Transport for NSW

McKanes Bridge over Coxs River

Conservation Management Plan

ENDORSED
CONSERVATION MANAGEMENT PLAN
Heritage Council of New South Wales
Date endorsed 29/04/2021
OEH/HC File DOC21/254545

Transport for NSW

McKanes Bridge over Coxs River

Conservation Management Plan

Prepared by Transport for New South Wales

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Executive summary

Description of Item

McKanes Bridge over the Cox's River is a McDonald type timber truss bridge which has been assessed as being of State significance and is listed on the State Heritage Register (SHR 01473 McKanes Falls Bridge). Located approximately 10 km south of Bowenfels on McKanes Falls Road, which is a lightly trafficked rural road, the bridge is in a pleasant rural setting. It was constructed by the Department of Public Works in 1893 and is under the care and control of Transport for New South Wales (NSW).

McKanes bridge is located on a road which is still of importance to the local and regional community. It is used by the school bus, for access to local properties, as a convenient short-cut from the Great Western Highway to the Jenolan Caves Road, as a detour route when required, as well as being of substantial importance as a tourist and recreation route. The reserve next to the bridge continues to be used for various recreational purposes such as fishing.

The bridge, which has been in use for 125 years, demonstrates the historical theme of transport, although the current load limit detracts somewhat from that theme. The bridge also demonstrates the historical theme of technology, being clearly distinguishable as a McDonald truss bridge.

Statement of Significance

McKanes Bridge is of State significance as the longest span McDonald truss surviving in New South Wales. It is rare and representative as the only remaining example of a 90' McDonald truss and as one of only four remaining examples of McDonald truss bridges of approximately 90 built.

The excellence in design of the McDonald truss is historically significant as the second of five stages of timber truss road bridge design in New South Wales, showing the growing knowledge of timber as a structural material, and also the increasing vehicle weights requiring stronger bridges. It is historically significant through its association with the expansion of the State road network, and the contribution of that road system to settlement, development and economic activity.

As a McDonald truss, McKanes Bridge has strong associations with John Alexander McDonald, a very capable engineering and the designer of this truss type. McDonald contributed to a great variety of engineering works both in New South Wales, throughout Australia and overseas.

The historical context for the original design and construction of McKanes Bridge was plentiful New South Wales hardwoods, particularly that large and long old growth timbers were readily available and vast numbers of bridges were being built, but budgets were tight and skilled workmen were few. The New South Wales hardwood timbers used were second to none in Australia, and indeed compared favourably, both for strength and durability, with any timbers in the world. The design is an example of innovative and practical engineering in a time when large and long old growth timbers were readily available and vast numbers of bridges were being built with a tight budget.

McKanes Bridge fits neatly into the rural landscape, being aesthetically pleasing in scale, proportion and materials used. The timber trusses and original masonry abutments contribute substantially to the aesthetic significance of the bridge, while the central concrete pier (a later addition) detracts somewhat from the aesthetic significance. The bridge largely performs the function for which it was originally designed, which was to carry traffic, although the road is currently load limited.

Conservation Policies

Policy 1	Retention of the cultural significance of this bridge a) Cultural significance of this bridge will be protected or enhanced b) Conservation will be in accordance with the principles of the *Burra Charter* c) All relevant staff will be advised and jointly responsible for conservation d) Conservation will be done in collaboration with relevant experts
Policy 2	Adoption, implementation and review of the CMP a) Transport for NSW will adopt this CMP b) Transport for NSW will resource implementation of this CMP c) Transport for NSW will train relevant staff in the use of this CMP d) Transport for NSW will make this CMP available to the public e) Transport for NSW will review this CMP every five years
Policy 3	Use of the bridge a) Transport for NSW will continue to engage with communities about their needs b) This bridge will continue to be used for vehicular traffic c) This bridge will not be used for anything that may cause damage to the bridge d) Transport for NSW will consider arranging for the removal of any existing utilities
Policy 4	Maintenance and repair a) Appropriate ongoing repair and maintenance will be carried out b) Transport for NSW will prepare an Incident Response Plan for this bridge c) This bridge will be maintained to support both functionality and form d) This bridge will be regularly inspected by specialists for structural integrity e) Termites will be inspected for twice a year and treated as necessary f) Any support structures used for repairs will be removed when no longer needed
Policy 5	New work a) Elements will be conserved in accordance with their level of significance b) New works and adaptations may be required to ensure continued operability c) Excellence in design and quality in construction will be provided d) Approvals will be undertaken in accordance with relevant processes
Policy 6	Interpretation a) Cultural significance of this bridge will be effectively communicated b) Interpretation of this bridge will be based on this CMP c) Interpretation will conform to relevant guidelines
Policy 7	Protection and enhancement of visual setting a) Development in the vicinity is to be managed not to have an unacceptable visual impact b) Signage in the vicinity should be kept to a minimum c) Vegetation in the vicinity of the bridge should be kept to a minimum d) Relevant planning and statutory controls must be adhered to for any work in the vicinity

Policy 8	Archival recording a) Records will be managed to ensure permanent retention as State records b) Photographic archival recording will be completed before, during and after any works c) A complete archival recording with 3D mapping will be undertaken of this bridge d) Full documentation will be kept for all methods and materials used during any works e) Representative samples will be retained as a moveable heritage collection
Policy 9	Archaeology a) Relevant Aboriginal stakeholders will be consulted about any proposed impact b) Relevant guidelines and legislation will be adhered to regarding archaeological potential c) Relevant guidelines will be adhered to regarding unexpected finds
Policy 10	Exemptions and Approvals a) Routine maintenance works are identified in Appendix A, Table 1 b) Works requiring further approvals are identified in Appendix A, Table 2
Policy 11	Top chords a) Will be reconstructed to their original design details b) Will be preserved following reconstruction c) Will be replaced before deterioration affects safety or serviceability
Policy 12	Bottom chords and butting blocks a) Will be reconstructed to as original as possible and strengthened with external steel plates b) Will be preserved following reconstruction and strengthening c) Will be replaced before deterioration affects safety or serviceability
Policy 13	Principals and diagonals props a) Will be reconstructed to their original design details b) Will be preserved following reconstruction c) Will be replaced before deterioration affects safety or serviceability
Policy 14	Diagonals a) Will be reconstructed to their original design details b) Will be preserved following reconstruction c) Will be replaced before deterioration affects safety or serviceability
Policy 15	Tension rods a) Will be reconstructed to their original design dimensions and detailing
Policy 16	Cast iron shoes a) Will be reconstructed to their original design dimensions and detailing
Policy 17	Sway braces a) Will be replaced with new strengthened sway braces at original locations only
Policy 18	Truss span cross girders a) Secondary cross girders will be reconstructed to their original design details b) Primary cross girders will be replaced in steel to reflect the form and function of the originals

Policy 19	Decking a) Will be replaced with new decking to reflect the fabric, function and aesthetic of the original b) Will be maintained to ensure safety of vehicles
Policy 20	Railings a) Will be replaced with a new visually recessive but complying traffic barrier
Policy 21	Abutments a) Masonry will be preserved and scour protection provided b) If cleaning is required, a gentle method will be used c) If repair to stone is required, the new stone will match the old as nearly as possible d) If repair to mortar is required, lime mortar similar to the original will be used e) Where stones are temporarily removed, they will be reinstated to their original locations
Policy 22	Piers a) The concrete pier will be painted dark grey with an anti-graffiti coating applied

Contents

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Appendices

1. Introduction

1.1 Purpose and scope

The purpose of this conservation management plan (CMP) is to guide the conservation and management of McKanes Bridge with a continuing role and use in the life of the local community. This CMP has been informed by, and is consistent with, the Overarching CMP (OCMP), which provides a methodology to address the collective conservation and management of the overall population.[1]

Transport for NSW is responsible for the operation and maintenance of this timber truss bridge. When planning for maintenance and ongoing use, the heritage significance both of this particular bridge and its contribution to the overall population of timber truss bridges must be considered. This CMP identifies the significance of the bridge and provides conservation policies and strategies to ensure its ongoing use.

The CMP:

- Understands the heritage item through investigation of the history of the bridge in its setting, its associations, its aesthetic and technical attributes, its importance to the community, its rarity and representativeness as well as its research potential.
- Provides a statement of significance by analysing documentary and physical evidence.
- Examines constraints and opportunities for conservation, including the requirements of Transport for NSW to maintain the operability and ongoing use of the bridge.
- Develops conservation policies, arising out of the assessment of significance, to ensure the retention of the heritage significance and develops strategies to manage the significance.

1.2 Background

In 2010, Roads and Maritime prepared *Timber Truss Road Bridges – A Strategic Approach to Conservation* (the Strategy). The Strategy detailed a methodology for assessing the conservation suitability and approach to managing the (then) 48 remaining timber truss bridges managed by Roads and Maritime listed on the Roads and Maritime's Section 170 Heritage and Conservation Register (S170). A large proportion of the bridges were also listed on the State Heritage Register (SHR) and some on Local Environment Plans (LEPs). The final version of the Strategy was endorsed by the NSW Heritage Council in August 2012.

After some years of implementation of the Strategy, the list of bridges to be retained under the Strategy was reviewed due to lessons learned with respect to the original design intent of the bridges, the achievable capacity of the strengthened bridges and changing community needs. The updated list was endorsed by the NSW Heritage Council in June 2019.

The Strategy requires Transport for NSW to develop conservation planning documentation to set out how individual bridges are to be managed and how the overall heritage values of the retained population will be conserved. Roads and Maritime prepared an Overarching CMP for NSW timber truss road bridges which was endorsed by the NSW Heritage Council in February 2018. The OCMP sets out the overall policy framework so that a consistent approach can be applied to all bridges to be retained. Transport for NSW has committed to the development of a bridge specific CMP for each of the timber truss bridges it manages and intends to retain under the Strategy, which includes this CMP for McKanes Bridge.

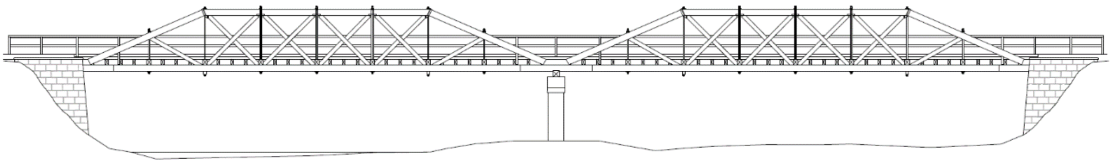
[1] Roads and Maritime, *NSW Timber Truss Road Bridges Overarching Conservation Management Plan*, February 2018, endorsed by the Heritage Council of NSW on 20 February 2018.

1.3 Overview of McKanes Bridge

McKanes Bridge over the Cox's River is a McDonald type timber truss bridge which has been assessed as being of State significance, and is listed on the State Heritage Register (SHR). Located approximately 10 km south of Bowenfels on a lightly trafficked rural road, McKanes Bridge is in a pleasant rural setting. The bridge was constructed by the Department of Public Works in 1893 and is under the care and control of Transport for NSW.

The bridge is approximately 55 m long and 5.5 m wide carrying a single lane of traffic, consisting of two 90' (27.432 m) McDonald type truss spans. The spans are supported on original masonry abutments and a central concrete pier constructed in 1987.

Figure 1-1: Diagram showing general arrangement of McKanes Bridge.



(source: author)

Figure 1-2: Photograph of McKanes Bridge in its setting from below.

(source: author 2013)

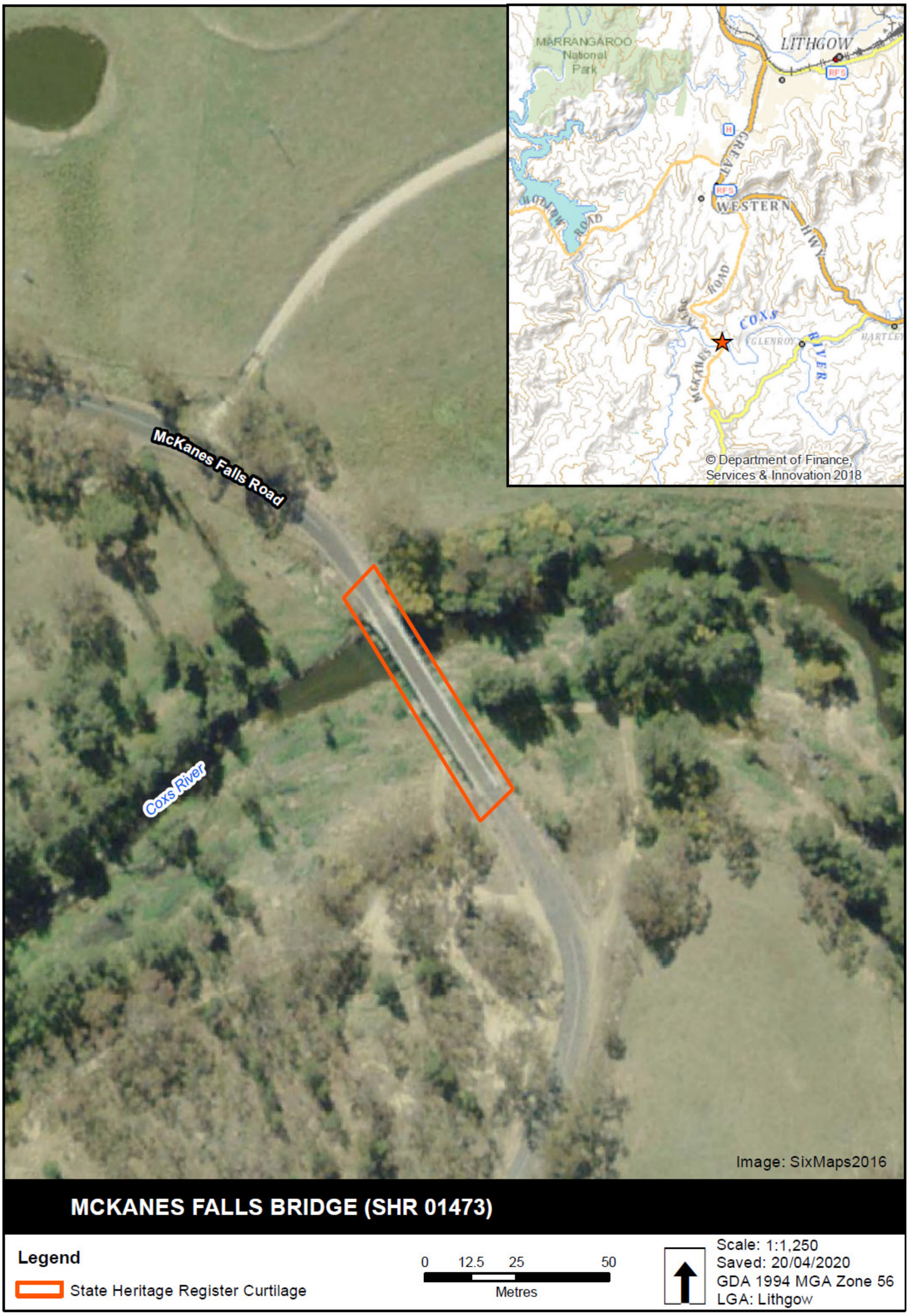
Figure 1-3: Photograph of McKanes Bridge in its setting from above.

