be required for the Proposal rectification works of each heritage item..

### **3.2.3 Development approval under the Norfolk Island Heritage Act 2002**

The Act requires the preparation of a HIS for all works to Heritage Register Places that require development approval under the *Norfolk Island Planning Act 2002*.

Table 4 Environmental Approvals Pathways for the KAVHA Rectification Works

| No | Heritage Item                                      | Proposed rectification work   | Environmental Approval Framework   |   |                               |  | Remarks   |
|----|--|---|--|---|-------------------------------|--|---|
|    |  |   | <i>EPBC Act 1999 Commonwealth</i>  | <i>Planning Act 2002 (NI)</i>   | <i>Building Act 2002 (NI)</i> | <i>Heritage Act 2002</i>   |   |
|    |  |   | Referral   | Development approval / EIS  | Building approval             | HIS  |   |
| 1  | Civil Hospital (Northern Gable and Retaining Wall) | <ul style="list-style-type: none"> <li>Civil Hospital: Build a bracing mechanism of timber structure to tie the wall back</li> <li>Retaining wall: do nothing</li> <li>Timber lintel: reinstatement of the timber lintel</li> </ul>                                 | Likely, depending on design of bracing, and findings of HIS  | Development approval may be exempt under the Heritage Overlay. HIS required to demonstrate eligibility for exemption                        | Building approval required    | HIS required to inform approvals (or exemptions) under <i>Planning Act</i> | To consult DIRC on the Proposal<br>Separate CMP likely required.  |
| 2  | Arthur's Vale Retaining Wall                       | <ul style="list-style-type: none"> <li>Install earth bund uphill to direct water away from the wall</li> <li>Install agricultural drain behind the wall to divert surface runoff</li> </ul>   | Possible, depending on extent of wall reconstruction and ground disturbance required, and findings of HIS  | Development approval may be exempt under the Heritage Overlay. HIS required to demonstrate eligibility for exemption<br>EIS likely required | As above                      | As above   | CMP may be required.<br>May require permit under <i>Public Reserves Act 1997 (NI)</i>   |
| 3  | Bounty Street Bridge                               | <ul style="list-style-type: none"> <li>Identify and rectify septic systems contaminating Watermill Creek</li> <li>Confirm methodology for desilting and dewatering Watermill Creek</li> <li>Undertake a detailed investigation into Bounty Street Bridge</li> </ul> | Likely, depending on extent of works at bridge and dam, likely archaeological impacts, and findings of HIS | As above  | As above                      | As above   | EIS scope to cover heritage, water quality, waste and ecology.<br>The scope and format to be determined in consultation with NIRC/NIPeB |

| No | Heritage Item             | Proposed rectification work   | Environmental Approval Framework                           |  |                               |                          | Remarks   |
|----|---------------------------|---|--|--|-------------------------------|--------------------------|---|
|    |                           |   | <i>EPBC Act 1999 Commonwealth</i>                          | <i>Planning Act 2002 (NI)</i>  | <i>Building Act 2002 (NI)</i> | <i>Heritage Act 2002</i> |   |
|    |                           |   | Referral   | Development approval / EIS   | Building approval             | HIS                      |   |
|    |                           |   |  |  |                               |                          | CMP likely required<br>Bridge over Windmill Creek likely under the jurisdiction of Norfolk Island Regional Council<br>May require permit under <i>Public Reserves Act 1997 (NI)</i> |
| 4  | Longridge Barracks Arches | <ul style="list-style-type: none"> <li>Underpinning footings</li> <li>Install temporary bracing on both sides of the arch jack up wall and supported by underpinning</li> <li>Provide steel bracing behind arches (less obtrusive)</li> </ul> | Likely, depending on extent of bracing and findings of HIS | Development approval may be exempt under the Heritage Overlay. HIS required to demonstrate eligibility for exemption | As above                      | As above                 | Updated CMP likely required   |



| No | Heritage Item         | Proposed rectification work   | Environmental Approval Framework   |   |   |  | Remarks   |
|----|-----------------------|---|--|---|---|--|---|
|    |                       |   | <i>EPBC Act 1999 Commonwealth</i>  | <i>Planning Act 2002 (NI)</i>   | <i>Building Act 2002 (NI)</i>                 | <i>Heritage Act 2002</i>   |   |
|    |                       |   | Referral   | Development approval / EIS  | Building approval                             | HIS  |   |
| 5  | REO Entry Portico     | <ul style="list-style-type: none"> <li>Dismantling and reconstruction of existing portico using existing materials / segments</li> <li>Installation of stainless steel tie backs from the front of the portico to the rear lintels</li> </ul> | Likely, due to dismantling and reassembly work and findings of HIS                     | Development approval may be exempt under the Heritage Overlay. HIS required to demonstrate eligibility for exemption<br>EIS likely required   | As above                                      | As above   | EIS scope to cover visual impacts<br>CMP likely required-   |
| 6  | Overall project scope | <ul style="list-style-type: none"> <li>All works covering five heritage items</li> </ul>  | EPBC referral would be required if HIS concludes significant impact on heritage values | Development approval may be exempt under the Heritage Overlay for items 1 to 5. HIS required to demonstrate eligibility for exemption<br><br>EIS likely required for items 2 and 3. | Building approval required for items 1 to 5 b | HIS required to inform approvals (or exemptions) under <i>Planning Act</i> | Environmental approval pathways to be confirmed with the Norfolk Island Regional Council<br><br>HIS required for all heritage items |

## 4.0 Recommendations Development assessment pathway

Based on the current Proposal options, a desktop review of environmental approval pathways and a preliminary discussion with NIRC, the following is recommended to progress the Proposal:

- Initiate consultation with Norfolk Island authorities early to confirm the environmental approval pathway and refine the scale and scope of the heritage and environmental assessment as required. This should be carried out early in project design.
- Design to take into account the requirements of:
  - The Burra Charter (2013)
  - Eric Martin & Associates (2005) Norfolk Island: Longridge Arches Heritage Management Plan
  - GML (2016) Kingston and Arthur's Vale Historic Area Heritage Management Plan
  - GML (2018) KAVHA Cultural Landscape Management Plan Preliminary Draft Report.
- Where practicable, select design options that:
  - Have minimal impact on original fabric
  - Are visually recessive
  - Minimise ground disturbing works.
- Conduct a HIS for each Proposal options for each heritage item by a competent Heritage Specialist to support the building Approval submission.
- The Proposal options should be reviewed/ assessed by a competent Heritage Specialist early to advise design and facilitate selection of rectification options that do not result in a significant impact on heritage. The Proposal options shall be in compliance with the KAVHA HMP for items within the KAVHA and the Longridge Arches HMP for the Longridge Barracks Arches.
- Depending on outcomes of the HIS, proactively submit an EPBC Act referral to the Commonwealth for the proposed rectification options for each heritage item. This would allow an independent verification of the HIS to ensure all requirements of the World Heritage Convention and Operational Guidelines are fully complied with, and the heritage items are safeguarded with no risk to its World heritage values.
- For the Bounty Street Bridge, plan the work to commence after completion of sewerage treatment improvement works being carried out upstream. Provide mitigation measures for potential impacts of pollution from Windmill Creek desilting works to safeguard against sewage from upstream of the KAVHA impacting the marine water quality and coral reefs in Emily Bay. Desilting of Windmill Creek shall be carried out in accordance to the measures specified in the Commonwealth referral decision (EPBC 2008/4238)
- Waste from the proposal including sediment from desludging Windmill Creek below the Bounty Street Bridge should be managed in compliance to the *Norfolk Island Waste Management Strategy*.
- Conduct an environmental impact assessment for the proposed Bounty Street Bridge rectification work and formulate site specific mitigation and management measures to minimise the impacts on the environment. The scope shall include but not be limited to water quality, waste management (desilted material), ecology, erosion and sedimentation and heritage.
- Consider the potential impact to tourism during construction. This is to prevent a sense of feeling 'short changed' for tourists that have chosen to visit KAVHA only to find that parts of the site are not open to public due to repair works and views of the site are adversely impacted. Negative comments on social media could adversely impact the historical tourism industry of Norfolk Island.

## 5.0 References

- APC Waste Consultants and Econorfolk Foundation Inc Ltd (2015) The Administration of Norfolk Island Waste Management Strategy Plan
- Building Act (2002) (Norfolk Island)
- Department of Environment (DoE) (2013a) Significant impact guidelines 1.1 - Matters of National Environmental Significance
- Department of Environment (DoE) (2013b) Significant impact guidelines 1.2 – Actions on, or impacting upon, Commonwealth land and Actions by Commonwealth Agencies
- Department of Environment, Water, Heritage and Arts (2008) Referral Decision for the Management of Kingston Waterways, Kingston, Norfolk Island (EPBC 2008/ 4238)
- Environmental Protection and Biodiversity Conservation Act 1999
- Eric Martin & Associates (2005) *Norfolk Island: Longridge Arches Heritage Management Plan*. Unpublished report to Department of Transport and Regional Services.
- Godden Mackay Logan Pty Ltd. (2016) *Kingston and Arthur's Vale Historic Area Heritage Management Plan*. Report to the Australian Government. Godden Mackay Logan Pty Ltd. (2018) Kingston Arthur's Vale Historic Area Safety Hazards Study Draft Report
- Godden Mackay Logan Pty Ltd. (2018) Kingston Arthur's Vale Historic Area Cultural Landscape Management Plan Preliminary Draft Report
- ICOMOS (Australia) (2013) *The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance*. Burwood, Victoria: Australia ICOMOS.
- Norfolk Island Planning and Environment Board Act (2002)
- Norfolk Island Regional Council (2016) *Norfolk Island Community Strategic Plan 2016-2026*
- Norfolk Island Regional Council (2018) *Norfolk Island Operational Plan 2018-2019*. Accessed on the internet at: <http://www.norfolkisland.gov.nf/operational-plan-2018-2019>
- Norfolk Island Regional Council (2018) Water Quality in the KAVHA Catchment
- Planning Act (2002) (Norfolk Island)
- URS Australia Pty Ltd (2013) Norfolk Island Water Quality Study Emily Bay & Upper Cascade Creek Catchments, Administration of Norfolk Island

# **Annex A**

## **Protected Matters Search Tool Report**





# EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 17/09/18 14:42:43

[Summary](#)

[Details](#)

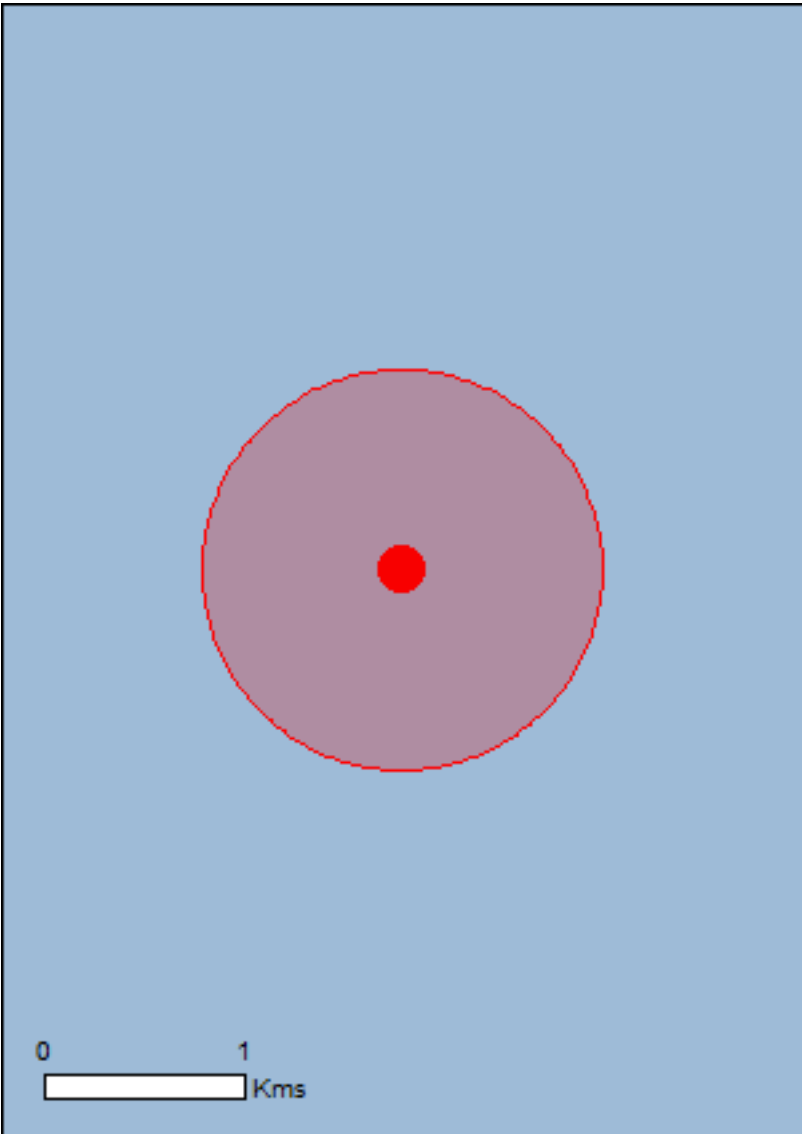
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

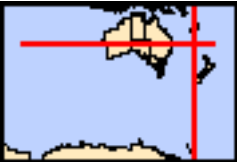
[Acknowledgements](#)



This map may contain data which are  
©Commonwealth of Australia  
(Geoscience Australia), ©PSMA 2010

[Coordinates](#)

Buffer: 1.0Km



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the [Administrative Guidelines on Significance](#).

|   |      |
|---|------|
| <a href="#">World Heritage Properties:</a>                | 1    |
| <a href="#">National Heritage Places:</a>                 | 2    |
| <a href="#">Wetlands of International Importance:</a>     | None |
| <a href="#">Great Barrier Reef Marine Park:</a>           | None |
| <a href="#">Commonwealth Marine Area:</a>                 | 1    |
| <a href="#">Listed Threatened Ecological Communities:</a> | None |
| <a href="#">Listed Threatened Species:</a>                | 69   |
| <a href="#">Listed Migratory Species:</a>                 | 40   |

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

A [permit](#) may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

|  |      |
|--|------|
| <a href="#">Commonwealth Land:</a>                 | None |
| <a href="#">Commonwealth Heritage Places:</a>      | 2    |
| <a href="#">Listed Marine Species:</a>             | 32   |
| <a href="#">Whales and Other Cetaceans:</a>        | 28   |
| <a href="#">Critical Habitats:</a>                 | None |
| <a href="#">Commonwealth Reserves Terrestrial:</a> | None |
| <a href="#">Australian Marine Parks:</a>           | 1    |

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

|  |      |
|--|------|
| <a href="#">State and Territory Reserves:</a>    | None |
| <a href="#">Regional Forest Agreements:</a>      | None |
| <a href="#">Invasive Species:</a>                | 21   |
| <a href="#">Nationally Important Wetlands:</a>   | None |
| <a href="#">Key Ecological Features (Marine)</a> | 2    |

# Details

## Matters of National Environmental Significance

| World Heritage Properties  |       | [ Resource Information ] |
|--|-------|--------------------------|
| Name   | State | Status                   |
| <a href="#">Australian Convict Sites (Kingston and Arthurs Vale Historic Area)</a> | EXT   | Declared property        |

| National Heritage Properties                            |       | [ Resource Information ] |
|---|-------|--------------------------|
| Name  | State | Status                   |
| Historic  |       |                          |
| <a href="#">HMS Sirius Shipwreck</a>                    | EXT   | Listed place             |
| <a href="#">Kingston and Arthurs Vale Historic Area</a> | EXT   | Listed place             |

| Commonwealth Marine Area  |  | [ Resource Information ] |
|---|--|--------------------------|
| Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast. |  |                          |

| Name                    |
|-------------------------|
| EEZ and Territorial Sea |

| Marine Regions  | [ Resource Information ] |
|---|--------------------------|
| If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act. |                          |

| Name                           |
|--------------------------------|
| <a href="#">Temperate East</a> |

| Listed Threatened Species  |            | [ Resource Information ]                         |
|--|------------|--|
| Name   | Status     | Type of Presence                                 |
| Birds  |            |  |
| <a href="#">Calidris canutus</a><br>Red Knot, Knot [855]   | Endangered | Species or species habitat may occur within area |
| <a href="#">Cyanoramphus cookii</a><br>Norfolk Island Green Parrot, Tasman Parakeet, Norfolk Island Parakeet [67046] | Endangered | Species or species habitat may occur within area |
| <a href="#">Diomedea antipodensis</a><br>Antipodean Albatross [64458]  | Vulnerable | Species or species habitat may occur within area |
| <a href="#">Diomedea antipodensis gibsoni</a><br>Gibson's Albatross [82270]  | Vulnerable | Species or species habitat may occur within area |
| <a href="#">Diomedea epomophora</a><br>Southern Royal Albatross [89221]  | Vulnerable | Species or species habitat may occur within area |
| <a href="#">Diomedea exulans</a><br>Wandering Albatross [89223]  | Vulnerable | Species or species habitat may occur within area |
| <a href="#">Diomedea sanfordi</a><br>Northern Royal Albatross [64456]  | Endangered | Species or species habitat may occur within area |

| Name   | Status                | Type of Presence   |
|--|-----------------------|--|
| <a href="#">Fregetta grallaria grallaria</a><br>White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438] | Vulnerable            | Species or species habitat likely to occur within area             |
| <a href="#">Limosa lapponica baueri</a><br>Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]                           | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Limosa lapponica menzbieri</a><br>Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]                   | Critically Endangered | Species or species habitat may occur within area                   |
| <a href="#">Macronectes giganteus</a><br>Southern Giant-Petrel, Southern Giant Petrel [1060]   | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Macronectes halli</a><br>Northern Giant Petrel [1061]  | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Ninox novaeseelandiae undulata</a><br>Norfolk Island Boobook, Southern Boobook (Norfolk Island) [26188]                        | Endangered            | Species or species habitat likely to occur within area             |
| <a href="#">Numenius madagascariensis</a><br>Eastern Curlew, Far Eastern Curlew [847]  | Critically Endangered | Species or species habitat known to occur within area              |
| <a href="#">Pachycephala pectoralis xanthoprocta</a><br>Golden Whistler (Norfolk Island) [64444]   | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Petroica multicolor</a><br>Norfolk Island Robin [604]  | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Pterodroma heraldica</a><br>Herald Petrel [66973]  | Critically Endangered | Species or species habitat may occur within area                   |
| <a href="#">Pterodroma leucoptera leucoptera</a><br>Gould's Petrel, Australian Gould's Petrel [26033]                                      | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Pterodroma neglecta neglecta</a><br>Kermadec Petrel (western) [64450]  | Vulnerable            | Foraging, feeding or related behaviour may occur within area       |
| <a href="#">Thalassarche cauta steadi</a><br>White-capped Albatross [82344]  | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche eremita</a><br>Chatham Albatross [64457]  | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche impavida</a><br>Campbell Albatross, Campbell Black-browed Albatross [64459]                                       | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche melanophris</a><br>Black-browed Albatross [66472]   | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche salvini</a><br>Salvin's Albatross [64463]   | Vulnerable            | Foraging, feeding or related behaviour likely to occur within area |
| Fish   |                       |  |
| <a href="#">Epinephelus daemeli</a><br>Black Rockcod, Black Cod, Saddled Rockcod [68449]   | Vulnerable            | Species or species habitat likely to occur within area             |



| Name  | Status                | Type of Presence                                       |
|---|-----------------------|--|
| Mammals   |                       |  |
| <a href="#">Balaenoptera borealis</a><br>Sei Whale [34]                                       | Vulnerable            | Species or species habitat may occur within area       |
| <a href="#">Balaenoptera musculus</a><br>Blue Whale [36]                                      | Endangered            | Species or species habitat may occur within area       |
| <a href="#">Balaenoptera physalus</a><br>Fin Whale [37]                                       | Vulnerable            | Species or species habitat may occur within area       |
| <a href="#">Eubalaena australis</a><br>Southern Right Whale [40]                              | Endangered            | Species or species habitat may occur within area       |
| <a href="#">Megaptera novaeangliae</a><br>Humpback Whale [38]                                 | Vulnerable            | Species or species habitat may occur within area       |
| Other   |                       |  |
| <a href="#">Advena campbellii</a><br>Campbell's Helicarionid Land Snail [81250]               | Critically Endangered | Species or species habitat may occur within area       |
| <a href="#">Mathewsoconcha grayi ms</a><br>Gray's Helicarionid Land Snail [81852]             | Critically Endangered | Species or species habitat likely to occur within area |
| <a href="#">Mathewsoconcha suteri</a><br>a helicarionid land snail [81851]                    | Critically Endangered | Species or species habitat likely to occur within area |
| Plants  |                       |  |
| <a href="#">Abutilon julianae</a><br>Norfolk Island Abutilon [27797]                          | Critically Endangered | Species or species habitat likely to occur within area |
| <a href="#">Achyranthes arborescens</a><br>Chaff Tree, Soft-wood [65879]                      | Critically Endangered | Species or species habitat known to occur within area  |
| <a href="#">Blechnum norfolkianum</a><br>Norfolk Island Water-fern [65885]                    | Endangered            | Species or species habitat may occur within area       |
| <a href="#">Calystegia affinis</a><br>[48909]   | Critically Endangered | Species or species habitat may occur within area       |
| <a href="#">Clematis dubia</a><br>a creeper, Clematis [22035]                                 | Critically Endangered | Species or species habitat may occur within area       |
| <a href="#">Coprosma baueri</a><br>Coastal Coprosma [37851]                                   | Endangered            | Species or species habitat likely to occur within area |
| <a href="#">Euphorbia norfolkiana</a><br>Norfolk Island Euphorbia [65887]                     | Critically Endangered | Species or species habitat likely to occur within area |
| <a href="#">Euphorbia obliqua</a><br>a herb [44385]   | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Hypolepis dicksonioides</a><br>Downy Ground-fern, Brake Fern, Ground Fern [10243] | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Melicope littoralis</a><br>Shade Tree [22042]                                     | Vulnerable            | Species or species                                     |

| Name   | Status                | Type of Presence                                       |
|--|-----------------------|--|
|  |                       | habitat may occur within area                          |
| <a href="#">Melicytus latifolius</a><br>Norfolk Island Mahoe [56677]                       | Critically Endangered | Species or species habitat may occur within area       |
| <a href="#">Meryta angustifolia</a><br>a tree [65881]                                      | Vulnerable            | Species or species habitat may occur within area       |
| <a href="#">Meryta latifolia</a><br>Shade Tree, Broad-leaved Meryta [65882]                | Critically Endangered | Species or species habitat likely to occur within area |
| <a href="#">Muehlenbeckia australis</a><br>Shrubby Creeper, Pohuehue [68510]               | Endangered            | Species or species habitat likely to occur within area |
| <a href="#">Myoporum obscurum</a><br>Popwood, Sandalwood, Bastard Ironwood [50255]         | Critically Endangered | Species or species habitat likely to occur within area |
| <a href="#">Myrsine ralstoniae</a><br>Beech [83889]  | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Pennantia endlicheri</a><br>Pennantia [65890]                                  | Endangered            | Species or species habitat may occur within area       |
| <a href="#">Phreatia limenophylax</a><br>Norfolk Island Phreatia [9239]                    | Critically Endangered | Species or species habitat may occur within area       |
| <a href="#">Pittosporum bracteolatum</a><br>Oleander [47181]                               | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Pteris kingiana</a><br>King's Brakefern [35183]                                | Endangered            | Species or species habitat likely to occur within area |
| <a href="#">Pteris zahlbruckneriana</a><br>Netted Brakefern [65893]                        | Endangered            | Species or species habitat likely to occur within area |
| <a href="#">Senecio australis</a><br>a daisy [40250]                                       | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Senecio evansianus</a><br>a daisy [55340]                                      | Endangered            | Species or species habitat known to occur within area  |
| <a href="#">Senecio hooglandii</a><br>a daisy [55346]                                      | Vulnerable            | Species or species habitat known to occur within area  |
| <a href="#">Streblus pendulinus</a><br>Siah's Backbone, Sia's Backbone, Isaac Wood [21618] | Endangered            | Species or species habitat may occur within area       |
| <a href="#">Taeniophyllum norfolkianum</a><br>Minute Orchid, Ribbon-root Orchid [82347]    | Vulnerable            | Species or species habitat likely to occur within area |
| <a href="#">Tmesipteris norfolkensis</a><br>Hanging Fork-fern [65895]                      | Vulnerable            | Species or species habitat may occur within area       |
| <a href="#">Ungeria floribunda</a><br>Bastard Oak [41714]                                  | Vulnerable            | Species or species habitat may occur within            |

| Name   | Status                | Type of Presence   |
|--|-----------------------|--|
| area   |                       |  |
| <a href="#">Wikstroemia australis</a><br>Kurrajong [42074]                                       | Critically Endangered | Species or species habitat may occur within area                   |
| <a href="#">Zehneria baueriana</a><br>Native Cucumber, Giant Cucumber [39253]                    | Endangered            | Species or species habitat may occur within area                   |
| Reptiles   |                       |  |
| <a href="#">Caretta caretta</a><br>Loggerhead Turtle [1763]                                      | Endangered            | Species or species habitat likely to occur within area             |
| <a href="#">Chelonia mydas</a><br>Green Turtle [1765]  | Vulnerable            | Species or species habitat likely to occur within area             |
| <a href="#">Dermochelys coriacea</a><br>Leatherback Turtle, Leathery Turtle, Luth [1768]         | Endangered            | Species or species habitat likely to occur within area             |
| <a href="#">Eretmochelys imbricata</a><br>Hawksbill Turtle [1766]                                | Vulnerable            | Species or species habitat likely to occur within area             |
| <a href="#">Natator depressus</a><br>Flatback Turtle [59257]                                     | Vulnerable            | Species or species habitat likely to occur within area             |
| Sharks   |                       |  |
| <a href="#">Carcharodon carcharias</a><br>White Shark, Great White Shark [64470]                 | Vulnerable            | Species or species habitat likely to occur within area             |
| Listed Migratory Species   |                       | [ Resource Information ]   |
| * Species is listed under a different scientific name on the EPBC Act - Threatened Species list. |                       |  |
| Name   | Threatened            | Type of Presence   |
| Migratory Marine Birds   |                       |  |
| <a href="#">Anous stolidus</a><br>Common Noddy [825]   |                       | Breeding known to occur within area                                |
| <a href="#">Ardenna carneipes</a><br>Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]   |                       | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Ardenna pacifica</a><br>Wedge-tailed Shearwater [84292]                              |                       | Breeding known to occur within area                                |
| <a href="#">Diomedea antipodensis</a><br>Antipodean Albatross [64458]                            | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Diomedea epomophora</a><br>Southern Royal Albatross [89221]                          | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Diomedea exulans</a><br>Wandering Albatross [89223]                                  | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Diomedea sanfordi</a><br>Northern Royal Albatross [64456]                            | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Fregata ariel</a><br>Lesser Frigatebird, Least Frigatebird [1012]                    |                       | Species or species habitat known to occur within area              |
| <a href="#">Fregata minor</a><br>Great Frigatebird, Greater Frigatebird [1013]                   |                       | Species or species   |