(source: author 2013)

1.3.1 Location and site identification

For the purpose of this CMP the place consists of the bridge with its curtilage and a visual setting and context which surrounds and includes the historical crossing.

Figure 1-4: Map showing location and curtilage of McKanes Bridge.



Source: Heritage NSW

1.3.2 Visual setting and context

As noted in the Strategy, McKanes Bridge forms a component of an important heritage landscape including Mt Victoria, Hartley Vale and Bowenfels.[2] The bridge is located on a rural road between Lithgow and Oberon and is situated in steep, hilly country which is primarily used for grazing.[3] Some of the more prominent and important views of the bridge are below.

Figure 1-5: Aerial View of Bridge with locations from which views are seen.

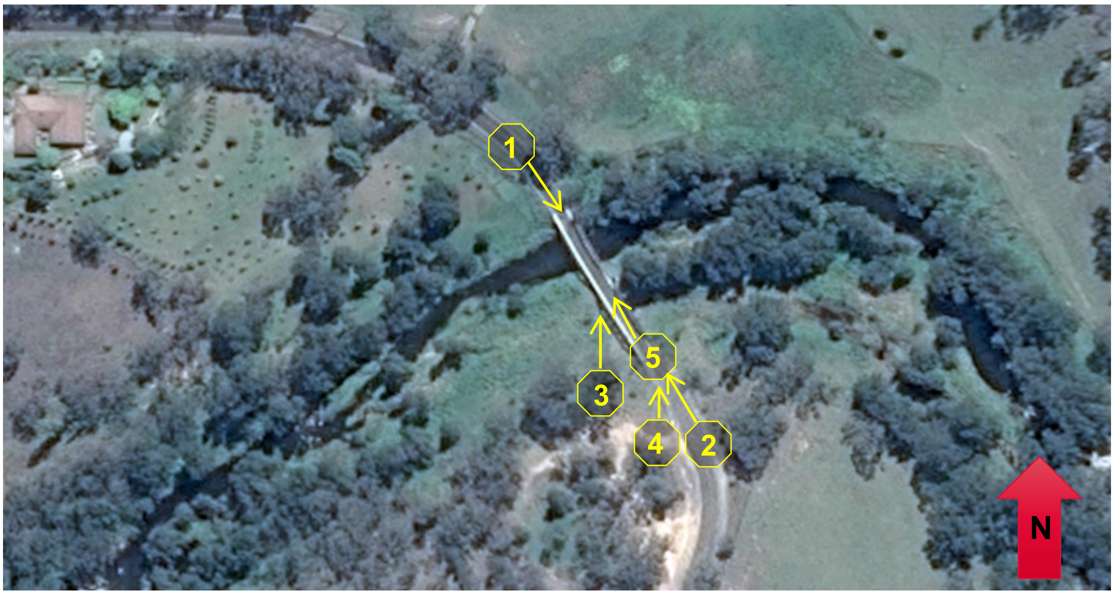


Figure 1-6: View 1 approaching the bridge from the north.

(source: author 2013)

[2] Roads and Traffic Authority (now Roads and Maritime Services), *Timber truss road bridges – A strategic approach to conservation*, July 2011, RTA/Pub.11.267, ISBN 978-1-921899-49-2, appendix 1B, p 3.
[3] Hughes Trueman Reinhold, McDonald Truss Road Bridges in NSW, Heritage Significance Study, p 66.

Figure 1-7: View 2 approaching the bridge from the south

(source: author 2017)

Figure 1-8: View 3 from southwestern side of the bridge.

(source: author 2013)

Figure 1-9: View 4 showing Engineers Australia plaque at southern end.

(source: author 2013)

Figure 1-10: View 5 crossing the bridge from the southern end heading north.

(source: author 2013)

1.3.3 The curtilage

The heritage curtilage is defined as the area of land surrounding an item of heritage significance which is essential for retaining and interpreting its heritage significance. A curtilage is used to establish the boundaries of a zone worthy of special protection, and should contain all elements contributing to the heritage significance, conservation and interpretation of a heritage item. [4]

The heritage curtilage for bridges listed on the SHR managed by Roads and Maritime is generally set as a horizontal buffer of five metres from the outward side and termination of the bridge deck. The curtilage also extends in space above and below deck level. McKanes Bridge is listed on the SHR, and has a slightly enlarged curtilage as indicated in Figure 1.10 on the following page.

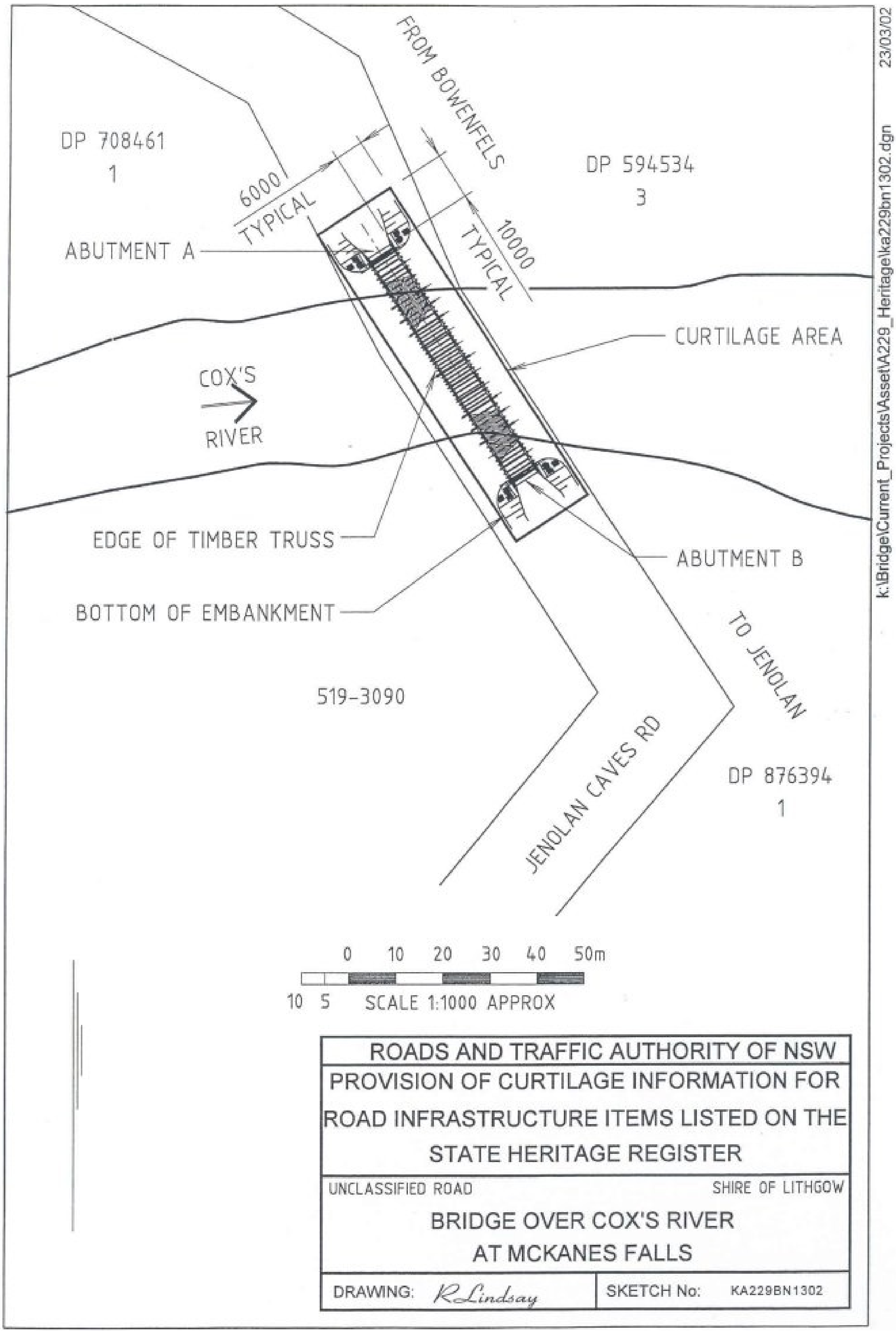
The heritage curtilage for McKanes Bridge is therefore a horizontal buffer extending ten metres back from the termination of the bridge deck at each end of the bridge and six metres from the edge of the bridge on either side. The curtilage also extends in space above and below deck level. This is contiguous with the SHR listing boundary and this curtilage remains suitable.

1.3.4 Statutory Listings

State Heritage Register name and number	McKanes Falls Bridge SHR 01473
Roads and Maritime s170 number	4300003
Local Environmental Plan (LEP) listing number	McKanes Bridge is listed as a heritage item in the 2014 Lithgow LEP (item A077) and it is also located in a conservation area (Heritage Map – Sheet HER_003B) in the 2014 LEP
Alternate / locally used names	McKanes Bridge over Coxs River
Roads and Maritime Bridge number	1302
Road name	McKanes Falls Road
Coordinates [centre point] – latitude / longitude	Lat: -33.5495127485 Long: 150.1243908350
Local Government Area	Lithgow Council
Roads and Maritime region	Western Region
Descriptive location	Approximately 10km south of Bowenfels

[4] Heritage Office, Dept. Urban Affairs and Planning, *Heritage Curtilages*, Harley & Jones, 1996, pp 1-5.

Figure 1-11: Curtilage Plan.



(source: SHR Listing)

1.4 Methodology and structure

The OCMP provides a methodology to address collective management, so that a representative population of New South Wales timber truss road bridges is conserved and managed into the future, continuing to have a role and use in the life of communities. The methodology and structure of this bridge specific CMP is guided by the OCMP. The primary purpose of a CMP is to establish policies which will guide the future care and development of a place.[5] This CMP has been prepared according to the methodology recommended in *Assessing Heritage Significance*, and is consistent with the guidelines set out in the Australia ICOMOS Burra Charter, 2013 *(Burra Charter)* and in the Conservation Plan.[6]

Cultural significance is defined in the *Burra Charter* as aesthetic, historic, scientific, social or spiritual value for past, present or future generations.[7] In order to conserve significance, it is necessary to understand why the bridge is significant. Identifying the heritage significance of an item relies on understanding and analysing documentary and physical evidence.

A site inspection was undertaken on Wednesday 8th February 2017 to examine the current condition and integrity of the bridge. Historical research was undertaken making use of previous reports where applicable, but also undertaking further research through the services of a local historian as well as Transport for NSW archives and the online resources of the State and National libraries.

The format and structure of this report follows the Transport for NSW template, developed in conjunction with Heritage NSW of the Department of Premier and Cabinet, and includes the following:

- A historical investigation seeking to understand the bridge and its setting (chapter 2)
- An investigation of the documentary and physical evidence from the bridge (chapter 3)
- An assessment and statement of significance considering the documentary and physical evidence against the seven criteria outlined in the NSW Heritage Manual (chapter 4)
- An analysis of the constraints and opportunities arising from both the heritage significance of the bridge and the operational requirements for the bridge (chapter 5)
- An investigation into a range of conservation options, taking into account the current condition, the ongoing maintenance requirements, other requirements imposed by external factors (such as legislation) and a range of strategies to provide for the safe ongoing use of the bridge while maintaining or enhancing the heritage value (chapter 6)
- Conservation policies for the bridge (chapter 7)

1.5 Contributors

This CMP has been prepared by Amie Nicholas, Roads and Maritime, Chartered Heritage and Conservation Engineer (Structural), BE, Grad Dip (PM), M.E., M.Herit.Cons., MIEAust, CPEng.

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[5] James Semple Kerr, Conservation Plan, 7th edition, National Trust of Australia (NSW), January 2013, p 22.

[6] Assessing Heritage Significance, NSW Heritage Manual, NSW Heritage Office, 2001; Burra Charter, 2013; James Semple Kerr, Conservation Plan, 7th edition, National Trust of Australia (NSW), January 2013.

[7] The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance, 2013

1.6 Terminology

The terminology in this report is consistent with the definitions given in the *Burra Charter 2013* (copied in full below) with bridge specific terminology as defined in 1.6.2 and Figure 1-12 to Figure 1-14.

1.6.1 Burra Charter definitions

Place *means a geographically defined area. It may include elements, objects, spaces and views. Place may have tangible and intangible dimensions.*

Cultural significance *means aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the place itself, its fabric, setting, use, associations, meanings, records, related places and related objects. Places may have a range of values for different individuals or groups.*

Fabric *means all the physical material of the place including elements, fixtures, contents and objects.*

Conservation *means all the processes of looking after a place so as to retain its cultural significance.*

Maintenance *means the continuous protective care of a place, and its setting. Maintenance is to be distinguished from repair which involves restoration or reconstruction.*

Preservation *means maintaining a place in its existing state and retarding deterioration.*

Restoration *means returning a place to a known earlier state by removing accretions or by reassembling existing elements without the introduction of new material.*

Reconstruction *means returning a place to a known earlier state and is distinguished from restoration by the introduction of new material.*

Adaptation *means changing a place to suit the existing use or a proposed use.*

Use *means the functions of a place, including the activities and traditional and customary practices that may occur at the place or are dependent on the place.*

Compatible use *means a use which respects the cultural significance of a place. Such a use involves no, or minimal, impact on cultural significance.*

Setting *means the immediate and extended environment of a place that is part of or contributes to its cultural significance and distinctive character.*

Related place *means a place that contributes to the cultural significance of another place.*

Related object *means an object that contributes to the cultural significance of a place but is not at the place.*

Associations *mean the connections that exist between people and a place.*

Meanings *denote what a place signifies, indicates, evokes or expresses to people.*

Interpretation means all the ways of presenting the cultural significance of a place.

1.6.2 Bridge specific definitions

Abutment means the structure on which the ends of the outer spans are supported (Figure 1-13)

Bottom chord means the lower horizontal member of the truss (Figure 1-12).

Butting block means the timber component used to transfer the loads from the principals to the bottom chords (Figure 1-12).

Cast iron shoe means the cast iron component which connects the ends of the truss principals to top and bottom chords (Figure 1-12).

Cross girder means a transverse bending member spanning between the upstream truss and the downstream truss which supports the deck. Primary cross girders are of larger dimensions and are located at panel points. Secondary cross girders are located between panel points (Figure 1-12).

Deck means the components of the bridge which directly support vehicles (Figure 1-14)

Diagonal means a truss member placed at an angle, excluding principals (Figure 1-12).

Laminate means a single timber component which forms part of a laminated timber member.