| Name   | Threatened  | Type of Presence   |
|--|-------------|--|
| <a href="#">Macronectes giganteus</a><br>Southern Giant-Petrel, Southern Giant Petrel [1060]         | Endangered  | habitat known to occur within area<br><br>Species or species habitat may occur within area |
| <a href="#">Macronectes halli</a><br>Northern Giant Petrel [1061]                                    | Vulnerable  | Species or species habitat may occur within area   |
| <a href="#">Phaethon rubricauda</a><br>Red-tailed Tropicbird [994]                                   |             | Breeding known to occur within area  |
| <a href="#">Sula dactylatra</a><br>Masked Booby [1021]   |             | Breeding known to occur within area  |
| <a href="#">Thalassarche eremita</a><br>Chatham Albatross [64457]                                    | Endangered  | Species or species habitat may occur within area   |
| <a href="#">Thalassarche impavida</a><br>Campbell Albatross, Campbell Black-browed Albatross [64459] | Vulnerable  | Species or species habitat may occur within area   |
| <a href="#">Thalassarche melanophris</a><br>Black-browed Albatross [66472]                           | Vulnerable  | Species or species habitat may occur within area   |
| <a href="#">Thalassarche salvini</a><br>Salvin's Albatross [64463]                                   | Vulnerable  | Foraging, feeding or related behaviour likely to occur within area                         |
| <a href="#">Thalassarche steadi</a><br>White-capped Albatross [64462]                                | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area                         |
| Migratory Marine Species   |             |  |
| <a href="#">Balaena glacialis australis</a><br>Southern Right Whale [75529]                          | Endangered* | Species or species habitat may occur within area   |
| <a href="#">Balaenoptera bonaerensis</a><br>Antarctic Minke Whale, Dark-shoulder Minke Whale [67812] |             | Species or species habitat likely to occur within area                                     |
| <a href="#">Balaenoptera borealis</a><br>Sei Whale [34]  | Vulnerable  | Species or species habitat may occur within area   |
| <a href="#">Balaenoptera edeni</a><br>Bryde's Whale [35]   |             | Species or species habitat may occur within area   |
| <a href="#">Balaenoptera musculus</a><br>Blue Whale [36]   | Endangered  | Species or species habitat may occur within area   |
| <a href="#">Balaenoptera physalus</a><br>Fin Whale [37]  | Vulnerable  | Species or species habitat may occur within area   |
| <a href="#">Carcharodon carcharias</a><br>White Shark, Great White Shark [64470]                     | Vulnerable  | Species or species habitat likely to occur within area                                     |
| <a href="#">Caretta caretta</a><br>Loggerhead Turtle [1763]  | Endangered  | Species or species habitat likely to occur within area                                     |
| <a href="#">Chelonia mydas</a><br>Green Turtle [1765]  | Vulnerable  | Species or species habitat likely to occur within area                                     |



| Name   | Threatened | Type of Presence                                       |
|--|------------|--|
| <a href="#">Dermochelys coriacea</a><br>Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Species or species habitat likely to occur within area |
| <a href="#">Eretmochelys imbricata</a><br>Hawksbill Turtle [1766]                        | Vulnerable | Species or species habitat likely to occur within area |
| <a href="#">Lamna nasus</a><br>Porbeagle, Mackerel Shark [83288]                         |            | Species or species habitat may occur within area       |
| <a href="#">Megaptera novaeangliae</a><br>Humpback Whale [38]                            | Vulnerable | Species or species habitat may occur within area       |
| <a href="#">Natator depressus</a><br>Flatback Turtle [59257]                             | Vulnerable | Species or species habitat likely to occur within area |
| <a href="#">Orcinus orca</a><br>Killer Whale, Orca [46]                                  |            | Species or species habitat may occur within area       |
| <a href="#">Physeter macrocephalus</a><br>Sperm Whale [59]                               |            | Species or species habitat may occur within area       |

| Migratory Wetlands Species  |                       |   |
|---|-----------------------|---|
| <a href="#">Actitis hypoleucos</a><br>Common Sandpiper [59309]                        |                       | Species or species habitat known to occur within area |
| <a href="#">Calidris acuminata</a><br>Sharp-tailed Sandpiper [874]                    |                       | Species or species habitat known to occur within area |
| <a href="#">Calidris canutus</a><br>Red Knot, Knot [855]                              | Endangered            | Species or species habitat may occur within area      |
| <a href="#">Calidris melanotos</a><br>Pectoral Sandpiper [858]                        |                       | Species or species habitat known to occur within area |
| <a href="#">Limosa lapponica</a><br>Bar-tailed Godwit [844]                           |                       | Species or species habitat known to occur within area |
| <a href="#">Numenius madagascariensis</a><br>Eastern Curlew, Far Eastern Curlew [847] | Critically Endangered | Species or species habitat known to occur within area |

### Other Matters Protected by the EPBC Act

| Commonwealth Heritage Places                                       |       | [ <a href="#">Resource Information</a> ] |
|--|-------|--|
| Name   | State | Status                                   |
| Historic   |       |  |
| <a href="#">HMS Sirius Shipwreck</a>                               | EXT   | Listed place                             |
| <a href="#">Kingston and Arthurs Vale Commonwealth Tenure Area</a> | EXT   | Listed place                             |

| Listed Marine Species  |            | [ <a href="#">Resource Information</a> ]              |
|--|------------|---|
| * Species is listed under a different scientific name on the EPBC Act - Threatened Species list. |            |   |
| Name   | Threatened | Type of Presence                                      |
| Birds  |            |   |
| <a href="#">Actitis hypoleucos</a><br>Common Sandpiper [59309]                                   |            | Species or species habitat known to occur within area |

| Name   | Threatened            | Type of Presence   |
|--|-----------------------|--|
| <a href="#">Anous stolidus</a><br>Common Noddy [825]   |                       | Breeding known to occur within area                                |
| <a href="#">Calidris acuminata</a><br>Sharp-tailed Sandpiper [874]                             |                       | Species or species habitat known to occur within area              |
| <a href="#">Calidris canutus</a><br>Red Knot, Knot [855]                                       | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Calidris melanotos</a><br>Pectoral Sandpiper [858]                                 |                       | Species or species habitat known to occur within area              |
| <a href="#">Diomedea antipodensis</a><br>Antipodean Albatross [64458]                          | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Diomedea epomophora</a><br>Southern Royal Albatross [89221]                        | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Diomedea exulans</a><br>Wandering Albatross [89223]                                | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Diomedea gibsoni</a><br>Gibson's Albatross [64466]                                 | Vulnerable*           | Species or species habitat may occur within area                   |
| <a href="#">Diomedea sanfordi</a><br>Northern Royal Albatross [64456]                          | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Fregata ariel</a><br>Lesser Frigatebird, Least Frigatebird [1012]                  |                       | Species or species habitat known to occur within area              |
| <a href="#">Fregata minor</a><br>Great Frigatebird, Greater Frigatebird [1013]                 |                       | Species or species habitat known to occur within area              |
| <a href="#">Limosa lapponica</a><br>Bar-tailed Godwit [844]                                    |                       | Species or species habitat known to occur within area              |
| <a href="#">Macronectes giganteus</a><br>Southern Giant-Petrel, Southern Giant Petrel [1060]   | Endangered            | Species or species habitat may occur within area                   |
| <a href="#">Macronectes halli</a><br>Northern Giant Petrel [1061]                              | Vulnerable            | Species or species habitat may occur within area                   |
| <a href="#">Numenius madagascariensis</a><br>Eastern Curlew, Far Eastern Curlew [847]          | Critically Endangered | Species or species habitat known to occur within area              |
| <a href="#">Phaethon rubricauda</a><br>Red-tailed Tropicbird [994]                             |                       | Breeding known to occur within area                                |
| <a href="#">Procelsterna cerulea</a><br>Grey Noddy, Grey Ternlet [64378]                       |                       | Breeding known to occur within area                                |
| <a href="#">Puffinus carneipes</a><br>Flesh-footed Shearwater, Fleshy-footed Shearwater [1043] |                       | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Puffinus pacificus</a><br>Wedge-tailed Shearwater [1027]                           |                       | Breeding known to occur within area                                |

| Name   | Threatened  | Type of Presence   |
|--|-------------|--|
| <a href="#">Sula dactylatra</a><br>Masked Booby [1021]   |             | Breeding known to occur within area                                |
| <a href="#">Thalassarche eremita</a><br>Chatham Albatross [64457]                                    | Endangered  | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche impavida</a><br>Campbell Albatross, Campbell Black-browed Albatross [64459] | Vulnerable  | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche melanophris</a><br>Black-browed Albatross [66472]                           | Vulnerable  | Species or species habitat may occur within area                   |
| <a href="#">Thalassarche salvini</a><br>Salvin's Albatross [64463]                                   | Vulnerable  | Foraging, feeding or related behaviour likely to occur within area |
| <a href="#">Thalassarche steadi</a><br>White-capped Albatross [64462]                                | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Fish   |             |  |
| <a href="#">Halicampus boothae</a><br>Booth's Pipefish [66218]                                       |             | Species or species habitat may occur within area                   |
| Reptiles   |             |  |
| <a href="#">Caretta caretta</a><br>Loggerhead Turtle [1763]  | Endangered  | Species or species habitat likely to occur within area             |
| <a href="#">Chelonia mydas</a><br>Green Turtle [1765]  | Vulnerable  | Species or species habitat likely to occur within area             |
| <a href="#">Dermochelys coriacea</a><br>Leatherback Turtle, Leathery Turtle, Luth [1768]             | Endangered  | Species or species habitat likely to occur within area             |
| <a href="#">Eretmochelys imbricata</a><br>Hawksbill Turtle [1766]                                    | Vulnerable  | Species or species habitat likely to occur within area             |
| <a href="#">Natator depressus</a><br>Flatback Turtle [59257]   | Vulnerable  | Species or species habitat likely to occur within area             |
| Whales and other Cetaceans   |             | [ <a href="#">Resource Information</a> ]                           |
| Name   | Status      | Type of Presence   |
| Mammals  |             |  |
| <a href="#">Balaenoptera acutorostrata</a><br>Minke Whale [33]                                       |             | Species or species habitat may occur within area                   |
| <a href="#">Balaenoptera bonaerensis</a><br>Antarctic Minke Whale, Dark-shoulder Minke Whale [67812] |             | Species or species habitat likely to occur within area             |
| <a href="#">Balaenoptera borealis</a><br>Sei Whale [34]  | Vulnerable  | Species or species habitat may occur within area                   |
| <a href="#">Balaenoptera edeni</a><br>Bryde's Whale [35]   |             | Species or species habitat may occur within area                   |
| <a href="#">Balaenoptera musculus</a><br>Blue Whale [36]   | Endangered  | Species or species habitat may occur within area                   |

| Name  | Status     | Type of Presence                                 |
|---|------------|--|
| <a href="#">Balaenoptera physalus</a><br>Fin Whale [37]   | Vulnerable | Species or species habitat may occur within area |
| <a href="#">Delphinus delphis</a><br>Common Dophin, Short-beaked Common Dolphin [60]                                  |            | Species or species habitat may occur within area |
| <a href="#">Eubalaena australis</a><br>Southern Right Whale [40]  | Endangered | Species or species habitat may occur within area |
| <a href="#">Feresa attenuata</a><br>Pygmy Killer Whale [61]   |            | Species or species habitat may occur within area |
| <a href="#">Globicephala macrorhynchus</a><br>Short-finned Pilot Whale [62]   |            | Species or species habitat may occur within area |
| <a href="#">Globicephala melas</a><br>Long-finned Pilot Whale [59282]   |            | Species or species habitat may occur within area |
| <a href="#">Grampus griseus</a><br>Risso's Dolphin, Grampus [64]  |            | Species or species habitat may occur within area |
| <a href="#">Kogia breviceps</a><br>Pygmy Sperm Whale [57]   |            | Species or species habitat may occur within area |
| <a href="#">Kogia simus</a><br>Dwarf Sperm Whale [58]   |            | Species or species habitat may occur within area |
| <a href="#">Lagenodelphis hosei</a><br>Fraser's Dolphin, Sarawak Dolphin [41]   |            | Species or species habitat may occur within area |
| <a href="#">Megaptera novaeangliae</a><br>Humpback Whale [38]   | Vulnerable | Species or species habitat may occur within area |
| <a href="#">Mesoplodon densirostris</a><br>Blainville's Beaked Whale, Dense-beaked Whale [74]                         |            | Species or species habitat may occur within area |
| <a href="#">Mesoplodon grayi</a><br>Gray's Beaked Whale, Scamperdown Whale [75]                                       |            | Species or species habitat may occur within area |
| <a href="#">Mesoplodon layardii</a><br>Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556] |            | Species or species habitat may occur within area |
| <a href="#">Orcinus orca</a><br>Killer Whale, Orca [46]   |            | Species or species habitat may occur within area |
| <a href="#">Peponocephala electra</a><br>Melon-headed Whale [47]  |            | Species or species habitat may occur within area |
| <a href="#">Physeter macrocephalus</a><br>Sperm Whale [59]  |            | Species or species habitat may occur within area |
| <a href="#">Stenella attenuata</a><br>Spotted Dolphin, Pantropical Spotted Dolphin [51]                               |            | Species or species habitat may occur within area |



| Name  | Status | Type of Presence                                 |
|---|--------|--|
| <a href="#">Stenella coeruleoalba</a><br>Striped Dolphin, Euphrosyne Dolphin [52]     |        | Species or species habitat may occur within area |
| <a href="#">Stenella longirostris</a><br>Long-snouted Spinner Dolphin [29]            |        | Species or species habitat may occur within area |
| <a href="#">Steno bredanensis</a><br>Rough-toothed Dolphin [30]                       |        | Species or species habitat may occur within area |
| <a href="#">Tursiops truncatus s. str.</a><br>Bottlenose Dolphin [68417]              |        | Species or species habitat may occur within area |
| <a href="#">Ziphius cavirostris</a><br>Cuvier's Beaked Whale, Goose-beaked Whale [56] |        | Species or species habitat may occur within area |

| Australian Marine Parks |                                      | [ Resource Information ] |
|-------------------------|--------------------------------------|--------------------------|
| Name                    | Label                                |                          |
| Norfolk                 | Special Purpose Zone (Norfolk) (IUCN |                          |