Laminated means three or more rows of parallel components are joined together (by glue, bolts or stressed strand) to form a single member which is longer than any of the individual components.

Panel means the area between the panel points (or main joints) in a truss (for example, the truss of McKanes Bridge shown in Figure 1-12 consists of eight panels of varying lengths).

Panel point means the locations of the intersections of the main members in a truss.

Pier means a support for the adjacent ends of two bridge spans (Figure 1-13).

Principal means the primary end (diagonal) timber member in a truss (Figure 1-12).

Railing means the timber posts and rails provided for delineation for vehicles and prevention of accidental falls from the bridge for pedestrians and animals using the crossing (Figure 1-14)

Splice means a discontinuity in the timber in either the top or bottom chord (or in an element of a pier) which is made to carry loads by use of a metal plate or other metal sections (Figure 1-12).

Sway brace means a member located outside the truss extending between the top chord and a cross girder to resist sway and vibration of the truss under vehicular loading (Figure 1-14).

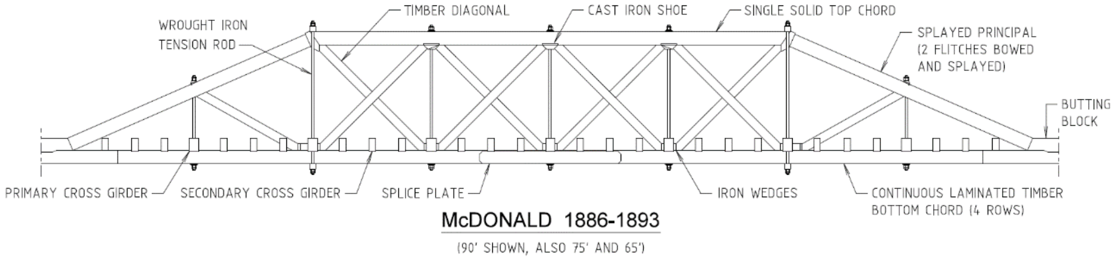
Tension rod means a vertical metal bar connecting the top and bottom chords of a truss (Figure 1-12).

Top chord means the upper horizontal member of a truss (Figure 1-12).

Truss means a special class of structure in which members are connected at joints in a manner that permits rotation so that the individual members can only carry either tension or compression.

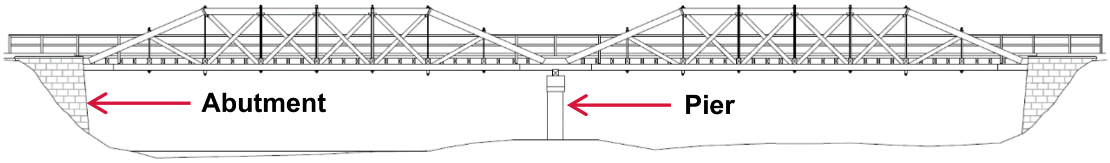
Wedge means a tapered metal element provided in opposing pairs in McDonald trusses and placed between the ends of the diagonals and the sides of the cross girders, so that, by regular blows from a sledge hammer, shrinkage and creep distortion can be taken up (Figure 1-12).

Figure 1-12: Diagram showing McDonald truss terminology from elevation.



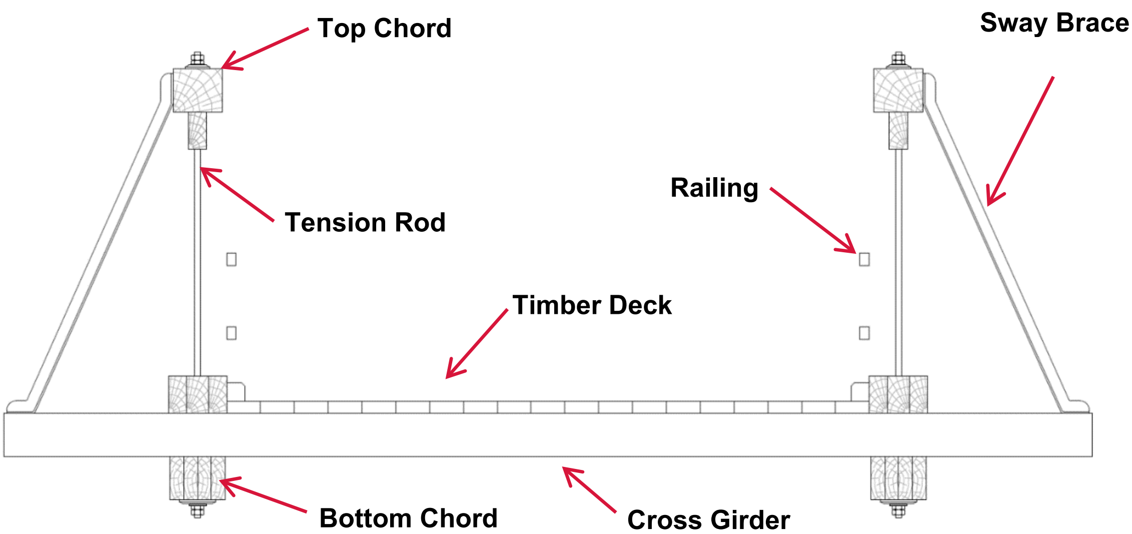
(source: author)

Figure 1-13: Diagram showing bridge terminology from elevation.



(source: author)

Figure 1-14: Diagram showing McDonald truss terminology from section.



(source: author)

2. Historical context

2.1 History of timber truss bridge design in New South Wales

For more information on local hardwood timbers, the early timber industry in New South Wales and early timber bridges including the development of the truss, see the OCMP.

Experiments made at the foundry of P.N. Russell & Co. in 1860 showed how much tougher the New South Wales ironbark is when compared to Baltic or American timber. The conclusion made was that whatever span had been possible with timber in other countries could certainly be imitated, if not surpassed, in New South Wales. The New South Wales Government therefore made considerable use of hardwood timber for public infrastructure, as well as for export. By the early 1900s, the rapid disappearance of hardwoods was reported due to the recognition of its value by the commercial world of Europe, South Africa, and the East.

Between 1856 and 1936, over 400 timber truss road bridges were built in NSW with this extraordinary local timber. Five exceptional engineers working for the New South Wales Department of Public Works (PWD) applied their sound engineering principles to design these elegant and durable timber truss bridges, some of which continue to carry vehicles today that are larger and heavier and faster than the original designers could possibly have imagined. The vast majority of these bridges can be divided into five types:

1) Old PWD trusses designed by William Christopher Bennett, 1824-1889, Figure 2-1(1)
2) McDonald trusses designed by John Alexander McDonald, 1856-1930, Figure 2-1(2)
3) Allan trusses designed by Percy Allan, 1861-1930, Figure 2-1(3)
4) De Burgh trusses designed by Ernest Macartney de Burgh, 1863-1929, Figure 2-1(4)
5) Dare trusses designed by Henry Harvey Dare, 1867-1949, Figure 2-1(5)

Figure 2-1: The timber truss bridge engineers, Bennett, McDonald, Allan, de Burgh and Dare

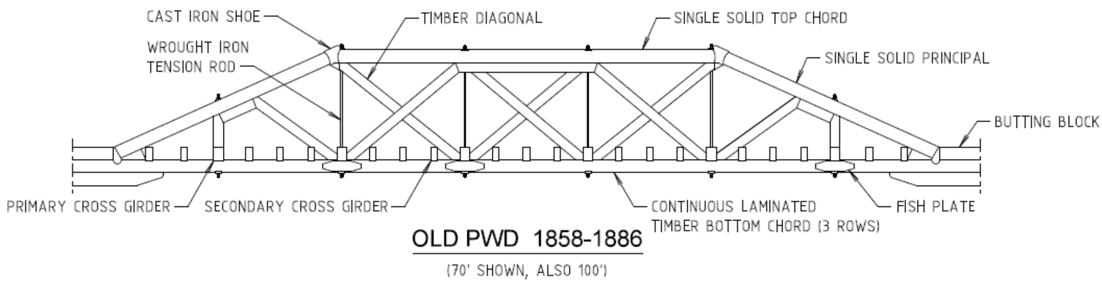
Sources 1 & 4: MBK, Study of Relative Heritage Significance of All Timber Truss Road Bridges in NSW, 1998, pp 23, 37; 2: "Pix from the past", Gisborne Photo News, No. 239, 22 May 1974, p 56; 3: "Mr Percy Allan, Noted Engineer's Death", The SMH, Thursday 8 May 1930, p 12; 5: Engineering Heritage, Sydney http://www.engheritage-sydney.org.au/PDFs/Darlington.pm.pdf.

The earlier trusses made use of the vast resource of large, long, strong and durable New South Wales hardwoods. As the unique New South Wales hardwoods became known around the world, so much of it was exported that these earlier types of timber truss bridges could no longer be built as the timber was no longer available. The later truss designs limited the sizes of the timbers to smaller shorter sections which were still readily available.

Old PWD trusses (also called Bennett trusses)

Approximately 150 Old PWD type timber truss bridges were built between 1858 and 1886. The Old PWD trusses designed by Bennett are examples of innovative and practical engineering in a time when large long timbers were readily available and vast numbers of bridges were being built, but budgets were tight and skilled workmen were few. The Old PWD trusses were not designed as permanent structures because the required routes were very likely to be diverted by circumstances impossible to anticipate. For these reasons, any deteriorated timbers are difficult to replace so the bridges tend to have been heavily modified.

Figure 2-2: Annotated diagram of the Old PWD truss design

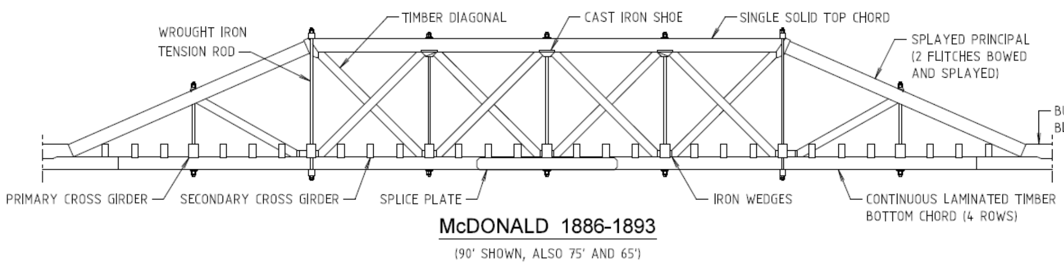


Source: Drawn by Jack Pulczynski for Amie Nicholas 2017.

McDonald trusses

Approximately 90 McDonald type timber truss bridges were built between 1886 and 1893. The historical context which drove the design of the McDonald truss is similar to the Old PWD truss as large, long, quality hardwoods were still plentiful and permanent bridges were not considered economical. The changes in design stem from the growing knowledge of timber as a structural material due to extensive testing at the University of Sydney in 1886, and also the increasing heavy vehicle loads. Again, due to the very large timbers included and the fact that they were not intended as permanent structures, deteriorated timbers are very difficult to replace and remaining examples of this type of truss tends to have been heavily modified.

Figure 2-3: Annotated diagram of the McDonald truss design

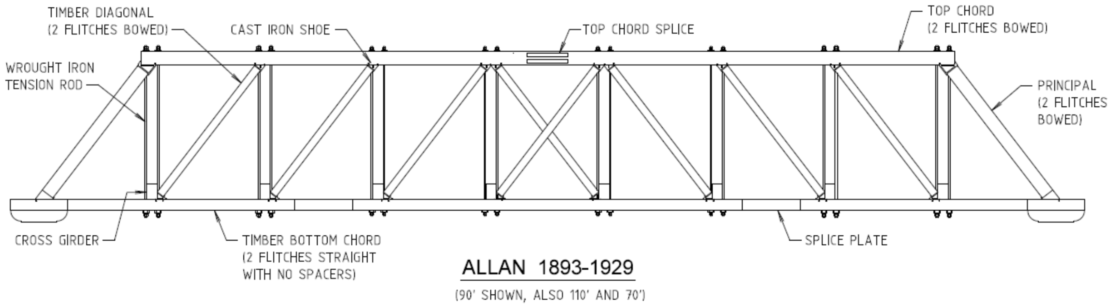


Source: Drawn by Jack Pulczynski for Amie Nicholas 2017.

Allan trusses

Approximately 100 Allan type timber truss bridges were built between 1893 and 1929. The historical context which drove the design of the Allan truss was the increasing difficulty in obtaining large timbers. Allan introduced two important innovations. The first was the detailing of timbers to enable the replacement of deteriorated timber, giving his timber bridges the same life expectancy as metal bridges. The second was his splice connection in the bottom chord which was stronger than previous bottom chord connections. Many Allan and Dare truss bridges were constructed to replace Old PWD or McDonald trusses, sometimes reusing the original foundations if those foundations were constructed in iron or masonry.

Figure 2-4: Annotated diagram of the Allan truss design

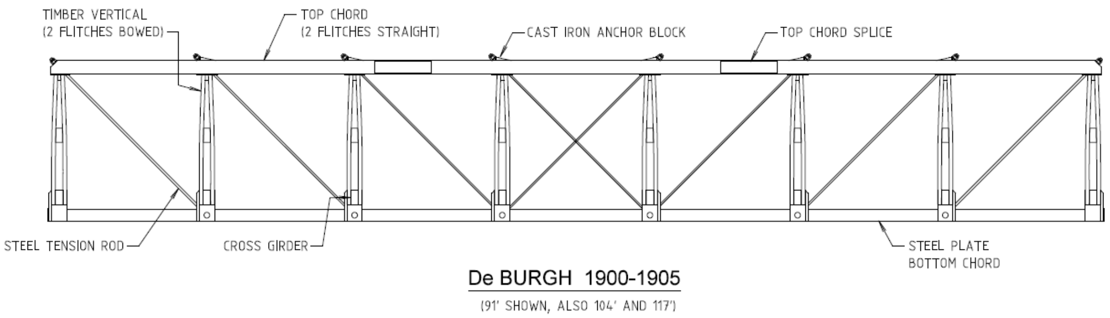


Source: Drawn by Jack Pulczynski for Amie Nicholas 2017.

De Burgh trusses

Approximately 20 de Burgh type timber truss bridges were built between 1900 and 1905. The historical context which drove the design of the de Burgh truss was that materials other than timber had become increasingly available and economical. The de Burgh truss includes the greatest variety of materials found in any of the timber truss bridges, with de Burgh using each material to its best advantage. The result was a stiffer and stronger truss, so that de Burgh achieved the longest span (50m) timber truss bridge in NSW.