Extra Information

| Invasive Species  | [ Resource Information ] |
|---|--------------------------|
| Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001. |                          |

| Name   | Status | Type of Presence                                       |
|--|--------|--|
| Birds  |        |  |
| Anas platyrhynchos<br>Mallard [974]                            |        | Species or species habitat likely to occur within area |
| Callipepla californica<br>California Quail [59451]             |        | Species or species habitat likely to occur within area |
| Carduelis carduelis<br>European Goldfinch [403]                |        | Species or species habitat likely to occur within area |
| Carduelis chloris<br>European Greenfinch [404]                 |        | Species or species habitat likely to occur within area |
| Columba livia<br>Rock Pigeon, Rock Dove, Domestic Pigeon [803] |        | Species or species habitat likely to occur within area |
| Gallus gallus<br>Red Junglefowl, Domestic Fowl [917]           |        | Species or species habitat likely to occur within area |
| Passer domesticus<br>House Sparrow [405]                       |        | Species or species habitat likely to occur within area |

| Name  | Status | Type of Presence                                       |
|---|--------|--|
| Sturnus vulgaris<br>Common Starling [389]                   |        | Species or species habitat likely to occur within area |
| Turdus merula<br>Common Blackbird, Eurasian Blackbird [596] |        | Species or species habitat likely to occur within area |
| Turdus philomelos<br>Song Thrush [597]                      |        | Species or species habitat likely to occur within area |

| Mammals  |  |  |
|--|--|--|
| Felis catus<br>Cat, House Cat, Domestic Cat [19]   |  | Species or species habitat likely to occur within area |
| Mus musculus<br>House Mouse [120]                  |  | Species or species habitat likely to occur within area |
| Rattus exulans<br>Pacific Rat, Polynesian Rat [79] |  | Species or species habitat likely to occur within area |
| Rattus rattus<br>Black Rat, Ship Rat [84]          |  | Species or species habitat likely to occur within area |

| Plants   |  |  |
|--|--|--|
| Anredera cordifolia<br>Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]                              |  | Species or species habitat likely to occur within area |
| Asparagus plumosus<br>Climbing Asparagus-fern [48993]  |  | Species or species habitat likely to occur within area |
| Eichhornia crassipes<br>Water Hyacinth, Water Orchid, Nile Lily [13466]  |  | Species or species habitat likely to occur within area |
| Lantana camara<br>Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] |  | Species or species habitat likely to occur within area |
| Lycium ferocissimum<br>African Boxthorn, Boxthorn [19235]  |  | Species or species habitat likely to occur within area |
| Rubus fruticosus aggregate<br>Blackberry, European Blackberry [68406]  |  | Species or species habitat likely to occur within area |

| Reptiles  |  |  |
|---|--|--|
| Hemidactylus frenatus<br>Asian House Gecko [1708] |  | Species or species habitat likely to occur within area |

| Key Ecological Features (Marine)   | [ <a href="#">Resource Information</a> ] |
|--|--|
| Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area. |  |

| Name  | Region         |
|---|----------------|
| <a href="#">Norfolk Ridge</a>               | Temperate east |
| <a href="#">Tasman Front and eddy field</a> | Temperate east |

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Coordinates

-29.05523 167.959

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Office of Environment and Heritage, New South Wales](#)
- [Department of Environment and Primary Industries, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment, Water and Natural Resources, South Australia](#)
- [Department of Land and Resource Management, Northern Territory](#)
- [Department of Environmental and Heritage Protection, Queensland](#)
- [Department of Parks and Wildlife, Western Australia](#)
- [Environment and Planning Directorate, ACT](#)
- [Birdlife Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [South Australian Museum](#)
- [Queensland Museum](#)
- [Online Zoological Collections of Australian Museums](#)
- [Queensland Herbarium](#)
- [National Herbarium of NSW](#)
- [Royal Botanic Gardens and National Herbarium of Victoria](#)
- [Tasmanian Herbarium](#)
- [State Herbarium of South Australia](#)
- [Northern Territory Herbarium](#)
- [Western Australian Herbarium](#)
- [Australian National Herbarium, Canberra](#)
- [University of New England](#)
- [Ocean Biogeographic Information System](#)
- [Australian Government, Department of Defence](#)
- [Forestry Corporation, NSW](#)
- [Geoscience Australia](#)
- [CSIRO](#)
- [Australian Tropical Herbarium, Cairns](#)
- [eBird Australia](#)
- [Australian Government – Australian Antarctic Data Centre](#)
- [Museum and Art Gallery of the Northern Territory](#)
- [Australian Government National Environmental Science Program](#)
- [Australian Institute of Marine Science](#)
- [Reef Life Survey Australia](#)
- [American Museum of Natural History](#)
- [Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the [Contact Us](#) page.



# Appendix B

## 50% Design Stage Cost Estimates

## Kingston and Arthurs Vale Safety Hazard Investigations

## 50% Design Stage Cost Estimate

## Civil Hospital (Northern Gable, Retaining Wall and Lintels)

16-Nov-2018

| Item No.  | Description  | Unit     | Qty. | Unit Rate  | Amount            | Notes  |
|---|--|----------|------|------------|-------------------|--|
| <b>Detailed Design &amp; Documentation</b>      |  |          |      |            |                   |  |
|   | Detailed site investigation  | lump sum | 1    | \$ 16,000  | \$ 16,000         | Engineer and Heritage Specialist x 5 days  |
|   | Detailed design, drawings, specifications  | lump sum | 1    | \$ 30,000  | \$ 30,000         |  |
|   | Heritage review & approvals  | lump sum | 1    | \$ 10,000  | \$ 10,000         |  |
|   | Contract documentation   | lump sum | 1    | \$ 25,000  | \$ 25,000         |  |
|   | Expenses (travel, accommodation etc.)  | lump sum | 1    | \$ 3,500   | \$ 3,500          | Engineer and Heritage Specialist x 3 days  |
|   |  |          |      |            | \$ 84,500         |  |
| <b>Construction</b>                             |  |          |      |            |                   |  |
|   | <b>Early Works</b>   |          |      |            |                   |  |
|   | - Exclusion zones and signage to fall extent of northern gable   | lump sum | 1    | \$ 10,000  | \$ 10,000         |  |
|   | <b>Stabilising of the Northern Gable as per below scope:</b>   |          |      |            |                   |  |
|   | - Excavation of footings for gable support frame & investigations to base of Northern walls                                    |          |      |            |                   |  |
|   | - Construction of new timber bracing frame   |          |      |            |                   |  |
|   | - Repointing base of Northern wall   |          |      |            |                   |  |
|   | - Reinstatement of earth to Northern batter  |          |      |            |                   |  |
|   | Temporary stabilisation and protective works   | lump sum | 1    | \$ 30,000  | \$ 20,000         |  |
|   | Labour (general) to carefully excavate the base of the gable wall  | hr       | 48   | \$ 80      | \$ 3,840          | 3 men x 2 day x 8 hrs/day  |
|   | Labour (tradesman) to construct new timber bracing frame, assumed only behind the gable wall (to the south)                    | hr       | 96   | \$ 90      | \$ 8,640          | 3 men x 4 days x 8 hrs/day   |
|   | Labour (tradesman) to repoint base of Northern gable wall  | hr       | 32   | \$ 90      | \$ 2,880          | 2 men x 2 days x 8hrs/day  |
|   | Labour (general) to reinstate earth to Northern batter   | hr       | 16   | \$ 80      | \$ 1,280          | 2 men x 1 day x 8 hrs/day  |
|   | General small plant and equipment allowance  | lump sum | 1    | \$ 3,200   | \$ 3,200          |  |
|   | Materials (timber for bracing, mortar for repointing and soil for reinstatement of   | lump sum | 1    | \$ 10,000  | \$ 10,000         |  |
|   | <b>Inspection of Civil Hospital Retaining Walls as per below scope:</b>  |          |      |            |                   |  |
|   | - Inspection and opening up works if required to the existing drain through the wall   |          |      |            |                   |  |
|   | - Initiate biennial inspection of the wall with photographic records to be used for comparison purposes following inspections  |          |      |            |                   |  |
|   | Labour (tradesman) to inspect drain under the retaining wall and cleared out so that water can be removed from behind the wall | hr       | 32   | \$ 90      | \$ 2,880          | 2 men x 2 days x 8 hrs/day   |
|   | Initiate biennial inspection (only one inspection allowed as other inspections assumed to be under operation/maintenance cost) | lump sum | 1    | \$ 1,600   | \$ 1,600          | only one inspection allowed as others assumed to be under operation/maintenance cost |
|   | General small plant and equipment allowance  | lump sum | 1    | \$ 800     | \$ 800            |  |
|   | <b>Construction of Timber Lintels as per below scope:</b>  |          |      |            |                   |  |
|   | - Insertion of new timber lintels to openings with missing or rotten lintels   |          |      |            |                   |  |
|   | Labour (tradesman) to remove existing rotten lintel and replace with new   | hr       | 48   | \$ 90      | \$ 4,320          | allowed for 4 number lintels to be replaced and 3 days work x 2 men                  |
|   | General small plant and equipment allowance  | lump sum | 1    | \$ 1,200   | \$ 1,200          |  |
|   | Material (matching timber, miscellaneous minor materials)  | lump sum | 1    | \$ 3,000   | \$ 3,000          |  |
|   | <b>Supervision for above works</b>   |          |      |            |                   |  |
|   | Supervision  | hr       | 104  | \$ 100     | \$ 10,400         | supervision over 13 days   |
|   | Locality Allowance   | Rate     | 90%  |            | \$ 75,636         |  |
|   | Head Contractor Preliminaries and Profit   | Rate     | 20%  |            | \$ 31,935         |  |
|   |  |          |      |            | \$ 191,611        |  |
| <b>Archaeological Mitigations (Provisional)</b> |  |          |      |            |                   |  |
|   | Site supervision   | day      | 14   | \$ 800     | \$ 11,200         | allowed 2 days   |
|   | Expenses (travel, accommodation etc.)  | lump sum | 1    | \$ 1,500   | \$ 1,500          |  |
|   |  |          |      |            | \$ 12,700         |  |
| <b>Client Supervision &amp; Administration</b>  |  |          |      |            |                   |  |
|   | DIRDC Administration Costs (25%)   | Rate     | 25%  | \$ 288,811 | \$ 72,203         |  |
| <b>Contingency</b>                              |  |          |      |            |                   |  |
|   | Inherent Risk (Monte Carlo analysis)   | Rate     |      |            | \$ 79,585         |  |
|   | Contingent Risk (as per Risk Register)   | Rate     |      |            | \$ 33,517         |  |
|   |  |          |      |            |                   |  |
| <b>Total Cost (excl GST)</b>                    |  |          |      |            | <b>\$ 474,116</b> |  |

**Assumptions**

- Labour, plant and equipment will be mostly outsourced from either Brisbane or Sydney and assumes no out of hours work required. Location factor of 90% applied.
- New timber bracing frame, assumed only behind the gable wall (to the south)
- Biennial inspection - only one initial inspection allowed as other inspections assumed to be under operation/maintenance cost

**Exclusions**

- GST
- Escalation

**Information used**

- AECOM's Concept Design Report titled Kingston and Arthurs Vale Safety Hazard Investigations