Figure 2-5: Annotated diagram of the de Burgh truss design

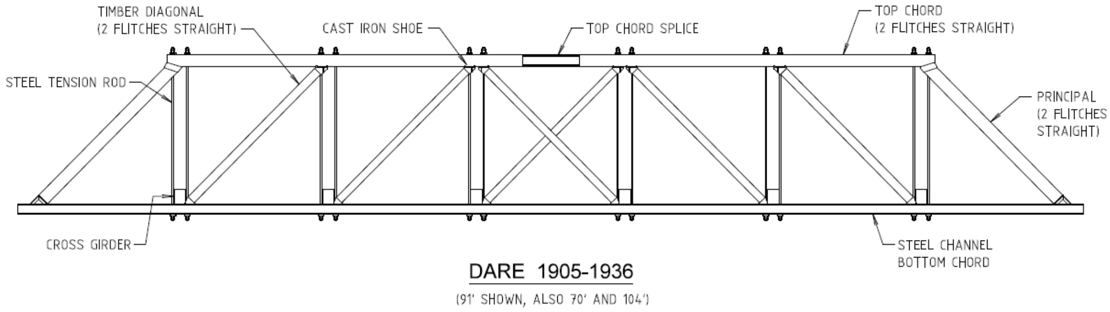


Source: Drawn by Jack Pulczynski for Amie Nicholas 2017.

Dare trusses

Approximately 40 Dare type timber truss bridges were built between 1905 and 1936. The Dare truss was designed to combine the best aspects from the de Burgh and Allan trusses while avoiding the primary problems with each. It has the simplest geometry and allows the easiest replacement of individual timbers.

Figure 2-6: Annotated diagram of the Dare truss design



Source: Drawn by Jack Pulczynski for Amie Nicholas 2017.

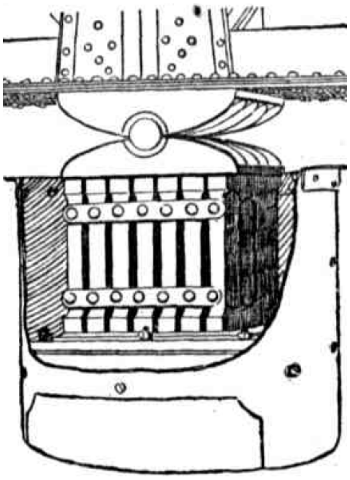
2.2 History of the McDonald truss

2.2.1 John Alexander McDonald

Figure 2-7: John A. McDonald.[8]

John Alexander McDonald was a member of the Institution of Civil Engineers, London, the Institution of Mechanical Engineers, London and the American Society of Civil Engineers, New York. Born in London on 10 January 1856, he studied at King's College, London, and after working for some time in England, he migrated to NSW in 1879 to superintend the erection of the iron bridges over the Parramatta River and Lane Cove, two of the largest bridges that time undertaken by the New South Wales Government. Upon the death of Bennett in 1889, McDonald was appointed Engineer for Bridges, a position he held until 1893.[9]

Figure 2-8: Diagram of McDonald's patent expansion rollers.



(source: Australian Town and Country Journal, 10 March 1888, page 485)

McDonald made a significant contribution to bridge design in NSW. His achievements include redesign in 1886 of the standard PWD truss to produce the McDonald truss; introduction of metal bottom chords in timber truss bridges for his 160 foot (48.5 m) span bridge over the Lachlan River at Cowra (thereby demonstrating the potential of the timber truss with all tension members in metal); design of all the lattice girder road bridges from 1884 to 1893, design of a series of sliding bridges at Lismore, Coopernook and Erina; and design of early bascule (drawbridge type) and lift bridges such as over the Darling River at Bourke.[10] He also designed two of the earliest steel beam bridges in NSW being the Unwin Bridge at Tempe and A'Becketts Creek Bridge at Parramatta. Two other engineers who joined the Roads and Bridges Branch at a similar time undoubtedly assisted, these being Percy Allan, who joined in 1878, and William Henry Warren, who worked in the Roads and Bridges Branch in 1881 (Figure 2-9).[11]

McDonald was also something of an inventor, and the patentee of "McDonald's patent expansion rollers" (Figure 2-8) for large bridges, used extensively in NSW, Queensland and America, and for which he received awards and medals at London, Chicago, Adelaide and Melbourne.[12]

McDonald was a collaborator in the University of Sydney timber testing and Warren gives him credit for the invention of an autographic strain recording device for the tests.[13] Figure 2-10 shows the device and some of the results produced. Little off-the-shelf equipment was available in those days so the device was made in the University of Sydney laboratory. McDonald commented in 1886 that Professor Warren's testing had provided valuable and interesting data, "which every engineer in this colony has felt the need of and been unable to

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[8] Source: 'Pix from the past', Gisborne Photo News, No. 239, 22 May 1974, p 56.

[9] "The Harbor Engineer", *Poverty Bay Herald* (New Zealand), Thursday 11 December 1913, p 7.

[10] Lynn Heather Mackay, *Iron Bridges in N.S.W, An Essay*, University of Sydney, 1972, pp 31-35.

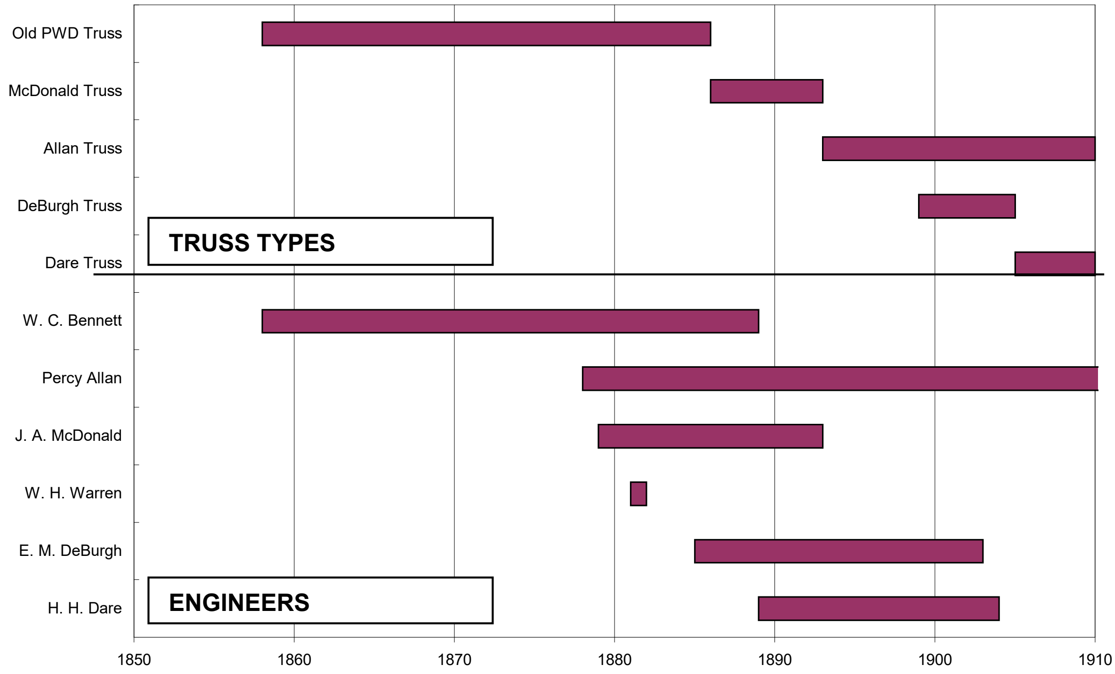
[11] Arthur Corbett, 'Warren, William Henry (1852–1926)', *Australian Dictionary of Biography*, National Centre of Biography, Australian National University, http://adb.anu.edu.au/biography/warren-william-henry-4804/text8007, published first in hardcopy 1976, accessed online 4 September 2017.

[12] "The Harbor Engineer", *Poverty Bay Herald* (New Zealand), Thursday 11 December 1913, p 7.

[13] Ian Bowie, "Australia's First Materials Testing Machine", *ASHET News*, Vol 3, No 4 Oct 2010, pp 4-6.

obtain with accuracy".[14] McDonald was immediately able to use this data to design what has become known as the McDonald truss.

Figure 2-9: Years employed by PWD and years of construction of truss types.

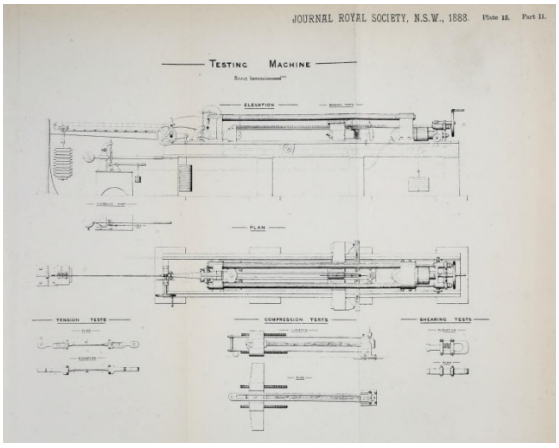


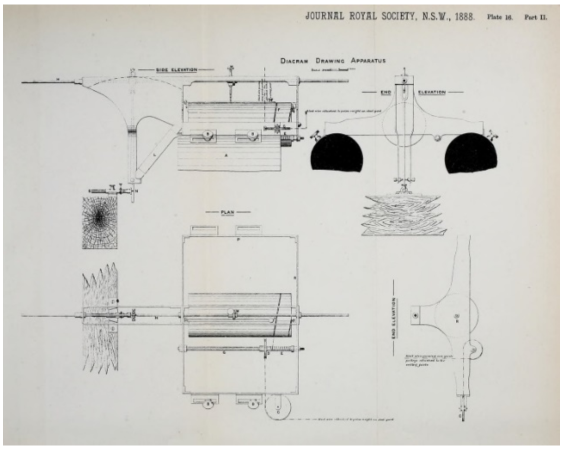
(source: author)

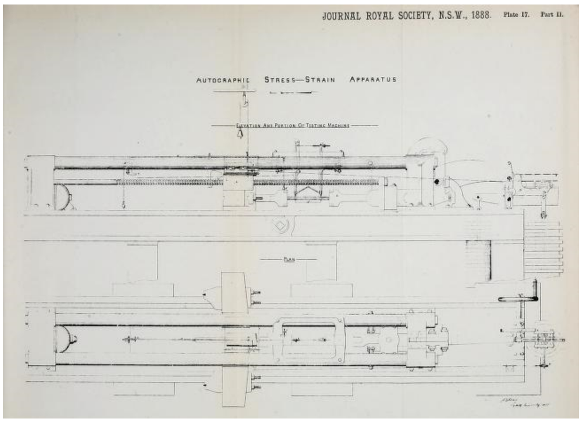
William Henry Warren was born in England in 1852 and migrated to Sydney in 1881 after working for the London Railways. In Sydney he worked in the Roads and Bridges Branch of the PWD while teaching applied mechanics at Sydney Technical College in the evenings. In 1882 he was appointed the first lecturer in engineering at the University of Sydney. An acknowledged leader of his profession, with a reputation extending beyond Australia, in 1919 Warren was the unanimous choice as first president of the new Institution of Engineers, Australia.[15] From his time working for the PWD, Warren noted the impressive range of hardwood timbers native to eastern Australia, as well as the fact that data on the properties of this resource was difficult to find in that no Australian testing facility of any reliability was available. At the University of Sydney, Warren obtained a Greenwood & Batley Testing Machine in 1886 (Figure 2-11).[16] On the 1st December 1886, he was able to report to the Royal Society of New South Wales the results of testing of ironbark timber.[17]

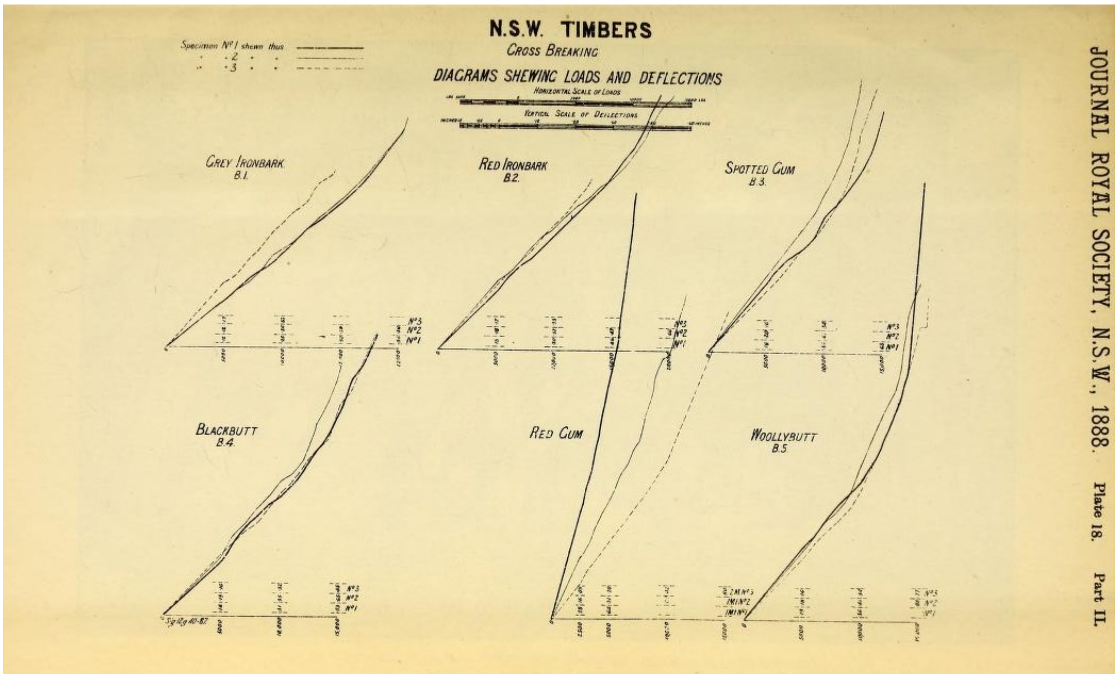
[14] William Henry Warren, *The Strength and Elasticity of Ironbark Timber as applied to Works of Construction*, read before the Royal Society of NSW 1-12-1886, p 275.
[15] Arthur Corbett, 'Warren, William Henry (1852–1926)', *Australian Dictionary of Biography*.
[16] Ian Bowie, "Australia's First Materials Testing Machine", *ASHET News*, Australian Society for History of Engineering and Technology Newsletter, Vol 3, No 4 Oct 2010, pp 4-6.
[17] William Henry Warren, *The Strength and Elasticity of Ironbark Timber as applied to Works of Construction*, read before the Royal Society of NSW 1-12-1886.

Figure 2-10: Warren and McDonald's autographic stress strain apparatus with some results.[18]









[18] Professor Warren, Description of the Autographic Stress-Strain Apparatus, Read before the Royal Society of N.S.W., August 1, 1888, *Journal & Proceedings Royal Society NSW 1888*, pp 253-256 and plates 15-18.

Figure 2-11: Greenwood and Batley Testing Machine at Sydney University.