## Kingston and Arthurs Vale Safety Hazard Investigations

## 50% Design Stage Cost Estimate

## Arthur Vale Retaining Wall

16-Nov-2018

| Item No.  | Description   | Unit     | Qty. | Unit Rate  | Amount            | Notes   |
|---|---|----------|------|------------|-------------------|---|
| <b>Detailed Design &amp; Documentation</b>      |   |          |      |            |                   |   |
|   | Detailed site investigation   | lump sum | 1    | \$ 6,400   | \$ 6,400          | Engineer and Heritage Specialist x 2 days   |
|   | Detailed design, drawings, specifications   | lump sum | 1    | \$ 15,000  | \$ 15,000         |   |
|   | Heritage review & approvals   | lump sum | 1    | \$ 5,000   | \$ 5,000          |   |
|   | Contract documentation  | lump sum | 1    | \$ 10,000  | \$ 10,000         |   |
|   | Expenses (travel, accommodation etc.)   | lump sum | 1    | \$ 3,000   | \$ 3,000          | Engineer and Heritage Specialist x 2 days   |
|   |   |          |      |            | \$ 39,400         |   |
| <b>Construction</b>                             |   |          |      |            |                   |   |
|   | <u>Early Works</u>  |          |      |            |                   |   |
|   | - Vehicle exclusion to rear of wall via signage and barriers  | lump sum | 1    | \$ 5,000   | \$ 5,000          |   |
|   | <u>Creation of bund to direct waterflows from the ridge to Watermill Creek via an alternative route</u>   |          |      |            |                   | Assume 40m length earth bund  |
|   | Labour (general) to create earth bund   | hr       | 96   | \$ 80      | \$ 7,680          | 3 men x 4 days x 8 hrs/day  |
|   | Plant and equipment allowance (including plant operator)  | lump sum | 1    | \$ 14,400  | \$ 14,400         | 3 no plant x 4 days x 8hrs/day  |
|   | Materials (soil for forming earth bund)   | lump sum | 1    | \$ 18,000  | \$ 18,000         | assumed 40m x 5m wide x 3m high<br>assumed that materials from swale excavation can be partly used for the bund   |
|   | <u>Agricultural drains behind retaining walls, work as per below scope:</u>   |          |      |            |                   |   |
|   | - Excavation for new swale and agricultural drain<br>- Construction of new swale and agricultural drain - Inspection and opening up works to three off existing drains through the wall<br>- Connection of new agricultural drain to existing drain points through the wall |          |      |            |                   | Assumed length of 90m   |
|   | Labour (general) to excavate and construct new swale and agricultural drain including connection to existing drain points   | hr       | 160  | \$ 80      | \$ 12,800         | 2 men x 10 days x 8 hrs/day   |
|   | Plant and equipment allowance (including plant operator)  | lump sum | 1    | \$ 32,000  | \$ 32,000         | 2 no plant x 10 days x 8hrs/day   |
|   | Materials (agricultural drain)  | m        | 90   | \$ 100     | \$ 9,000          |   |
|   | Disposal of excavated material  | lump sum | 1    | \$ 3,000   |                   | assumed excavated material can be used for forming bund. Cost allowance to transport the soil to location of bund |
|   | <u>Supervision for above works</u>  |          |      |            |                   |   |
|   | Supervision   | hr       | 112  | \$ 100     | \$ 11,200         | supervision over 14 days  |
|   | Locality Allowance  | Rate     | 90%  |            | \$ 99,072         |   |
|   | Head Contractor Preliminaries and Profit  | Rate     | 20%  |            | \$ 41,830         |   |
|   |   |          |      |            | \$ 250,982        |   |
| <b>Archaeological Mitigations (Provisional)</b> |   |          |      |            |                   |   |
|   | Site supervision  | day      | 5    | \$ 800     | \$ 4,000          | allowed 5 days  |
|   | Expenses (travel, accommodation etc.)   | lump sum | 1    | \$ 2,250   | \$ 2,250          |   |
|   |   |          |      |            | \$ 6,250          |   |
| <b>Client Supervision &amp; Administration</b>  |   |          |      |            |                   |   |
|   | DIRDC Administration Costs (25%)  | Rate     | 25%  | \$ 296,632 | \$ 74,158         |   |
| <b>Contingency</b>                              |   |          |      |            |                   |   |
|   | Inherent Risk (Monte Carlo analysis)  | Rate     |      |            | \$ 88,309         |   |
|   | Contingent Risk (as per Risk Register)  | Rate     |      |            | \$ 34,424         |   |
| <b>Total Cost (excl GST)</b>                    |   |          |      |            | <b>\$ 493,524</b> |   |

**Assumptions**

- Labour, plant and equipment will be mostly outsourced from either Brisbane or Sydney and assumes no out of hours work required. Location factor of 90% applied.
- Assumed that materials from swale excavation can be partly used for forming the earth bund
- Soil not contaminated

**Exclusions**

- Work to damaged portions of the retaining wall
- GST
- Escalation

**Information used**

- AECOM's Concept Design Report titled Kingston and Arthurs Vale Safety Hazard Investigations

## Kingston and Arthurs Vale Safety Hazard Investigations

## 50% Design Stage Cost Estimate

## Bounty Street Bridge Investigation and Preliminary Works

16-Nov-2018

| Item No.  | Description  | Unit     | Qty. | Unit Rate  | Amount              | Notes  |
|---|--|----------|------|------------|---------------------|--|
| <b>Detailed Design &amp; Documentation</b>            |  |          |      |            |                     |  |
|   | Survey   | lump sum | 1    | \$ 5,000   | \$ 5,000            |  |
|   | Detailed design, drawings, specifications  | lump sum | 1    | \$ 15,000  | \$ 15,000           |  |
|   | Heritage review & approvals  | lump sum | 1    | \$ 10,000  | \$ 10,000           |  |
|   | Contract documentation   | lump sum | 1    | \$ 10,000  | \$ 10,000           |  |
|   | Expenses (travel, accommodation etc.)  | lump sum | 1    | \$ 6,000   | \$ 6,000            |  |
|   | Watermill Dam Site Investigation   | lump sum | 1    | \$ 30,000  | \$ 30,000           |  |
|   |  |          |      |            | <b>\$ 76,000</b>    |  |
| <b>Preliminary Works</b>                              |  |          |      |            |                     |  |
|   | Install traffic control devices & signage to divert vehicles and limit bridge to pedestrian traffic only | lump sum | 1    | \$ 15,000  | \$ 15,000           |  |
| <b>Construction</b>                                   |  |          |      |            |                     |  |
|   | Site establishment   | lump sum | 1    | \$ 3,000   | \$ 3,000            |  |
|   | Implement Environmental Management Plan  | lump sum | 1    | \$ 5,000   | \$ 5,000            |  |
|   | Excavation of channel (as per profile)   |          |      |            |                     |  |
|   | 1 x 20 tonne excavator (wet hire)  | hr       | 20   | \$ 150     | \$ 3,000            |  |
|   | 2 x tandem trucks  | hr       | 40   | \$ 100     | \$ 4,000            |  |
|   | 1 x skid steer loader (wet hire)   | hr       | 20   | \$ 80      | \$ 1,600            |  |
|   | 1 x EBA Level 8 Supervisor   | hr       | 20   | \$ 46      | \$ 923              |  |
|   | Miscellaneous materials  | lump sum | 1    | \$ 5,000   | \$ 5,000            |  |
|   | Construction of coffer dam (inc. diversion pipe and pumping of water)                                    | lump sum | 1    | \$ 50,000  | \$ 50,000           | Assumes locally sourced labour, equipment and materials                        |
|   | Empty, desilt & repair dam (leaking under concrete spillway)   |          |      |            |                     |  |
|   | 1 x 20 tonne excavator (wet hire)  | hr       | 100  | \$ 150     | \$ 15,000           |  |
|   | 2 x tandem trucks  | hr       | 200  | \$ 100     | \$ 20,000           |  |
|   | 1 x skid steer loader (wet hire)   | hr       | 100  | \$ 80      | \$ 8,000            |  |
|   | 1 x EBA Level 8 Supervisor   | hr       | 100  | \$ 46      | \$ 4,615            |  |
|   | 2 x EBA level 4 Workers  | hr       | 200  | \$ 34      | \$ 6,730            |  |
|   | Supply & compact fill under spillway (ewks on lead)  | m3       | 75   | \$ 50      | \$ 3,750            |  |
|   | Supply & lay reinforced concrete spillway (incl SL82 mesh)   | m3       | 17   | \$ 1,000   | \$ 16,875           |  |
|   | Disposal costs   | m3       | 1590 | \$ 10      | \$ 15,900           |  |
|   | Reinstate vegetation (by seeding)  | m2       | 4000 | \$ 4       | \$ 16,000           |  |
|   | Maintenance watering   | week     | 10   | \$ 500     | \$ 5,000            |  |
|   | Locality Allowance   | Rate     | 90%  |            | \$ 165,954          | Allowance of 45% as labour, plant and equipment will be mostly sourced locally |
|   | Head Contractor Preliminaries and Profit   | Rate     | 20%  |            | \$ 70,069           |  |
|   |  |          |      |            | <b>\$ 435,416</b>   |  |
| <b>Detailed Investigation of Bounty Street Bridge</b> |  |          |      |            |                     |  |
|   | Survey   | lump sum | 1    | \$ 5,000   | \$ 5,000            |  |
|   | Geotechnical Investigation   | lump sum | 1    | \$ 10,000  | \$ 10,000           |  |
|   | Detailed site investigation  | lump sum | 1    | \$ 30,000  | \$ 30,000           |  |
|   | Detailed design, drawings, specifications  | lump sum | 1    | \$ 50,000  | \$ 50,000           |  |
|   | Heritage review & approvals  | lump sum | 1    | \$ 15,000  | \$ 15,000           |  |
|   | Contract documentation   | lump sum | 1    | \$ 10,000  | \$ 10,000           |  |
|   | Expenses (travel, accommodation etc.)  | lump sum | 1    | \$ 10,000  | \$ 10,000           |  |
|   |  |          |      |            | <b>\$ 130,000</b>   |  |
| <b>Archaeological Mitigations (Provisional)</b>       |  |          |      |            |                     |  |
|   | Site supervision   | day      | 15   | \$ 800     | \$ 12,000           |  |
|   | Expenses (travel, accommodation etc.)  | lump sum | 2    | \$ 3,000   | \$ 6,000            |  |
|   |  |          |      |            | <b>\$ 18,000</b>    |  |
| <b>Client Supervision &amp; Administration</b>        |  |          |      |            |                     |  |
|   | DIRDC Administration Costs (25%)   | Rate     | 25%  | \$ 659,416 | \$ 164,854          |  |
| <b>Contingency</b>                                    |  |          |      |            |                     |  |
|   | Inherent Risk (Monte Carlo analysis)   | Rate     |      |            | \$ 142,628          |  |
|   | Contingent Risk (as per Risk Register)   | Rate     |      |            | \$ 76,525           |  |
| <b>Total Cost (excl GST)</b>                          |  |          |      |            | <b>\$ 1,043,424</b> |  |

**Assumptions**

- Labour, plant and equipment will be mostly sourced locally and assumes no out of hours work required. . Location factor of 45% applied.
- Soil not contaminated

**Exclusions**

- GST
- Escalation

**Information used**

- AECOM's Concept Design Report titled Kingston and Arthurs Vale Safety Hazard Investigations



## Kingston and Arthurs Vale Safety Hazard Investigations

## 50% Design Stage Cost Estimate

## Longridge Barracks Archers

16-Nov-2018

| Item No.  | Description  | Unit     | Qty. | Unit Rate  | Amount            | Notes                                     |
|---|--|----------|------|------------|-------------------|---|
| <b>Detailed Design &amp; Documentation</b>      |  |          |      |            |                   |   |
|   | Detailed site investigation  | lump sum | 1    | \$ 6,400   | \$ 6,400          | Engineer and Heritage Specialist x 2 days |
|   | Detailed design, drawings, specifications  | lump sum | 1    | \$ 20,000  | \$ 20,000         |   |
|   | Heritage review & approvals  | lump sum | 1    | \$ 10,000  | \$ 10,000         |   |
|   | Contract documentation   | lump sum | 1    | \$ 15,000  | \$ 15,000         |   |
|   | Expenses (travel, accommodation etc.)  | lump sum | 1    | \$ 3,000   | \$ 3,000          | Engineer and Heritage Specialist x 2 days |
|   |  |          |      |            | <b>\$ 54,400</b>  |   |
| <b>Construction</b>                             |  |          |      |            |                   |   |
|   | Early Works  |          |      |            |                   |   |
|   | - Exclusion zones and signage to fall extent of arches   | lump sum | 1    | \$ 10,000  | \$ 10,000         |   |
|   | <b>Initial Phase as per below scope:</b>   |          |      |            |                   |   |
|   | - Temporary bracing to both sides of the wall  |          |      |            |                   |   |
|   | - Installation of vertical propping  |          |      |            |                   |   |
|   | - Underpinning with reinforced concrete bored pier including installation of pile cap          |          |      |            |                   |   |
|   | - Reintate surroundings with suitable fill   |          |      |            |                   |   |
|   | Temporary bracing to both sides to the full extent of the wall                                 | lump sum | 1    | \$ 60,000  | \$ 60,000         |   |
|   | Vertical propping to the full extent of the wall   | lump sum | 1    | \$ 30,000  | \$ 30,000         |   |
|   | Labour (general) to carefully excavate the base of the arches and reinstate with suitable fill | hr       | 240  | \$ 80      | \$ 19,200         | 3 men x 10 day x 8 hrs/day                |
|   | General plant and equipment allowance  | lump sum | 1    | \$ 16,800  | \$ 16,800         |   |
|   | <b>Second Phase as per below scope:</b>  |          |      |            |                   |   |
|   | - Excavation of footings for support structure   |          |      |            |                   |   |
|   | - Construction and install new timber support structure  |          |      |            |                   |   |
|   | - Reinstatement with suitable fill   |          |      |            |                   |   |
|   | Labour (general) to carefully excavate the base for the footing of the support structure       | hr       | 72   | \$ 80      | \$ 5,760          | 3 men x 3 day x 8 hrs/day                 |
|   | Labour (tradesman) to construct new timber bracing frame, assumed only behind the arches       | hr       | 120  | \$ 90      | \$ 10,800         | 3 men x 5 days x 8 hrs/day                |
|   | Labour (general) to reinstate with suitable fill   | hr       | 16   | \$ 80      | \$ 1,280          | 2 men x 1 day x 8 hrs/day                 |
|   | General small plant and equipment allowance  | lump sum | 1    | \$ 2,000   | \$ 2,000          |   |
|   | Materials (timber for bracing and suitable fill for backfilling)                               | lump sum | 1    | \$ 10,000  | \$ 10,000         |   |
|   | <b>Supervision for above works</b>   |          |      |            |                   |   |
|   | Supervision  | hr       | 120  | \$ 100     | \$ 12,000         | supervision over 15 days                  |
|   | Locality Allowance   | Rate     | 90%  |            | \$ 160,056        |   |
|   | Head Contractor Preliminaries and Profit   | Rate     | 20%  |            | \$ 67,579         |   |
|   |  |          |      |            | <b>\$ 405,475</b> |   |
| <b>Archaeological Mitigations (Provisional)</b> |  |          |      |            |                   |   |
|   | Site supervision   | day      | 10   | \$ 800     | \$ 8,000          | allowed 10 days                           |
|   | Expenses (travel, accommodation etc.)  | lump sum | 1    | \$ 1,500   | \$ 1,500          |   |
|   |  |          |      |            | <b>\$ 9,500</b>   |   |
| <b>Client Supervision &amp; Administration</b>  |  |          |      |            |                   |   |
|   | DIRDC Administration Costs (25%)   | Rate     | 25%  | \$ 469,375 | \$ 117,344        |   |
| <b>Contingency</b>                              |  |          |      |            |                   |   |
|   | Inherent Risk (Monte Carlo analysis)   | Rate     |      |            | \$ 140,327        |   |
|   | Contingent Risk (as per Risk Register)   | Rate     |      |            | \$ 54,471         |   |
| <b>Total Cost (excl GST)</b>                    |  |          |      |            | <b>\$ 781,517</b> |   |