(source: Ian Bowie)

After 14 years of service McDonald was retrenched.[19] Some of the other Departmental Heads did not appreciate the sardonic trait in his character, bringing them into conflict.[20] One of the engineers that later worked with McDonald in South Africa, however, testified to the valuable assistance he had received from him, and to his high professional qualifications as well as to the judgment, tact, and courtesy which had always been conspicuous features of his administration.[21]

McDonald then spent six months in the United States before returning to take up a position as Assistant Engineer to the Public Works Department in Western Australia and then Resident Engineer for Freemantle Harbour Works. In 1898 McDonald moved to South Africa, where he engaged in mining, designing electric light stations and various other activities until 1908, when he returned to Australia and tried his hand at farming. In 1912 McDonald moved to Gisborne, New Zealand and was Harbour and Port Engineer until 1917, then Gisborne Borough Engineer from 1918 to 1924.[22] He was the designer of the Gisborne Peel Street and Gladstone Road bridges.

He did not enjoy good health in the latter years of his life being a chronic sufferer from insomnia.[23] McDonald died by his own hand (he shot himself in the head) on 4 June 1930.[24]

2.2.2 Review of the McDonald truss design

The historical context which drove the design of the McDonald truss was similar to the Old PWD truss in that large, long, quality hardwoods were still plentiful and permanent stone or iron bridges were not considered economical. The changes in design stem from the extensive

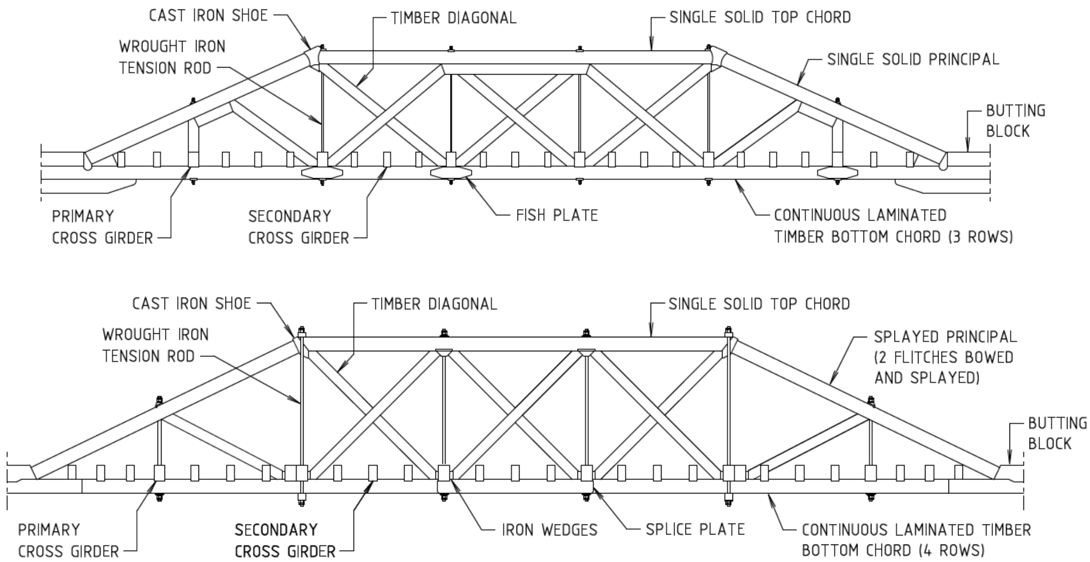
[19] Annual Report of the Department of Public Works to the Legislative Assembly 1894, p 123.
[20] Henry Harvey Dare, Tales of a Grandfather 1867-1941, unpublished autobiography, p 28; Lynn Heather Mackay, Timber Truss Bridges in New South Wales, Thesis, Bachelor of Architecture, 1972, p 74.
[21] "Harbor Affairs", *Poverty Bay Herald* (New Zealand), Tuesday 20 February 1912, p 4.
[22] "Harbor Affairs", *Poverty Bay Herald* (New Zealand), Tuesday 20 February 1912, p 4.
[23] Valediction in front cover of John A. McDonald's Calculation Book, held by RMS Bridge Engineering.
[24] "Shot Through the Head: John A. McDonald", *Poverty Bay Herald* (New Zealand), Wednesday 4 June 1930, p 7.

timber testing at the University of Sydney in 1886, and also the increasing heavy vehicle loads. McDonald updated the standard timber truss design for the new heavier design loads (a distributed live load of 4kPa and a traction engine weighing 16 tons) based on new information. McDonald did not greatly change the overall shape of the truss (see Figure 2-12), but he retained Bennett's innovation of combining the Palladio shape suited to large section timbers with the Howe truss tension rods.

The 1886 testing enabled McDonald immediately to modify the standard design to accommodate higher vehicular loads, as described by Percy Allan, commenting on the Old PWD type trusses:

> "Although this type of truss has for many years carried the traffic without accident, yet in view of the increase in settlement and *the greater risk of the structures being subjected to heavier loads, it was thought desirable in 1886 to adopt [the McDonald truss design]… These structures were designed for a distributed live load of 84 lbs. per square foot (4 kPa) of roadway and a traction engine weighing 16 tons…"* [25]

Figure 2-12: Comparison between Old PWD above and McDonald below.



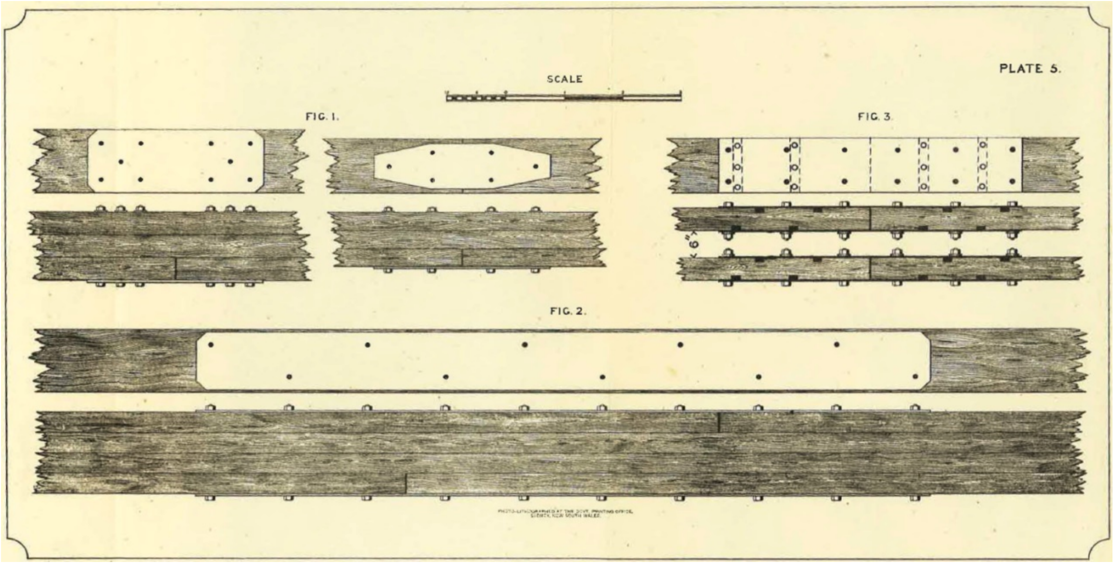
(source: author)

The first part that required strengthening for the heavier loads was the bottom chord. Percy Allan helpfully drew a sketch comparing bottom chords in the first three truss types (see Figure 2-13).

- FIG 1 shows details of Bennett's Old PWD truss, consisting of a laminated timber bottom chord with three rows of laminates and a small metal fish plate at each joint location, designed not to carry any loading, but to provide a template to ensure correct bolting.
- FIG 2 shows the details for the McDonald truss, which consists of a laminated timber bottom chord with four rows of laminates and two large central metal splice plates, designed to share the load because this truss type was designed for heavier vehicles.
- FIG 3 shows the details for the Allan truss, which consists of a double timber bottom chord with a gap between each element and a direct tension connection made up of four wrought iron plates with metal shear keys riveted to them and then these plates bolted to the timber.

[25] Percy Allan, *Timber Bridge Construction in New South Wales*, Royal Society of NSW, 1895, p 1.

Figure 2-13: Old PWD, McDonald and Allan Bottom Chords.



(source: Percy Allan, 1895).

Because McDonald's bottom chord was considerably wider than Bennett's, McDonald also had to modify the principals to fit. While all the timber truss road bridges make use of cast iron shoes, Bennett showed the most care in making these shoes a positive aesthetic feature. Bennett's shoes were specifically designed to frame the truss, both aesthetically and structurally, with the top chords, bottom chords and principals all being of the same dimensions, and all being the most critical structural members, these shoes ensured strong connections as well as aesthetic highlights. McDonald had worked closely with Bennett, and so understood that a change in bottom chord also required a change in principals and shoes. McDonald therefore returned to something which Bennett had tried much earlier, the splaying of the principals at the base to provide stability.

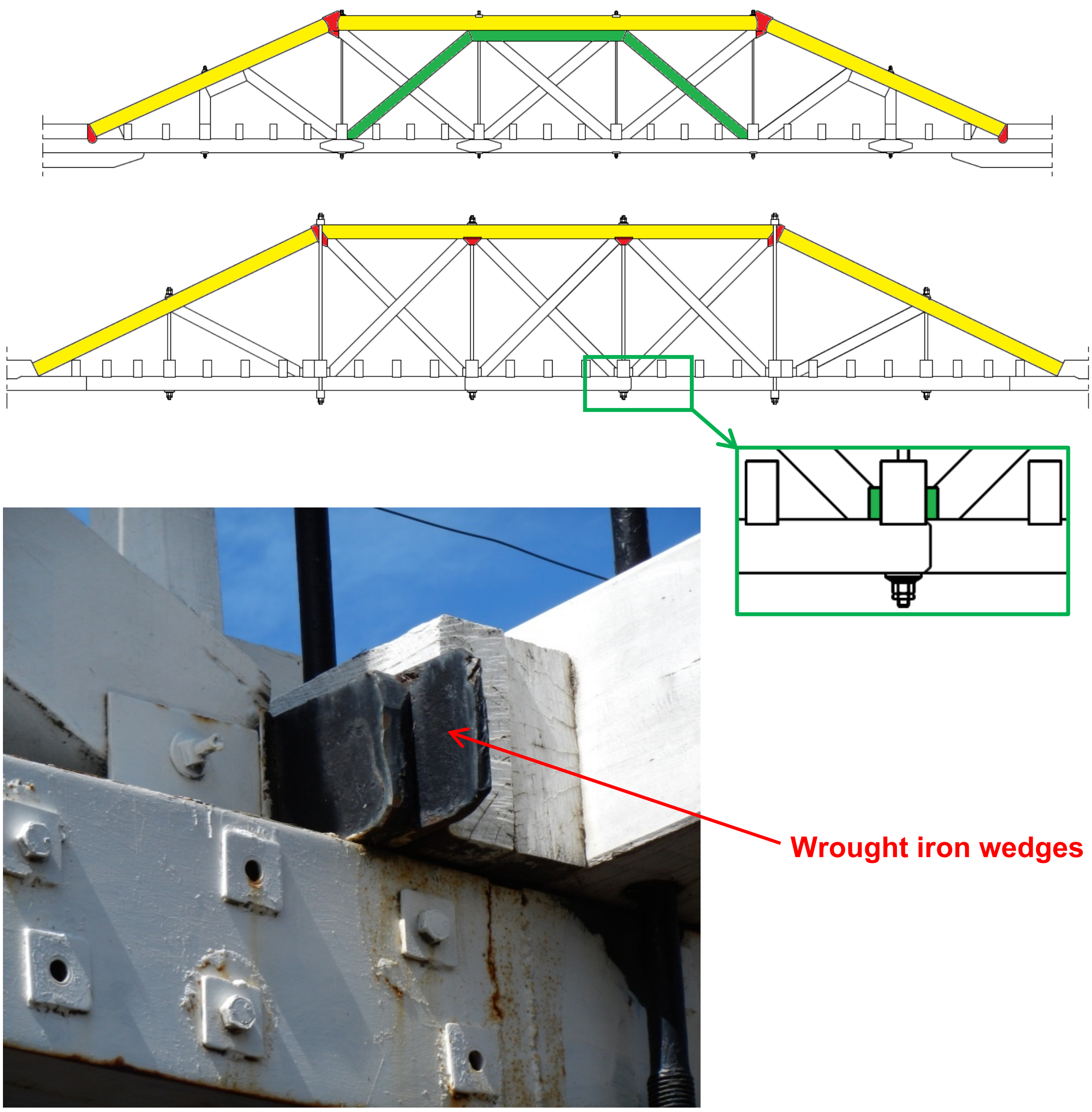
Figure 2-14: Splayed principals of McDonald truss, Bombala.

(source: author)

Because McDonald introduced the splayed principals for his truss, he no longer required the timber sway braces which were a feature of the Bennett truss, so he replaced these with far more slender metal sway braces. These metal sway braces were not designed to provide lateral support to the top chord, but only to resist excessive sway or vibration when heavy vehicles crossed the bridge.

While Bennett had maximised the use of large section timbers in order to manage shrinkage and warping of timbers by applying the structural system of an arch within an arch (see Figure 2-15 with green arch highlighted within the yellow arch), McDonald now had better information on the capabilities of the New South Wales hardwoods, and so he managed shrinkage and warping of timbers by using double timbers bowed around timber spacers and by providing metal wedges at the bases of diagonals to take up the slack (metal wedges are highlighted green in the McDonald truss in Figure 2-15). With these changes, McDonald also did away with the tear-drop shaped shoe at the base and introduced new cast iron shoes at the intersections of the diagonals and top chords (the cast iron shoes of each truss type highlighted in red in Figure 2-15).

Figure 2-15: Compare Old PWD above and McDonald below with iron wedges.



(source: author)

In common with the Old PWD truss, the McDonald truss was constructed as a temporary bridge and therefore was not designed for ease of member replacement. The primary cross girders form part of the truss (with the diagonals bearing against them and the tension rods bored through them) and are therefore exceedingly difficult to replace. The difficulty is exacerbated by the fact that the primary cross girders are also kept in place by being notched into the bottom chords.

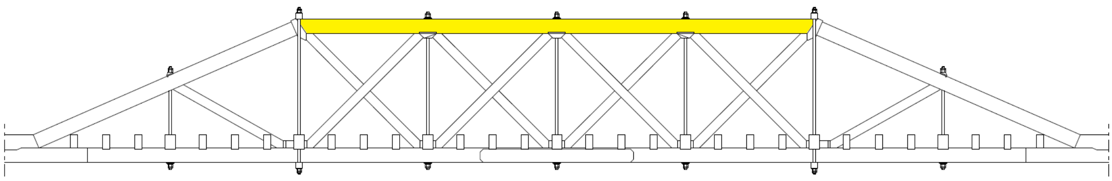
A unique and sometimes problematic feature of the McDonald truss is that none of the diagonals are actually connected to the top or bottom chords. At the top chords, they simply fit into a recess in the cast iron shoes, and at the bottom chords they again fit into a recess in the laminated timber bottom chords. In all of the later timber truss bridge designs, there was a bolted connection between the diagonals and the shoes at both the top and bottom chords, and in the earlier Old PWD truss, there was a direct bolted connection between the loaded diagonals and the top chords.