**Assumptions**

- Labour, plant and equipment will be mostly outsourced from either Brisbane or Sydney and assumes no out of hours work required. Location factor of 90% applied.
- New timber bracing frame, assumed only to behind the arches
- Biennial inspection - only one initial inspection allowed as other inspections assumed to be under operation/maintenance cost

**Exclusions**

- GST
- Escalation

**Information used**

- AECOM's Concept Design Report titled Kingston and Arthurs Vale Safety Hazard Investigations

## Kingston and Arthurs Vale Safety Hazard Investigations

## 50% Design Stage Cost Estimate

## Royal Engineers Office Portico

16-Nov-2018

| Item No.  | Description   | Unit     | Qty. | Unit Rate  | Amount            | Notes  |
|---|---|----------|------|------------|-------------------|--|
| <b>Heritage / archaeological supervision of southern column investigation works to determine condition of stone column</b>                |   |          |      |            |                   |  |
|   | Site supervision  | day      | 1    | \$ 800     | \$ 800            |  |
|   | Expenses (travel, accommodation etc.)   | lump sum | 1    | \$ 1,250   | \$ 1,250          | For 1 person x 1 day   |
|   |   |          |      |            | <b>\$ 2,050</b>   |  |
| <b>Detailed Design &amp; Documentation</b>  |   |          |      |            |                   |  |
|   | Detailed design, drawings, specifications   | lump sum | 1    | \$ 4,000   | \$ 4,000          |  |
|   | Heritage review & approvals   | lump sum | 1    | \$ 2,000   | \$ 2,000          |  |
|   | Contract documentation  | lump sum | 1    | \$ 2,500   | \$ 2,500          |  |
|   | Expenses (travel, accommodation etc.)   | lump sum | 1    | \$ 1,250   | \$ 1,250          | For 1 person x 1 day   |
|   | Investigation and testing for Asbestos  | lump sum | 1    | \$ 10,000  | \$ 10,000         |  |
|   |   |          |      |            | <b>\$ 19,750</b>  |  |
| <b>Construction</b>   |   |          |      |            |                   |  |
| <b>Early Works</b>  |   |          |      |            |                   |  |
|   | - Erect temporary barriers or kerbs to prevent vehicle impact   | lump sum | 1    | \$ 5,000   | \$ 5,000          |  |
| <b>Dismantling of existing portico</b>  |   |          |      |            |                   |  |
|   | Propping of portico roof  | lump sum | 1    | \$ 1,500   | \$ 1,500          |  |
|   | Labour (tradesman) to carefully dismantle existing columns, column capital and column bases and store for reuse                   | hr       | 32   | \$ 90      | \$ 2,880          | 2 men x 2 days x 8 hrs/day   |
|   | General small plant and equipment allowance   | lump sum | 1    | \$ 800     | \$ 800            |  |
|   | Asbestos removal allowance  | lump sum | 1    | \$ 50,000  | \$ 50,000         |  |
| <b>Reconstruction using existing materials / segments</b>   |   |          |      |            |                   |  |
|   | Labour (tradesman) to reconstruct portico structure using existing dismantled materials, including patching up adjoining surfaces | hr       | 64   | \$ 90      | \$ 5,760          | 2 men x 4 days x 8 hrs/day   |
|   | General small plant and equipment allowance   | lump sum | 1    | \$ 1,600   | \$ 1,600          |  |
|   | Allowance for miscellaneous materials to match existing in case certain segments are damaged in the process of removal            | lump sum | 1    | \$ 2,000   | \$ 2,000          | Assumed most of the existing materials will be in good condition and reused for construction |
|   | Assumed existing portico slab to remain, only allowance is for making good  | lump sum | 1    | \$ 500     | \$ 500            |  |
|   | Allowance to remove and dispose potential asbestos within roof structure  | lump sum | 1    | \$ 2,000   | \$ 2,000          |  |
| <b>Installation of stainless steel tie backs from the front of the portico to the rear lintels to prevent rotation of the front gable</b> |   |          |      |            |                   |  |
|   | Labour (tradesman) to install steel tie backs   | hr       | 16   | \$ 90      | \$ 1,440          | 2 men x 1 day x 8hrs/day   |
|   | General small plant and equipment allowance   | lump sum | 1    | \$ 400     | \$ 400            |  |
|   | Material  | lump sum | 1    | \$ 500     | \$ 500            |  |
| <b>Supervision for above works</b>  |   |          |      |            |                   |  |
|   | Supervision   | hr       | 56   | \$ 100     | \$ 5,600          | supervision over 7 days  |
|   | Locality Allowance  | Rate     | 90%  |            | \$ 71,982         |  |
|   | Head Contractor Preliminaries and Profit  | Rate     | 20%  |            | \$ 30,392         |  |
|   |   |          |      |            | <b>\$ 177,354</b> |  |
| <b>Archaeological Mitigations (Provisional)</b>   |   |          |      |            |                   |  |
|   | Site supervision  | day      | 4    | \$ 800     | \$ 3,200          | allowed 4 days   |
|   | Expenses (travel, accommodation etc.)   | lump sum | 1    | \$ 2,000   | \$ 2,000          |  |
|   |   |          |      |            | <b>\$ 5,200</b>   |  |
| <b>Client Supervision &amp; Administration</b>  |   |          |      |            |                   |  |
|   | DIRDC Administration Costs (25%)  | Rate     | 25%  | \$ 204,354 | \$ 51,089         |  |
| <b>Contingency</b>  |   |          |      |            |                   |  |
|   | Inherent Risk (Monte Carlo analysis)  | Rate     |      |            | \$ 69,214         |  |
|   | Contingent Risk (as per Risk Register)  | Rate     |      |            | \$ 23,715         |  |
| <b>Total Cost (excl GST)</b>  |   |          |      |            | <b>\$ 348,372</b> |  |

**Assumptions**

- Labour, plant and equipment will be mostly outsourced from either Brisbane or Sydney and assumes no out of hours work required. Location factor of 90% applied.
- Reconstruct portico structure using existing dismantled materials
- Assumed existing portico slab to remain, only allowance is for making good
- Assumed asbestos present within portico roof structure, allowance made to remove

**Exclusions**

- GST
- Escalation

**Information used**

- AECOM's Concept Design Report titled Kingston and Arthurs Vale Safety Hazard Investigations

# Appendix C

## Risk Register

| Risk Register |                                   |                 |  |   |   |                         |               |                               |                    | Risk Assessment     |              |                               | Assessed Risk Level |
|---------------|-----------------------------------|-----------------|--|---|---|-------------------------|---------------|-------------------------------|--------------------|---------------------|--------------|-------------------------------|---------------------|
|               | Category                          |                 | Risk Description   |   | Risk Treatment Strategies (RTS)   | Risk Action Assigned To | Date          |                               | COMMENTS           | Likelihood          |              | Selected Consequence override |                     |
|               |                                   |                 |  |   |   |                         |               |                               |                    | Selected Likelihood | Likelihood % |                               |                     |
|               |                                   |                 |  |   |   |                         |               |                               | Comments and Notes |                     |              |                               |                     |
| No.           | Category                          | Discipline      | Risk Description   | Consequence   | Risk Treatment Strategies (RTS)   | Risk Action Assigned To | Date          | Risk Status                   | Comments           | Selected Likelihood | Likelihood % | Consequence                   | Assessed Risk Level |
| 1             | 5.Programme / Approvals           | All             | <b>Approvals - Departmental and Government</b><br>- Poor quality products (Design reports, Business Case) result in approvals for capital expenditure being delayed          | Delay in achieving approval to expend capital funds resulting in additional escalation.                           | Documentation to be provided with sufficient time for DIRDC reviews and endorsement by sponsor and other agencies.  | Design Team and DIRDC   |               | Throughout development phase  |                    | Possible            | 50%          | Minor                         | M                   |
| 2             | 4.Works / Design / Engineering    | All             | <b>Scope Definition</b><br>- Insufficient definition or understanding of scope   | Delay in development of design resulting in additional escalation   | Confirm requirement. DSC to engage with users as part of design process   | Contractor/Design Team  |               | Throughout design             |                    | Likely              | 80%          | Minor                         | M                   |
| 3             | 1.Client / Commercial / Financial | All             | <b>Commercial and Financial</b><br>Limited construction market resulting in a change in costs<br>Inclusion of local participation requirements increases costs               | Cost overruns   | Appoint a DSC with competent Cost Planner.DIRDC to do independent checks (using existing data). Monitor construction market in lead up to appointment of contractor/sub contractors | DIRDC                   |               | Throughout development phase  |                    | Possible            | 50%          | Minor                         | M                   |
| 4             | 6.Construction                    | Environmental   | <b>Hazardous Materials Removal</b><br>Discovery of asbestos, heavy metals or other contaminants resulting in increased costs not covered by the contract (Latent conditions) | Cost for removal, treatment and/or storage of material  | Conduct site surveys and testing during design. Review existing documentation including contamination surveys.  | DIRDC                   |               | Throughout construction       |                    | Likely              | 80%          | Major                         | H                   |
| 5             | 5.Programme / Approvals           | Environmental   | <b>Approvals - Environment</b><br>Discovery of listed species results in extended process for environment and heritage approval  | Delay in development of design resulting in additional escalation and costs associated with compensatory planting | Conduct site surveys during design. Review existing documentation including existing EIR.   | Contractor/Design Team  | Up to 5% MPFR | Open                          |                    | Rare                | 10%          | Insignificant                 | L                   |
| 6             | 5.Programme / Approvals           | Environmental   | <b>Approvals - Heritage</b><br>Known and possible heritage issues including Indigenous and European heritage result in the need for additional studies                       | Delay in development of design resulting in additional escalation   | Conduct site surveys during design. Review existing documentation including existing EIR. Self Refer under EPBC-Act   | Contractor/Design Team  |               | Throughout design phase       |                    | Likely              | 80%          | Moderate                      | M                   |
| 7             | 6.Construction                    | All             | <b>Construction Delay</b><br>Local requirements and remote site constraints may delay works  | Delay in construction resulting in additional escalation  | Engagement with local community to identify critical periods  | DIRDC                   |               | Throughout construction       |                    | Possible            | 50%          | Minor                         | M                   |
| 8             | 6.Construction                    | Environmental   | <b>Construction Delay - Heritage Find</b><br>Discovery of a heritage item during construction  | Delay in construction resulting in additional escalation  | Heritage advisor on site  | DIRDC                   |               | Throughout construction       |                    | Possible            | 50%          | Insignificant                 | L                   |
| 9             | 6.Construction                    | Environmental   | <b>Weather</b><br>Extreme weather events delay works and incurring damage with resulting repairs   | Delay and additional construction cost  | Programing earthworks construction outside of the peak storm season   | Contractor              |               | Throughout construction       |                    | Possible            | 50%          | Moderate                      | M                   |
| 10            | 9.Other                           | Hydraulic       | <b>Reliance on Other Projects</b><br>Interdependencies between projects and constrained availability of resources causes delay.  | Delay and additional construction cost  | Liaise with NI Council to coordinate projects   | DIRDC                   |               | Up to commencing design       |                    | Possible            | 50%          | Minor                         | M                   |
| 11            | 5.Programme / Approvals           | Project Manager | <b>Council Approvals</b><br>NI Council delays heritage and building approvals  | Delay and additional construction costs   | Liaise with NI Council to maintain a good relationship  | DIRDC                   |               | Up to commencing construction |                    | Possible            | 50%          | Moderate                      | M                   |



# Appendix D

## Concept Sketches





**AECOM**

CONSULTANT  
AECOM Australia Pty Ltd  
A.B.N 20 093 846 925  
www.aecom.com

PROJECT  
**Territories Asset Management  
Advisory Services**  
KAVHA SAFETY HAZARD INVESTIGATION

SCALES  
0 50 100  
1:2000 m

PROJECT NUMBER  
60576687  
SHEET TITLE  
LOCATION PLAN

SKETCH NUMBER  
SK-60576687-001





**AECOM**

CONSULTANT  
AECOM Australia Pty Ltd  
A.B.N 20 093 846 925  
www.aecom.com

PROJECT  
Territories Asset Management  
Advisory Services  
KAVHA SAFETY HAZARD INVESTIGATION

SCALES  
0 50 100  
1:2000 m

PROJECT NUMBER  
60576687  
SHEET TITLE  
EXISTING UTILITIES

SKETCH NUMBER  
SK-60576687-002





**AECOM**

CONSULTANT

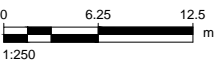
AECOM Australia Pty Ltd  
A.B.N 20 093 846 925  
www.aecom.com

PROJECT

Territories Asset Management  
Advisory Services

KAVHA SAFETY HAZARD INVESTIGATION

SCALES



PROJECT NUMBER

60576687

SHEET TITLE

BOUNTY STREET BRIDGE

SKETCH NUMBER

SK-60576687-003

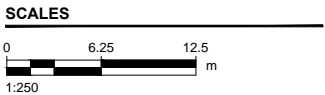




**AECOM**

CONSULTANT  
AECOM Australia Pty Ltd  
A.B.N 20 093 846 925  
www.aecom.com

PROJECT  
**Territories Asset Management  
Advisory Services**  
KAVHA SAFETY HAZARD INVESTIGATION



PROJECT NUMBER  
60576687

SHEET TITLE  
CIVIL HOSPITAL AND  
ARTHUR'S VALE RETAINING WALL

SKETCH NUMBER  
SK-60576687-004

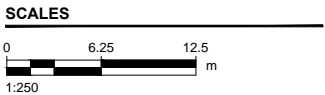




**AECOM**

CONSULTANT  
AECOM Australia Pty Ltd  
A.B.N 20 093 846 925  
www.aecom.com

PROJECT  
Territories Asset Management  
Advisory Services  
KAVHA SAFETY HAZARD INVESTIGATION



PROJECT NUMBER  
60576687  
SHEET TITLE  
WATERMILL CREEK  
SKETCH NUMBER  
SK-60576687-005

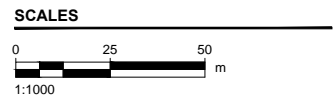




**AECOM**

CONSULTANT  
AECOM Australia Pty Ltd  
A.B.N 20 093 846 925  
www.aecom.com

PROJECT  
Territories Asset Management  
Advisory Services  
KAVHA SAFETY HAZARD INVESTIGATION