2.2.3 Distinguishing features of the McDonald design

The primary characteristics that distinguish John Alexander McDonald's designs for the McDonald type timber truss bridges from other timber truss bridge types are examined in this Section (refer back to definitions in Section 1.6.2 including Figure 1-12 to Figure 1-14 for McDonald truss terminology).

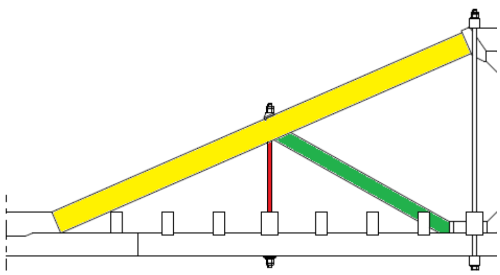
The top chords consist of single large cross-section long sawn timbers (similar to the Old PWD truss design). The later truss types (Allan, de Burgh and Dare) used not only paired members for the top chords, but also shorter lengths of timber with splices to make up the length.

Figure 2-16: Original 90' McDonald design with top chord highlighted.



(source: author)

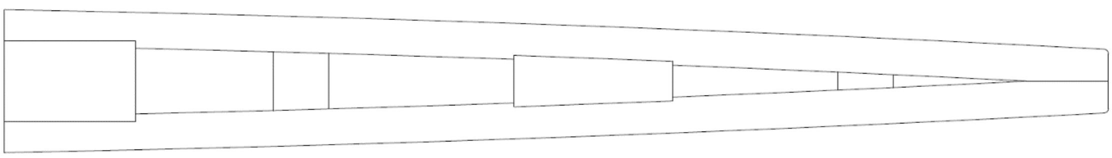
Figure 2-17: Principal.



(source: author)

Principals (yellow in Figure 2-17) in the McDonald truss are significantly longer than diagonals (a feature shared with the Old PWD truss), with a diagonal timber prop (green in Figure 2-17) approximately half way along the length and a vertical tension rod (red in Figure 2-17) also at that location. The principals are splayed, and are the only members in any timber truss bridge where the timber spacers are critical structural components in the member.

Figure 2-18: Original 90' McDonald design of principals with splay and spacers.

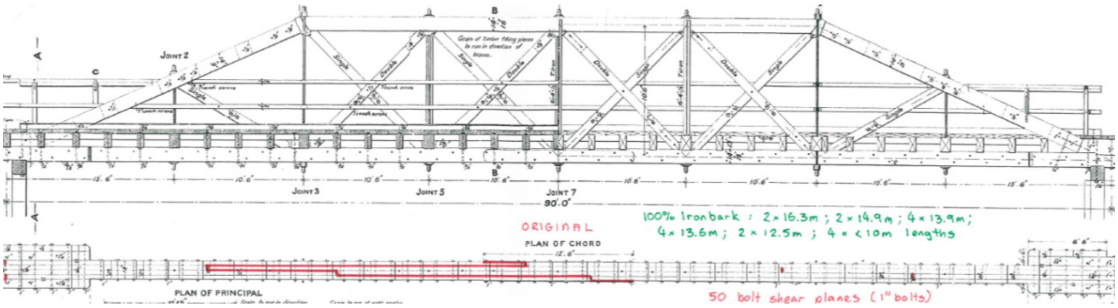


(source: author)

Principals are supported at the base on long timber butting blocks with no cast iron shoes. Butting blocks are bolted to bottom chords and notches with timber shear keys transfer the loads.

Bottom chords consist of four sawn timber laminates bolted together. Joints for all laminates occur only at secondary cross girders, not at panel points, and very long metal splice plates are provided at the centre of each span. The laminated timber bottom chords are continuous over piers and are common to the Old PWD and McDonald trusses, but the Old PWD always had three rows of laminates and the McDonald always had four because McDonald was designing for heavier loads. The laminate layout, the continuity of the bottom chord and the lengths of laminates are essential to the original design, with very careful detailing of every bolt location in the original design provided to maximise strength for the higher loads, requiring timbers in excess of 16 m in length.

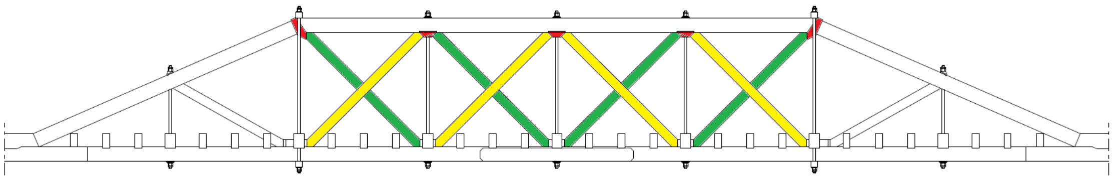
Figure 2-19: Original 90' McDonald design with laminate layout of bottom chord.



(source: author)

McDonald trusses had two, three or four counterbraced central panels, depending upon span length. All three standard span lengths for McDonald trusses remain (65', 75' and 90').

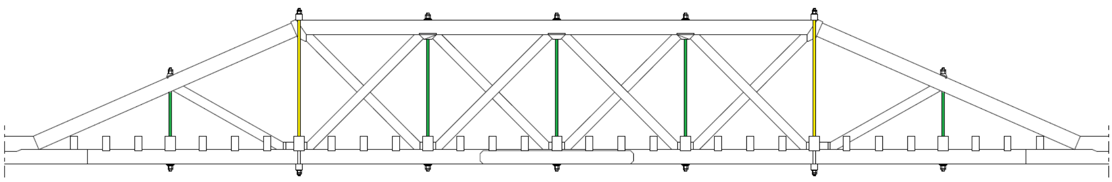
Figure 2-20: Original 90' McDonald with counterbraced central panels highlighted.



(source: author)

The diagonals of the McDonald truss consist of double and single diagonals counterbraced together. In Figure 2-20 above, the double diagonals are highlighted in yellow and the single diagonals are highlighted in green. Each diagonal is recessed into a cast iron shoe (highlighted in red in Figure 2-20) at the top and bears against the bottom chord and wrought iron wedges each side of the primary cross girders at the base. Each double diagonal has timber spacers each end.

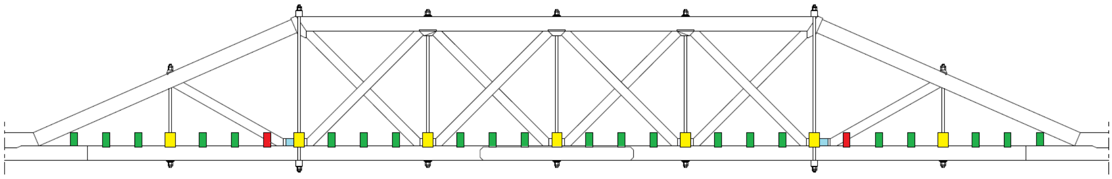
Figure 2-21: Original 90' McDonald with tension rods highlighted.



(source: author)

Single vertical wrought iron tension rods are installed through holes drilled in the top and bottom chords (highlighted in green in Figure 2-21). Double vertical wrought iron tension rods are provided at each end of the top chord, with iron saddled connections top and bottom. All tension rods are of the same diameter, with only the lengths varying for the three different types.

Figure 2-22: Original 90’ McDonald with cross girders highlighted.



(source: author)

Cross girders in McDonald trusses are closely spaced and carry diagonal decking similar to the Old PWD truss. The primary cross girders (highlighted in yellow in Figure 2-22) form part of the truss, whereas the secondary cross girders (highlighted in green in Figure 2-22) are of smaller cross-section and are provided only to support the diagonal decking. Two of the secondary cross girders (highlighted in red in Figure 2-22) have considerable notches cut out of them to accommodate the principal prop. This feature is unique to the McDonald truss. Bennett in his Old PWD truss had avoided such notching, but in so doing had arranged introduced eccentricity of load paths (ie. the centrelines of members did not all intersect at a single point at connections). McDonald did away with eccentricities, but this required that two thirds of the section of these secondary cross girders were removed, and it also necessitated the timber packing (highlighted in blue in Figure 2-22) between the principal diagonal prop and that particular primary cross girder.

Railings on McDonald truss bridges consist of two rows of rectangular timber rails, attached directly to the truss with no vertical posts. The McDonald truss is unique in that there were curved kerbs provided, with the carriageway width varying along the span, narrowest at the ends where the wide timber principals constrained the width, and widest in the centre with the more narrow timber diagonals. There were no enlarged timber end posts on McDonald truss bridges, as these were introduced in Allan truss bridges. Rails simply ended a small distance beyond the bridge.

2.3 History of the area around McKanes Bridge

2.3.1 Aboriginal history [26]

Lithgow is predominately recognised as falling within Wiradjuri country, but historian Jim Smith and the late anthropologist Dianne Johnson have concluded that much of the Greater Lithgow region, including the vicinity of McKanes Falls Bridge, was part of the lands used by the Gundungurra people.[27] According to Jim Smith, the Therabulat band of the Gundungurra lived around Hartley and the Wywandy were the band who lived at Pipers Flat, near Wallerawang. Another notable band was the Capiti, who lived in what is now known as the Capertee Valley. Smith noted that Therabulat is possibly a conjunction of the Gundungurra words ‘Terra’ or ‘Turra’ - hill and ‘Bula’ - two, meaning two hills. This may be a reference to the volcanic cones identified as Mount Blaxland and the Wentworth/Lawson Sugarloaf, which loom above the crossing at McKanes Falls.[28]

[26] This section on aboriginal history is copied in full from Ray Christison, McKanes Bridge over Cox’s River: Local historical context of the bridge, a report prepared for Roads and Maritime Services, 8/11/17, pp 2-5.

[27] Dianne Johnson, 2004. Report to the Gundungurra Tribal Council concerning Gundungurra Native Title Claim [Federal Court File No: NG606/98]. (Unpublished report).

[28] Jim Smith, 1991. *Wywandy and Therabulat*: The Aborigines of the Upper Cox River and their association with Hartley and Lithgow, Lithgow District Historical Society.

Figure 2-23: View from Mount Victoria towards Bowenfels taken in the 1880s. Wentworth/Lawson Sugarloaf is on the left of the village and Hassans Walls on the right

(source: John Henry Harvey Photograph. Pictures Collection, State Library of Victoria).

English settlers laid their words over many Aboriginal names. Moyne, the first land grant in Hartley, had been Tunumberee, a place of hunting and ceremony. According to Mr Cullen of Cullenbenbong, who listed Aboriginal place names for *The Lithgow Mercury* in November 1931, River Lett was a rhyming replacement for Tarrapalatt (Therabulat); Tuiwon became the Vale of Clwydd and Gnallwarra became Brown's Gap, after Thomas Brown who used it to get from his Eskbank property to the courthouse at Hartley.[29] Archaeological investigations undertaken during the 1990s identified large ceremonial grounds located along the valley of the Coxs River in the location of Lake Lyell. The Aboriginal people of the region actively resisted the European occupation of their country. A group of Gundungurra warriors from the Wingecarribee River (Southern Highlands) attacked the government post at Glenroy in 1816. The military force at this stockade was subsequently reinforced by a detachment of troops from the 46th Regiment of Foot and travellers between Springwood and Bathurst were provided with a military escort.[30]

By the 1820s the Wiradjuri people had begun to actively resist European occupation of their lands around Bathurst. The leader of these campaigns was the legendary Windradyne, warrior and friend of the Suttor family of 'Brucedale'. These insurrections, and particularly the killing of seven stockmen in May 1824, near Bells Falls Gorge above Sofala, led Governor Sir Thomas Brisbane to proclaim martial law west of the Blue Mountains on 14 August 1824. Major James Morrisset, the Commandant of Bathurst, planned a major punitive expedition against the Wiradjuri in the lands north of the established European settlements during September 1824. Infantry and mounted troops, led by local magistrates Lawson and Rankin from Bathurst, and James Walker, who had recently taken up a giant run he called 'Waller-o-wang', moved north

[29] Jim Smith, 1991. *Wywandy and Therabulat*.
[30] Jim Smith, 1991. *Wywandy and Therabulat.*

from Bathurst to Mudgee, where they swept the countryside for ten days. The exact numbers of Aboriginal deaths are difficult to ascertain, but Wiradjuri leaders sued for peace within the following two months.[31] This expedition appears to have marked the beginning of a series of massacres of Aboriginal people along the Great Dividing Range. As historian David Andrew Roberts has written, the exact events of this period are difficult to trace, because of a lack of documentary evidence, although oral history traditions about it, and about what is known as the Bells Falls Massacre, have a long history amongst settler communities.[32]

James Walker's 'Waller-o-wang' was, according to Jim Smith, in the country of the Wywandy, and as his vast runs extended over the Wolgan Valley and into the Lachlan, Walker and his staff undoubtedly met Aboriginal people, but little remains on the record about these interactions. Smith has studied the diaries of Walker's overseer, Andrew Brown, and says Brown was 'oddly silent' about Aboriginal people, though his diaries show smallpox, which was devastating to Aboriginal communities, hit the area in the 1830s. Smith also records rumours that the water supply at 'Cooerwull', the property Brown later obtained, was poisoned, to kill Aboriginal people. We can know that Walker's cousin Thomas Archer came to know and respect Myles ('King' Miles or My-ill) in 1838, and a headstone for a man known as 'Bobby' was erected by Archibald James Walker on 'Waller-o-wang' in 1856.[33]

Aboriginal people remained an enduring presence in Lithgow during the 19th century, although we can assume their numbers were much diminished. From 1838 until the 1880s the magistrates at Hartley Courthouse gave out around 50 blankets a year to Aboriginal people. New arrivals at Lithgow also reported their presence. In 1880 James Silcock, master potter, visited an Aboriginal camp and 'had a long chat with them, as they can speak English tolerably well.' In 1886-1887 the Aborigines Protection Board's Returns of Aboriginal People lists a 'full-blood' woman living at Hartley and two men, a woman and four children, all described as 'half-caste'. Three of the children were at school but none of the adults was aged younger than 45, and four Aboriginal people had died at Lithgow in the previous year.[34] It is not clear how these people identified themselves. Historian Jim Smith contends that most Gundungurra people moved to the Megalong by 1887 while others moved further west in search of work.[35] However, the Protection Board Minutes show two old women receiving rations at Hartley Vale in 1890, people receiving rations at Hartley Vale and the Coxs River in 1892 and medical aid being given at Hartley Vale and Katoomba in 1895.[36]

We can know when Aboriginal people stopped collecting blankets from the Hartley Courthouse, from a June 1888 report by *The Town and Country Journal*:

> *GOVERNMENT MANAGEMENT.-A bale of blankets supplied by the Government for the aboriginals of Hartley district is now lying at the courthouse, Lithgow, waiting to be claimed by the original inhabitants of New South Wales. These blankets will possibly remain there a good while, as only a very few aboriginals are now in this district; and those who are here, I think, are too proud to take Government assistance in any way. A little while ago the Hartley district had a tribe of blacks; but they are all gone. When they departed the blankets came.*[37]

Aborigines Protection Board records show requests for assistance and attempts to secure land title in the Megalong Valley from 1890 to 1895.[38] Billy Lynch moved from the Megalong Valley in the 1890s and settled in The Gully on the western edge of Katoomba, although when he

[31] Connor, J., 2002. *The Australian Frontier Wars 1788-1838*, Sydney: UNSW Press. pp.58-61.

[32] David Andrew Roberts, 'The Bells Falls massacre and oral tradition' in B. Attwood and SG Foster, *Frontier Conflict: The Australian Experience*, (Canberra: National Museum of Australia, 2003), pp. 150-158.

[33] Smith, *Wywandy and Therabulat*.

[34] State Records NSW, Board for Protection of Aborigines Returns of Aboriginal People 1886-1887, 5/18423.2, NRS 17323/1

[35] Smith, *Wywandy and Therabulat*.

[36] State Records NSW, Aborigines Welfare Board Minutes, 4.12.1890, 11.8.1892, 31.8.1893, 4/7108 and 10.1895, 4/7111.

[37] 'Lithgow', *Town and Country Journal*, 30 June 1888

[38] Naomi Parry, 2007. '"Such a longing": black and white children in welfare in New South Wales and Tasmania, 1880-1940', PhD Thesis, Department of History, University of New South Wales, p. 319.

died his body was returned to the Megalong Valley.[39] The Gully was a place of refuge for people forced from their traditional lands and pushed out of the towns of western Sydney and the Central West. It was a community of mostly Darug and Gundungurra people, with some non-Aboriginal members and Wiradjuri and Ngunnawal people from the Yass area. Although never officially recognised as an Aboriginal community, its members endured a high degree of official and unofficial oversight, including from child welfare agencies.[40] Despite this surveillance, the people of the Gully survived with minimal government support, until the 1950s, when they were dispersed so a car racing track could be built.

There was no such place of safety in Lithgow. In 1934, *The Sydney Morning Herald* reported that the police census of Lithgow and the Blaxland Shire had not identified a single Aboriginal person in the Lithgow district.[41] When reading such statements it is wise to reflect on the fact that, in the 1930s, the powers of the Aborigines Protection Board, as conferred by the *Aborigines Protection Act 1909* and a raft of Amendments, were at their height. By 1934, police and the staff of the Aborigines Protection Board had the right to decide if someone was Aboriginal by looking at them, and made judgments according to skin tone and whether the person lived with Aboriginal people, on a reserve or in a camp. The Board considered that people who were less than 'half-caste' and could 'pass as white' were not Aboriginal and did not qualify for government support, or have the right to live amongst people who did. It was hardly in the interests of an Aboriginal person to argue the case, because people who came under the Act could be forced to move anywhere in New South Wales determined by the Board, send their children to official Aboriginal Schools that were far inferior to ordinary public schools, or face losing their children altogether. At this time in New South Wales history, and until the 1960s, many Aboriginal families hid their identity, moved away from official oversight, stopped speaking their language and suppressed their stories.

2.3.2 European settlement [42]

In 1813 Gregory Blaxland, William Lawson and William Charles Wentworth led an exploration party across the Blue Mountains. This group were the first Europeans to set foot on the western side of the ridgeline that runs from Lapstone to Mount York. They reached Mount York on 28 May 1813, where "they encamped on the edge of the precipice and discovered to their great satisfaction … land below the Mountains to be forest land – covered with trees and good grass". On the following day, they descended the mountain and travelled two miles through "open meadow land clear of trees". They rested on Sunday 30 May then travelled west and south west on Monday 31 May. At the end of that day the party camped "by the side of a very fine stream of water a short distance from a high hill in the shape of a sugarloaf". (This was the mountain known to the Gundungurra as Therabulat.) In the afternoon, they climbed the sugarloaf mountain and saw all around them "forest land ... sufficient to feed the stocks of the colony … for the next thirty years". This sugarloaf, now known as Mount Blaxland, marked the end-point of their journey.

In his account of the journey Gregory Blaxland noted a change in the geology of the country near Mount Blaxland. This change was to have important implications for the development of mining in the area fifty years after their journey. In the stream that runs below Mount Blaxland (the River Lett) he observed:

> *… the stones at the bottom of the rivers was very fine large grained dark coloured granite the stones all appeared a kind of granite quite different from the stones of the Mountains or any stones they had before seen in the Colony.*[43]

[39] Dianne Johnson, 2007. *Sacred Waters: the story of the Blue Mountains Gully Aboriginal people*, Sydney: Halstead.
[40] Johnson, *Sacred Waters*; Parry, 'Such a longing'.
[41] 'Police Census: Lithgow', *The Sydney Morning Herald*, 11 January 1934.
[42] This section on European settlement is copied in full from Ray Christison, McKanes Bridge over Cox's River: Local historical context of the bridge, prepared for Roads and Maritime Services, 8/11/17, pp 8-11.
[43] Blaxland, G., 1813. "A Journal of a Tour of Discovery Across the Blue Mountains, New South Wales, in the Year 1813". pp.17-19.

This discovery was to have profound implications for the future development of the surrounding region. Without realising it at the time Blaxland had been the first European to note the boundary between the coal-bearing sandstone country of the western coalfield and the mineral rich granite belt of the Central Tablelands. The proximity of high value metallic ores to the coal deposits of the Lithgow region was to have a significant impact on the development of industry in the region. From the 1860s onwards the potential to make money supplying coal or coke to smelt the ores of the western region was a major motivator influencing investors in coalmining enterprises.

Therabulat appears to have acted as a magnet to subsequent explorers and surveyors. Following the return of Blaxland, Wentworth and Lawson Governor Macquarie instructed surveyor George Evans to "confirm and extend the Blaxland party's discoveries". Evans reached Mount York on Wednesday 24 November 1813 and proceeded across the valley towards "a Riverlett … which is a rapid stream from the NE". On 26 November Evan's party reached a larger stream. He noted:

> *… the soil still continues sandy but the feed is good, and better than any I have seen in New South Wales: I stopped this evening near the foot of a very handsome Mount, which I take the liberty to call Mount Blaxland, and also two Peaks rather north of it, and which the Riverlett separates Wentworth's and Lawson's Sugar Loaves. I am at a loss to describe the pleasant appearance of this place, the Grass being quite green and good makes it look a pleasing scene.*

Evans found it extremely difficult to navigate a passage from this valley as the granite ground and steep valley sides made it difficult for horse and cattle to climb to the ridges. He used the Mount Blaxland campsite as a base as he sought a way forward. He finally found a path to the ridgelines on Tuesday 30 November, then traced the course of the rivulets to a large granite outcrop. Having named this feature after himself, he led party westwards towards the O'Connells Plains area. Their journey followed the Fish River then on to the valley of the Macquarie River.[44]

[44] Kent, J., 2013. A Moment in Time. p.19; Evans, W., 1813-1814. "Assistant Surveyor Evans's Journal, 1813-1814". pp.28-31.

Figure 2-24: Monument at Mount Blaxland (Therabulat) identifying the western point of Blaxland, Lawson & Wentworth's 1813 expedition. This was created around 1913 by concreting the stump of a tree originally marked by the explorers. Coxs River is in the background[45]

Despite early restrictions on travellers crossing the Blue Mountains, a healthy pastoral industry had developed in the district by the 1820s. This industry was based on mobs of cattle driven across the mountains, and sheep, which were pastured further west. A large pastoral empire developed by Peninsula War veteran James Walker and his protégé Andrew Brown, linked the Bowenfels and Wallerawang districts to the Warrumbungles and Castlereagh River from the modern towns of Mendooran to Coonamble and Baradine.

Emancipist John Grant initially settled on a grant of 20 acres at Kanimbla. This property, carefully selected by Grant, included the rare asset of a triple spring. He built his Moyne Farm homestead in 1822 and in 1823 he obtained a ticket of occupation for an additional 1,200 acres. By 1826 he was running 1,000 sheep and 62 cattle on the property. In 1927, he increased both his landholdings and stock, and soon after began managing Dr William Redfern's nearby property. Grant also took up land in the Lachlan district and in 1839 he purchased John Wood's Lowther Park. Wood was a free settler who arrived in New South Wales in 1818, and initially established himself at Bringelly. In 1824, he was granted 1,280 acres in the Parish of Lower between Lowther Creek and Mount Morris. John Grant moved to Lowther Park. After Grant's death in 1866 Lowther Park was leased by the Luxton brothers, who grew hay and potatoes as well as running sheep and cattle.[46]

[45] source: Royal Australian Historical Society 020290
[46] Moyne, Office of Environment & Heritage Database No. SHI 1960148; Lowther Park, Office of Environment & Heritage Database No. SHR 1960089; Parish of Lowther County of Westmoreland 1890.

Figure 2-25: A Grant family wedding photographed at Lowther Park in the 1860s or 1870s

(source: Lithgow Regional Library, Lithgow District Historical Society Collection).

Smaller farms developed in the reasonably well watered valleys linked to Cox's River and settlers grew crops of wheat, corn and potatoes in the richer volcanic soils along the creeks and rivers. In September 1912, the *Lithgow Mercury* received information from a Mr. John Campbell, who claimed that his grandfather had been one of the first people to take up land at Blaxland's Swamp upstream from the confluence of Lowther Creek and Coxs River. According to Campbell his family had drained the swamp "and put it to good use, growing prolific crops of corn and potatoes".[47]

In the mid-1880s the Bryant family of Tarana took up much of the Blaxland's Swamp area on the southern bank of Cox's River, naming their property "Ecclesbourne". Percy Bryant, who was born in 1883, married Feodore Eather, a descendent of one of the earliest families to take up land at Blaxland's Swamp.[48] The Bryant family still owns "Ecclesbourne", having run sheep and cattle on the property for more than a century.

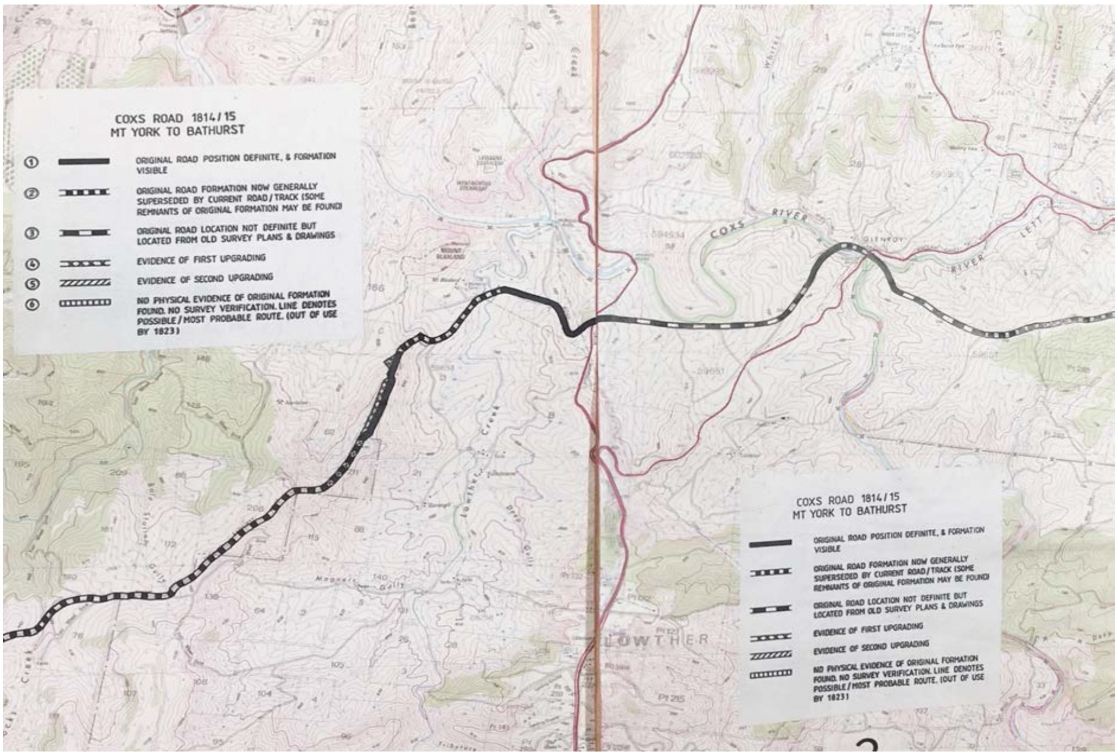
2.3.3 Local and regional transport [49]

Surveyor William Evans was followed in 1815 by William Cox and his convict road gangs, who were constructing a road to the west. Following the route identified by Evans, Cox developed a road from Mount York towards Mount Blaxland (Therabulat). On 3 November 1815, after having examined options for the descent of Mount York, Cox and others walked the two miles to "Blaxland's rivulet" to investigate the valley beyond. As work gangs were constructing the very difficult passage of Mount York, Cox sent survey parties forward to investigate routes to Mount Blaxland and the Fish River. By mid-November he had identified a point at which to construct a bridge over the larger watercourse, which was later named Cox's River.[50] The crossing point at Glenroy was a welcome resting place for parties travelling west from Sydney

[47] "The site of Mount Blaxland" in *Lithgow Mercury* 2 September 1912. p.2.
[48] "Death of Mr. P.H. Bryant" in *Lithgow Mercury* 9 October 1953. p.2.
[49] This section on local and regional transport consists of excerpts taken from Ray Christison, McKanes Bridge over Cox's River: Local historical context of the bridge, for Roads and Maritime, 8/11/17, pp 11-20.
[50] Cox, W., 1815. "Journal kept by Mr. W. Cox in making a road across the Blue Mountains from Emu Plains to a New Country Discovered by Mr Evans to the Westwards." pp.52-57.

towards Bathurst. This crossing served the main road to Hampton, Jenolan Caves and Oberon, until it was bypassed in the 1970s. From the bridge at Glenroy, Cox's Road travelled due west towards Therabulat and Blaxland's Swamp. The section of Cox's Road running south of Cox's River was relegated to a secondary function after Lockyer's and Mitchell's Roads were constructed in 1828 and 1832 respectively. These roads followed a line north of Cox's River, skirting the talus slope of Hassans Walls and running through Bowen's Hollow to Mount Walker.[51]