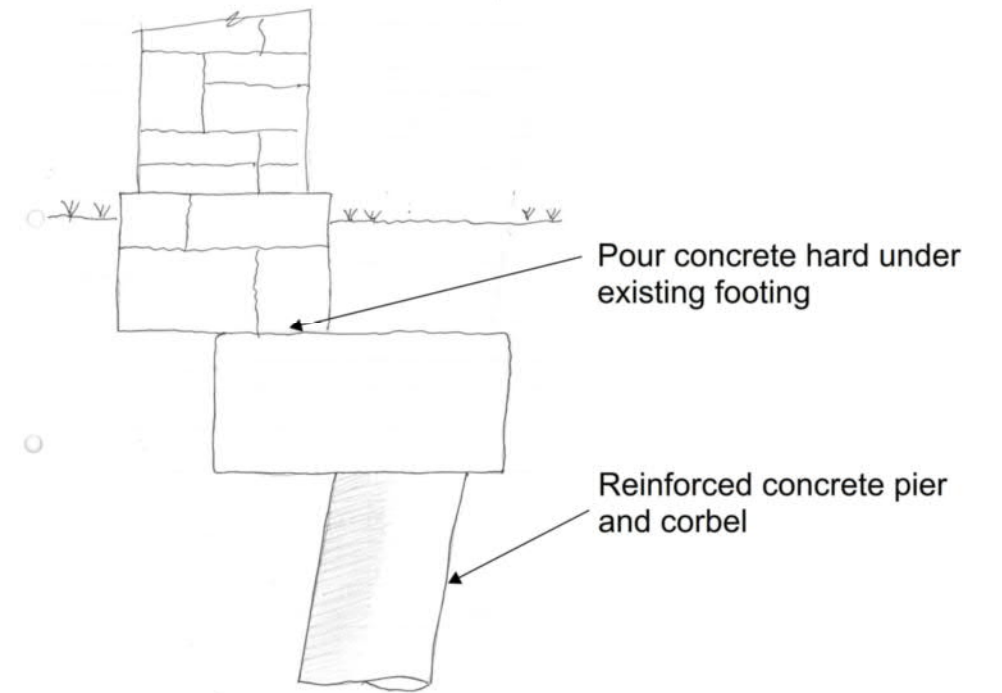


PROJECT NUMBER  
60576687  
SHEET TITLE  
WATERMILL CREEK WORK  
SKETCH NUMBER  
SK-60576687-006

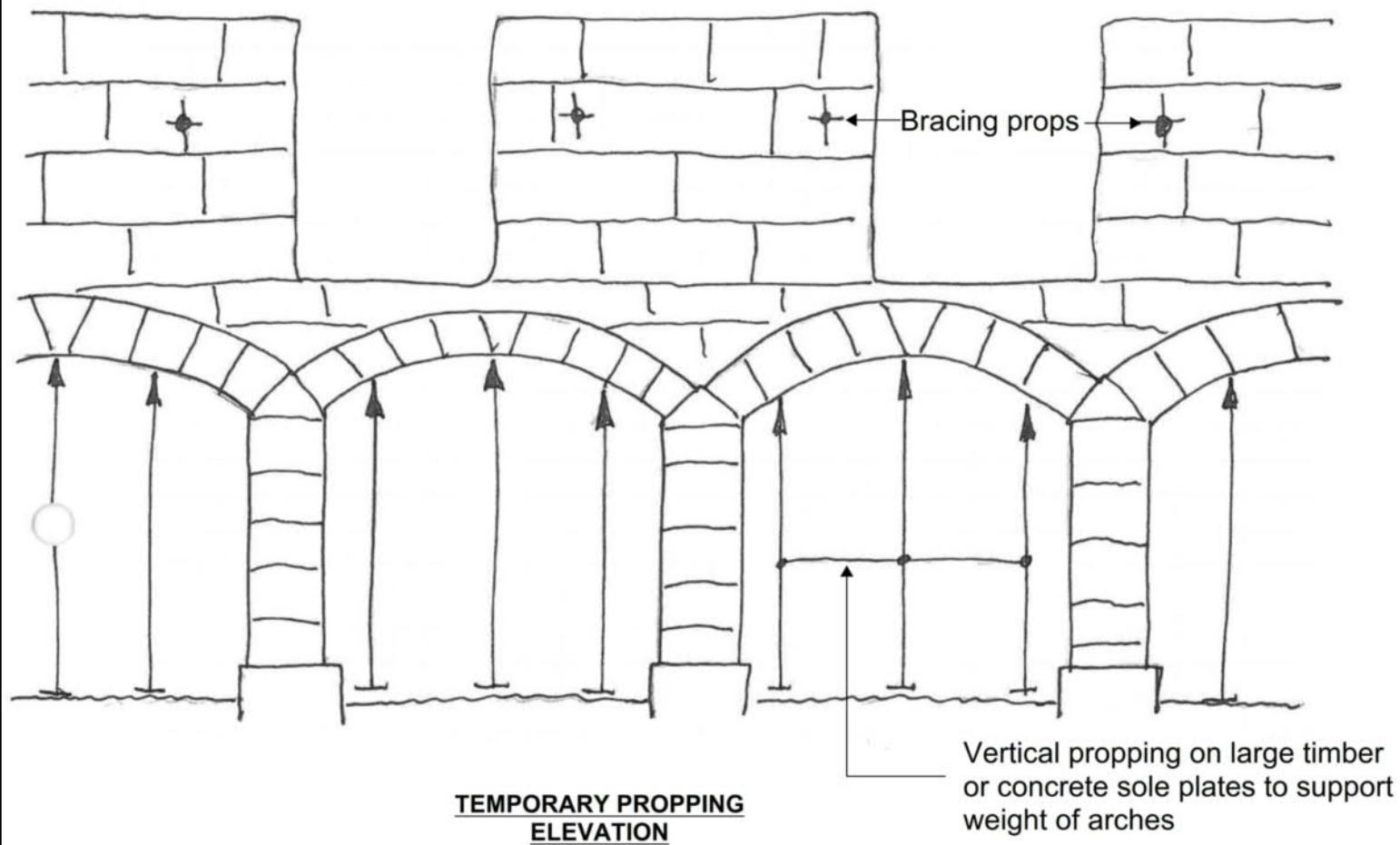




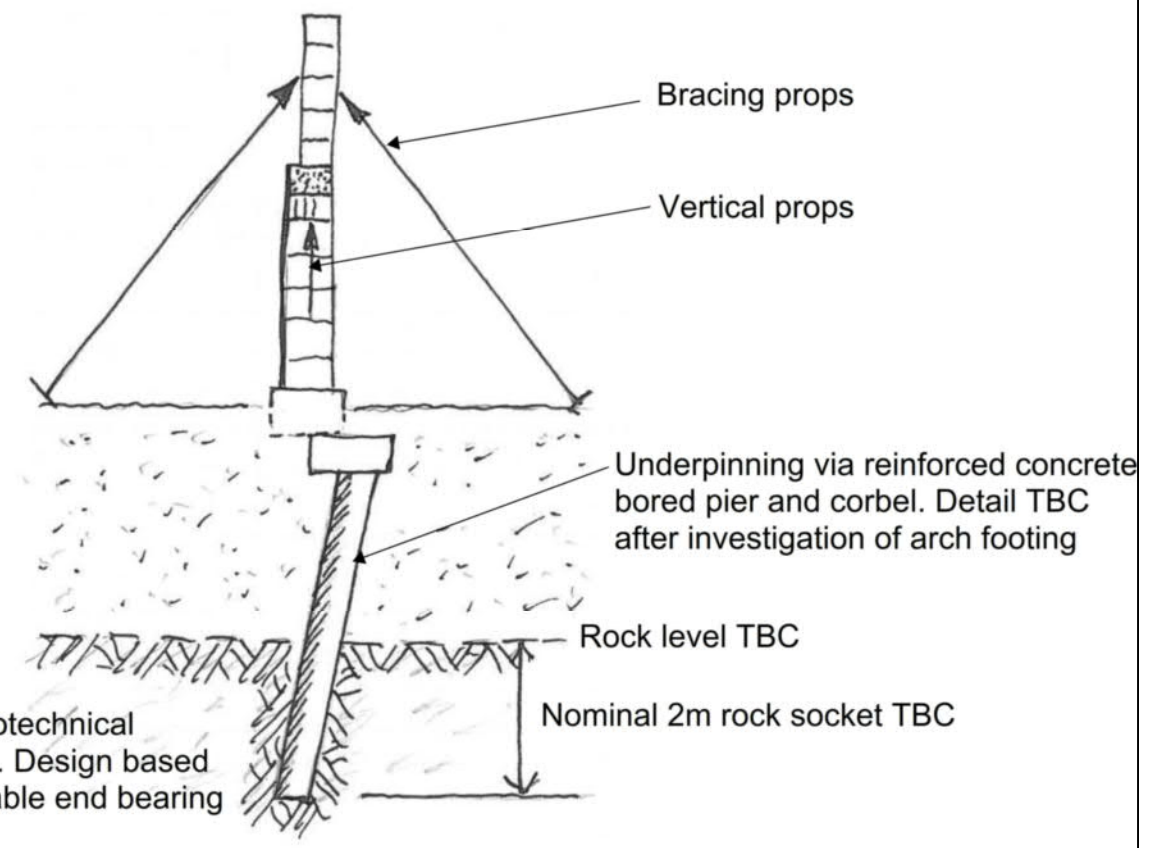
**LONGRIDGE ARCHES**



**UNDERPINNING DETAIL**



**TEMPORARY PROPPING  
ELEVATION**



**UNDERPINNING SECTION**

**AECOM**

CONSULTANT

AECOM Australia Pty Ltd  
A.B.N 20 093 846 925  
www.aecom.com

PROJECT

Territories Asset Management  
Advisory Services

KAVHA SAFETY HAZARD INVESTIGATION

PROJECT NUMBER

60576687

SHEET TITLE

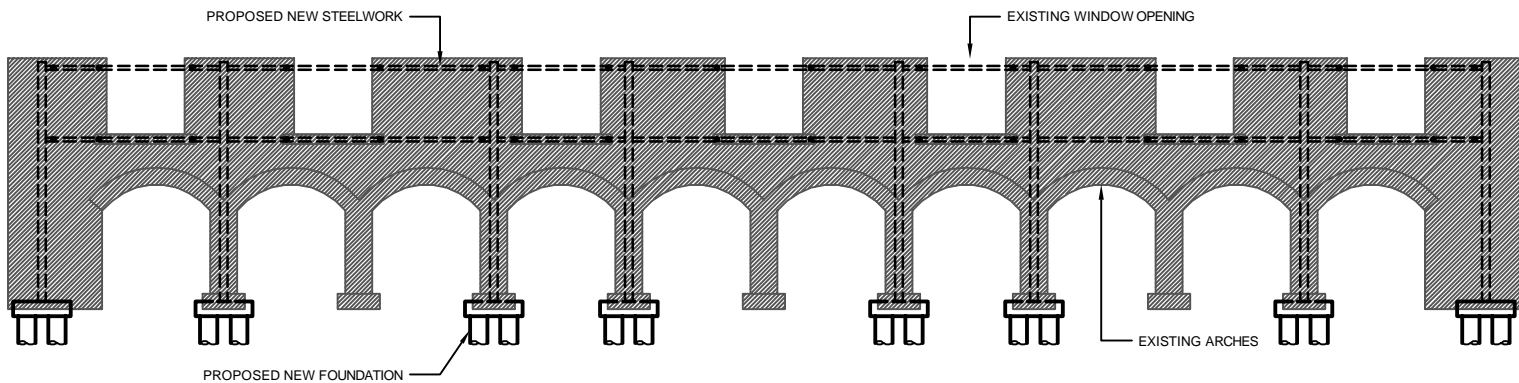
LONGRIDGE ARCHES  
UNDERPINNING

SKETCH NUMBER

SK-60576687-050



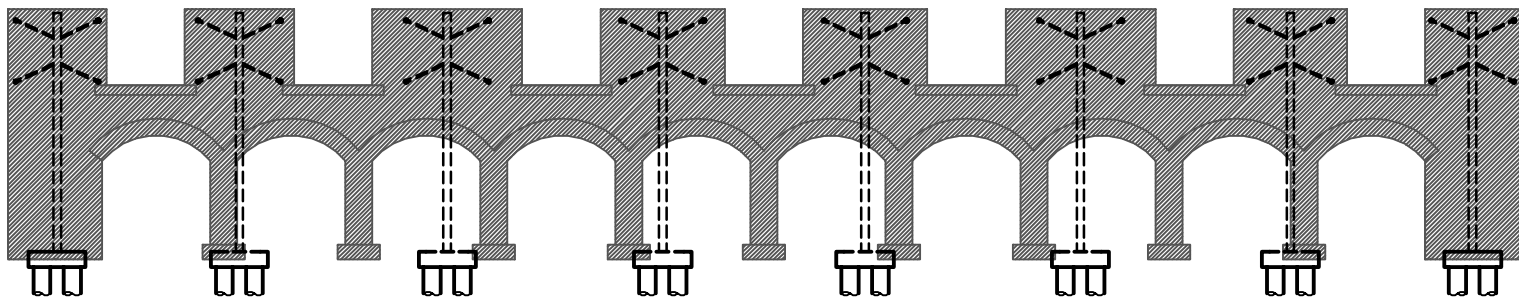
PHOTO OF PORT ARTHUR PENITENTIARY



SOUTHERN ELEVATION - OPTION 1

OPTION 1 FEATURES:

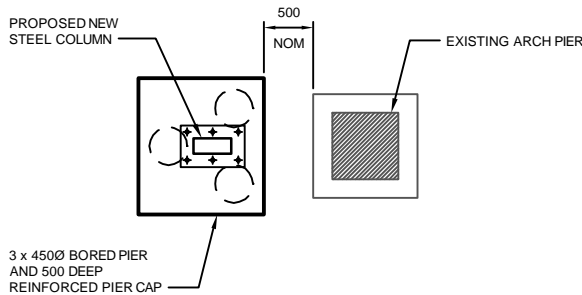
- NEW STEEL COLUMNS CENTRAL TO EXISTING ARCH PILLARS
- NEW HORIZONTAL STEEL BEAMS EXPOSED AT WINDOW LOCATIONS
- NEW STEEL COLUMNS SET BACK FROM EXISTING WALL AND FOUNDED ON NEW BORED PIERS & PIER CAP



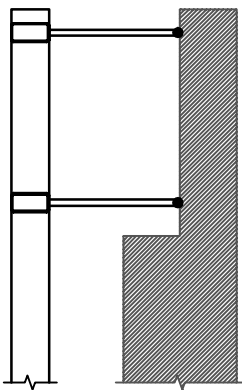
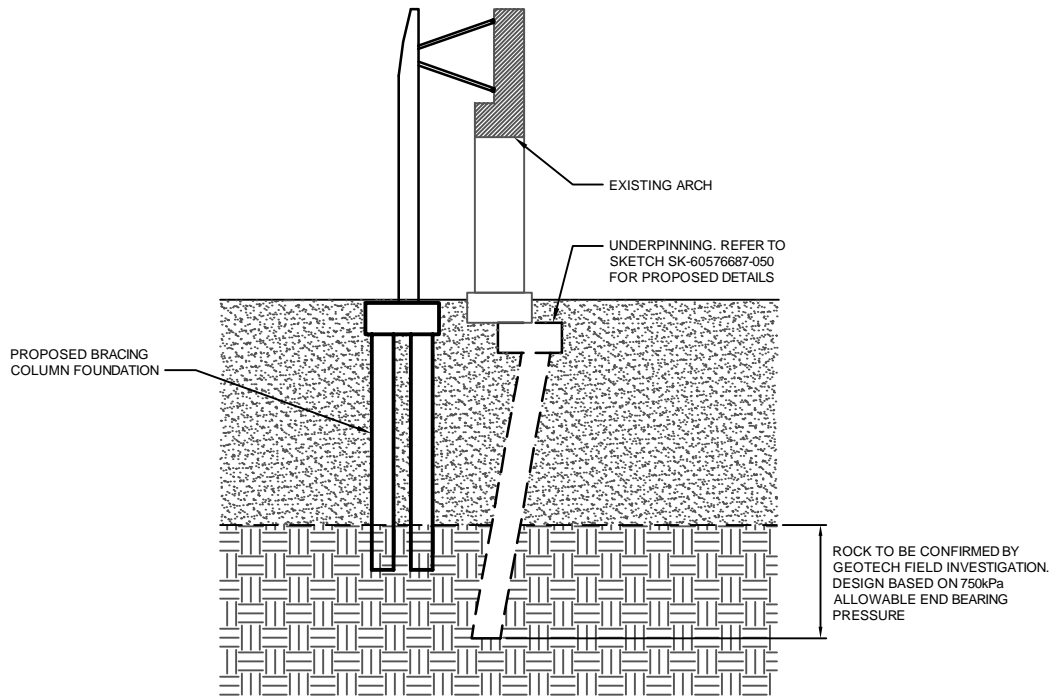
SOUTHERN ELEVATION - OPTION 2

OPTION 2 FEATURES:

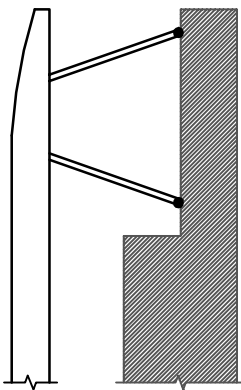
- NEW STEEL COLUMNS CENTRAL BETWEEN EXISTING WINDOW OPENINGS
- NEW STEEL COLUMNS NOT CENTRAL TO EXISTING ARCHES
- STEEL COLUMNS SET BACK FROM EXISTING WALL AND FOUNDED ON NEW BORED PIERS & PIER CAP



PROPOSED FOUNDATION PLAN



OPTION 1 SECTION

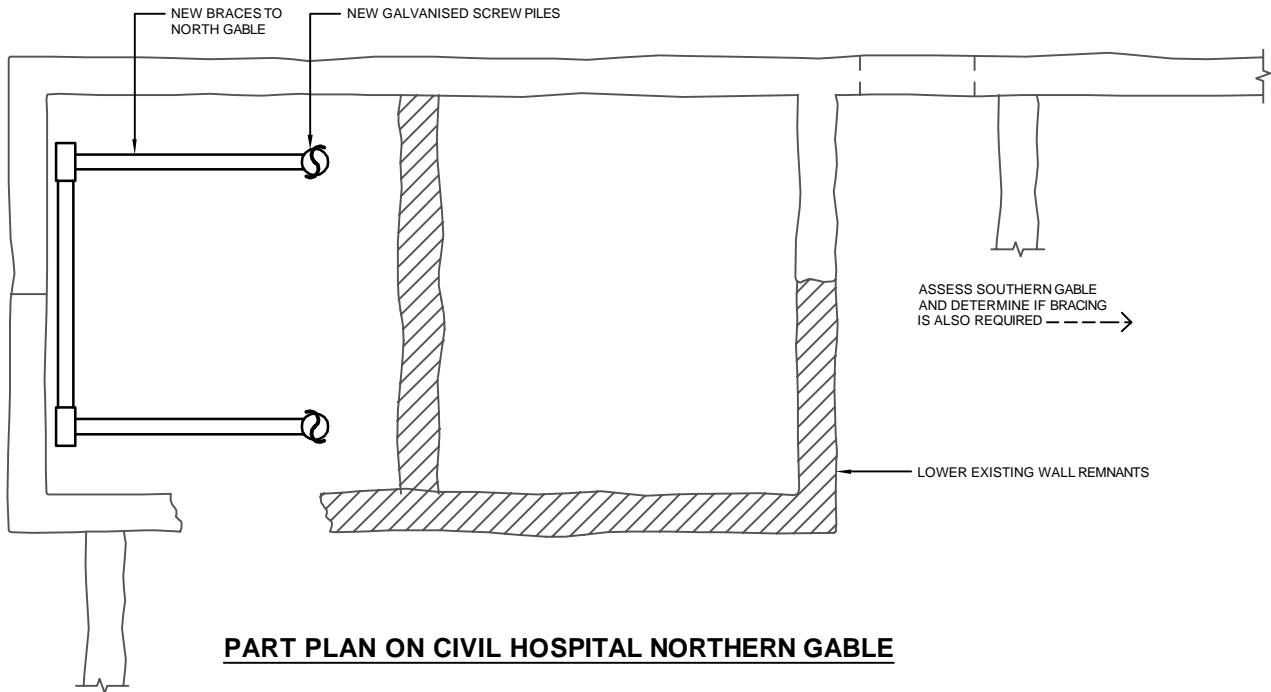


OPTION 2 SECTION

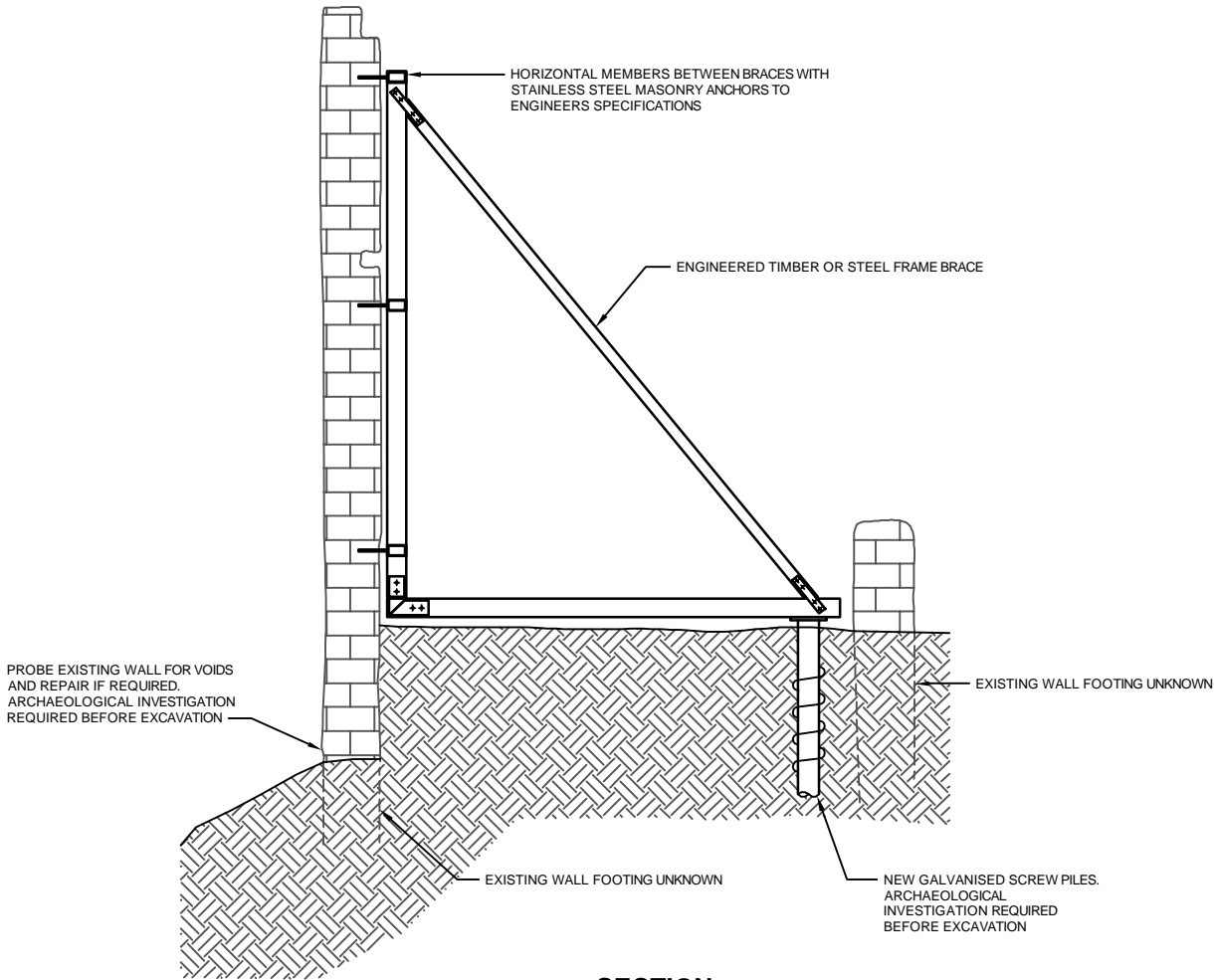




PHOTO OF PROPOSED GABLE BRACING



PART PLAN ON CIVIL HOSPITAL NORTHERN GABLE



SECTION