Figure 2-26: Scan of composite map showing the route of Cox's Road south of the present McKanes Falls Bridge. McKanes Falls Road runs north-south down the centre of the map.[52]



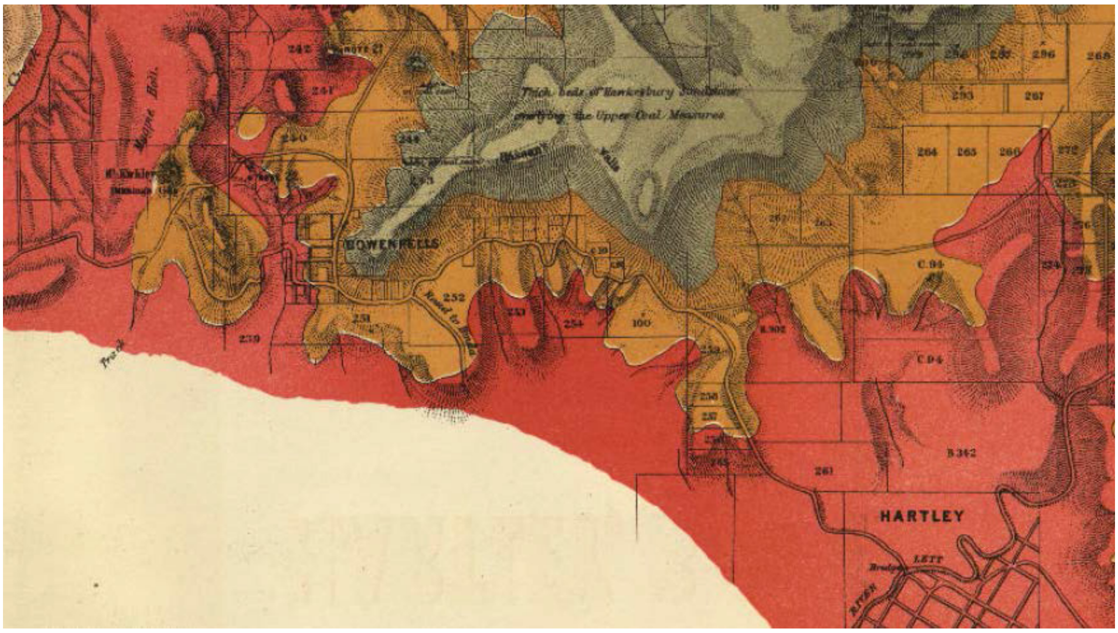
The development of a road to the west created opportunities for settlement and commerce, including the establishment of inns. A steady stream of free settlers moved into the district in the decades after 1820 and a string of inns was quickly established along the roads to the west. A road connecting the village of Bowenfels to Binda (Jenolan) Caves appears to have been developed in the early to mid-19th century. In June 1863 two Sydney newspapers carried a report of a journey from Bowenfels to the Binda Caves, written by Sir John Lucas MLA. Lucas made the following observations about the road from South Bowenfels to Good Forest:

> *… we started, a party of twelve, from Bowenfels, leaving the road near the Bowenfels toll bar … and within the distance of three miles, crossed Cox's River. The descent to this stream is about the worst part of the road to the caves. As to the river itself, it is scarcely worthy of the title, for, although after much rain it rises forty or fifty feet, yet in ordinary weather, it is not more than twenty-five feet wide, and from twelve to eighteen inches deep. The water is beautifully transparent, and runs rapidly over a pebbly and sandy bottom. Leaving the river, we ascended a long and steep hill, on to the leading range, which we kept for about twelve miles to the Binda pinch.*[53]

[51] Blue Mountains Western Escarpment Crossings Blackheath to Lithgow. A document prepared by Alan R. Carey for the Department of Lands 1975.
[52] source: Blue Mountains Western Escarpment Crossings Blackheath to Lithgow. A document prepared by Alan R. Carey for the Department of Lands 1975.
[53] 'A visit to the Binda Caves by Mr John Lucas MLA", *Sydney Mail*, 13 June 1863,

Lucas continued to describe the road along the range to Lowther, the pastoral properties along the ridge and the descent to Binda Caves. (Binda Caves later became known as Fish River Caves, then Jenolan Caves.) It is clear from John Lucas' account that the road crossed Cox's River by a shallow ford.[54] The northern section of this road is clearly marked on the Department of Mines Geological Map of the District of Hartley, Bowenfels, Wallerawang and Rydal, included in the Annual Report of the Department of Mines for 1877. It is marked as "Road to Binda".[55]

Figure 2-27: Detail of 1877 Department of Mines Geological Map of the Districts of Hartley, Bowenfels, Wallerawang and Rydal. This shows the road to Binda running south from the Main Western Road east of Bowenfels



(source: Annual Report of the Department of Mines NSW 1877).

The construction of railways from the mid-1850s created immense challenges for the colonial road system. Railways could deliver goods and passengers faster than roads, and could operate in all weathers. As the railways spread out from Sydney and Newcastle many roads fell into disrepair. To remedy this, and to advance a broad range of civil engineering improvements the Government of New South Wales established the Department of Public Works in 1859. This department took on responsibility for "the construction and repair of government buildings, army barracks, defence works, railways, roads, bridges, lighthouses, abattoirs, gaols, asylums and wharves". Among the earliest works undertaken was the gravelling of main roads to create more durable surfaces. The Main Western Road between the Nepean River and Bathurst was gravelled by 1866.[56]

The various families farming the country between Coxs River and Hampton transported their produce and stock to the population and transport centres located north of the river. Prior to the construction of the Main Western Railway to Bowenfels in 1869 most of this produce was taken across the river at Glenroy and travelled on to Mount Victoria and points east. Construction of the railway, and the subsequent growth of the town of Lithgow created new markets and transport destinations. It also enhanced the role of the road between Bowenfels

[54] The word "falls" was another word sometimes used for a ford (a ford is a shallow place with good footing where a river or stream may be crossed by wading, or inside a vehicle getting its wheels wet). The name of the road, "McKanes Falls Road" points to the first crossing of the Cox's River which was a ford located a little distance away from the bridge. The bridge is therefore properly called "McKanes Bridge" and not "McKanes Falls Bridge", as the crossing is no longer a ford (or falls).
[55] Annual Report of the Department of Mines New South Wales for the year 1877. Department of Mines New South Wales. Geological Map of the District of Hartley, Bowenfels, Wallerawang and Rydal.
[56] Dept. of Main Roads, 1976. *The Roadmakers*. A History of Main Roads in New South Wales. pp. 42-47.

and Binda Caves as a regional transport artery. It also increased the importance of the river crossing at McKanes Falls.

The railway rapidly became the principal route for conveyance of goods, minerals and rural produce. Traffic on the region's roads shifted to connect to railheads, rail transfer points and new centres of population. Between 1869 and 1878 the population of the Lithgow Valley grew to "about one thousand souls" and, in the subsequent ten years, this number grew to 4,000.[57] These increases in population created new markets for foodstuffs and other commodities. The development of rail transhipment facilities also encouraged pastoralists to travel stock to Bowenfels for transport elsewhere, thereby avoiding the arduous climb to Mount Victoria.

Representations made by the Hampton-Lowther Progress Committee during the late 1890s make it clear that pastoralists in this region were travelling livestock to Bowenfels for transport to markets elsewhere. The volume of traffic using the road from Bowenfels through Lowther and Hampton led to agitation for improvements in facilities for travellers and teamsters. In 1898, the Hampton and Lowther Progress Committee wrote to local Members of the Legislative Assembly requesting

> *… a camping reserve in the neighbourhood of the (McKanes Falls) bridge. Such reserve appears to be needed as a good deal of traffic to and from Lowther, Bowenfels and Lithgow, travels over this road. There is no other site in the district better suited for a reserve for travelling teams, inasmuch as Cox's River furnishes an unfailing supply of water, and there is a fair amount of feed in the neighbourhood.*

After much correspondence, the Lands Department promised to resume an area of 12 acres for a reserve. The Hampton and Lowther Progress Committee considered this "too small for the needs of the district. Twelve acres they say, would only be like a yard for the number of teams travelling the road and they reckon at least fifty acres should be resumed". Despite this report, the New South Wales Government Gazette of 8 November 1899 confirmed that, after considering the matter the Local Land Board had proposed the resumption of about 10 acres of land at McKanes Falls, out of John Maxwell's (now Burns and Stevenson's) 600 acres, for a camping reserve." This resumption was formalised on 6 June 1902, when Portion 12 Parish of Lowther was created from resumed sections of Portions 6 and 7. A Camping Reserve was dedicated on Portion 12 on 10 October 1906.[58] The reserve is currently designated as Lot 1 DP 1093659 and Lot 7003 DP 92867, and the location in relation to the current McKanes Bridge is shown in Figure 2-28.

[57] *Goulburn Herald and Chronicle* 9 March 1878; McKanes Falls Bridge, Office of Environment & Heritage Database No. SHR 5051377.
[58] "Camping Reserve at McKane's Falls" *Lithgow Mercury* 2 March 1900 p.6; NSW Government Gazette Wednesday 8 November 1899 No.889; Parish of Lowther, County of Westmoreland 1894; Parish of Lowther, County of Westmoreland 1926.

Figure 2-28: Satellite image of the locality of McKanes Bridge and camping reserve. The two sections of the reserve are outlined in red. This area covers the former Portions 6 & 7, which were dedicated as Portion 12, Camping Reserve in 1906

(source: Ray Christison, November 2017)

The size and condition of the Bowenfels trucking yards was a source of ongoing frustration for members of the Hampton and Lowther Progress Committee.[59] Despite their inadequacies, the trucking yards continued in use well into the 20th century. A deputation to the Railway Commissioner in 1925 described the yards as inadequate. There were no watering facilities for cattle and sheep, which travelled long distances to these yards, often arriving "in a famishing condition".[60] Stock were still being travelled to Bowenfels from the Hampton region in the 1940s with ongoing agitation for a dedicated stock route. In 1948, the Ganbenang-Lowther branch of the Agricultural Bureau of NSW noted that the lack of a dedicated track had resulted in the death of many stock, killed by fast moving traffic on the Great Western Highway.[61]

[59] "Visit of Railway Commissioners" *Lithgow Mercury* 18 April 1902 p.6; *Lithgow Mercury* 27 January 1905 p.5; *Lithgow Mercury* 8 March 1907 p.9
[60] "Bowenfels Railway Accommodation" *Lithgow Mercury* 1 April 1925
[61] "Motor Traffic Kills Stock" *Lithgow Mercury* 21 July 1948 p.2

2.4 Design and construction of the bridge

2.4.1 The need for the bridge

The 1860s road to Binda Caves was formally confirmed as the road between Bowenfels and Oberon on 5 May 1883. This road descended along the ridge through John James Robson Bowman's "Clwydd Valley" property, to the ford described by John Lucas in 1863. The 1890 map (see Figure 2-29) also shows a track deviating from the road part way down the ridge and meeting it again just above the ford of Cox's River. The 1892 map (see Figure 2-30) of the Parish of Lett indicates that the road leading down to the bridge had been re-aligned to form a gentler approach to the northern side of the newly constructed McKane's Bridge. This new road alignment was roughly consistent with the earlier track identified in 1890. It was formally confirmed as the main route on 6 February 1897 (see Figure 2-31).[62]

Figure 2-29: Historical Parish Map, County of Cook, Parish of Lett, Edition 2, 1890.

By contrast with maps of the Parish of Lett, the 1890 map (see Figure 2-32) of the Parish of Lowther, County of Westmoreland shows only a network of tracks criss-crossing Portion 7 on the southern side of Cox's River. One track runs south from the river towards the ridgeline and the Glenroy to Lowther road. Another, following the route of Cox's Road, runs east towards Glenroy. By 1894 the map (see Figure 2-33) of the Parish of Lowther shows a properly formed road leading south from the bridge across Cox's River. A ford is marked upstream of the timber truss bridge.[63]

[62] Parish of Lett, County of Cook 1890, 1892, Crown Plan 490-691 cited in Ray Christison 2017.
[63] Parish of Lowther, County of Westmoreland 1890, 1894 cited in Ray Christison 2017.

Figure 2-30: Historical Parish Map, County of Cook, Parish of Lett, Edition 3, 1892.

Figure 2-31: Historical Parish Map, County of Cook, Parish of Lett, Edition 4, 1897.

Figure 2-32: Historical Parish Map, County of Westmoreland, Parish of Lowther, Edition 1, 1890.

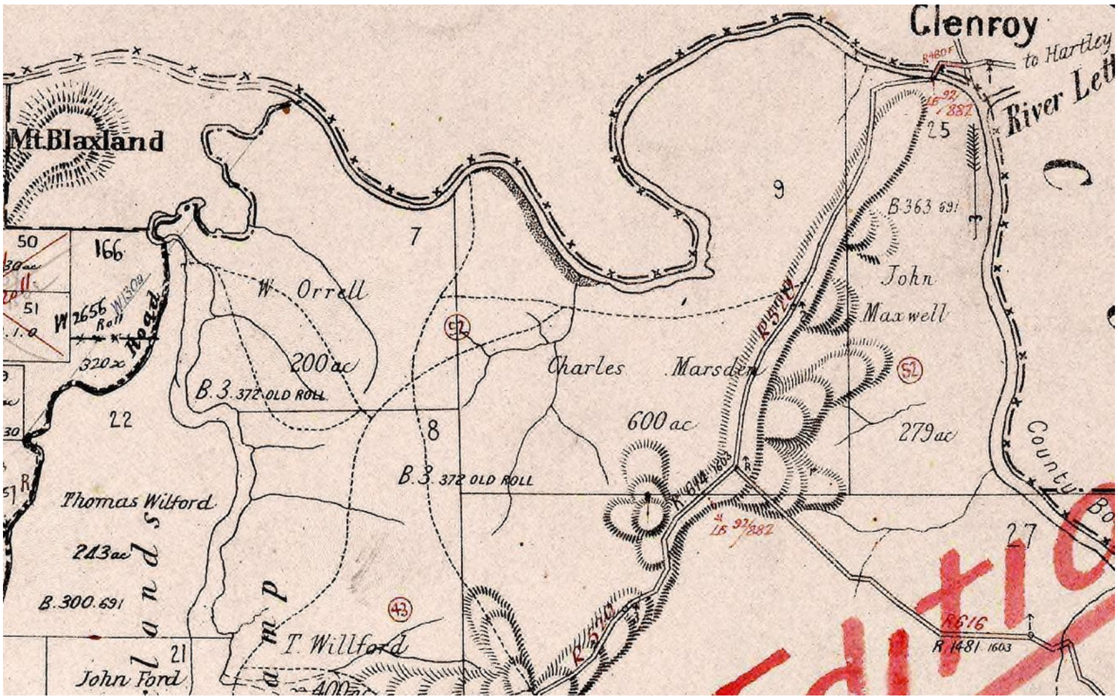
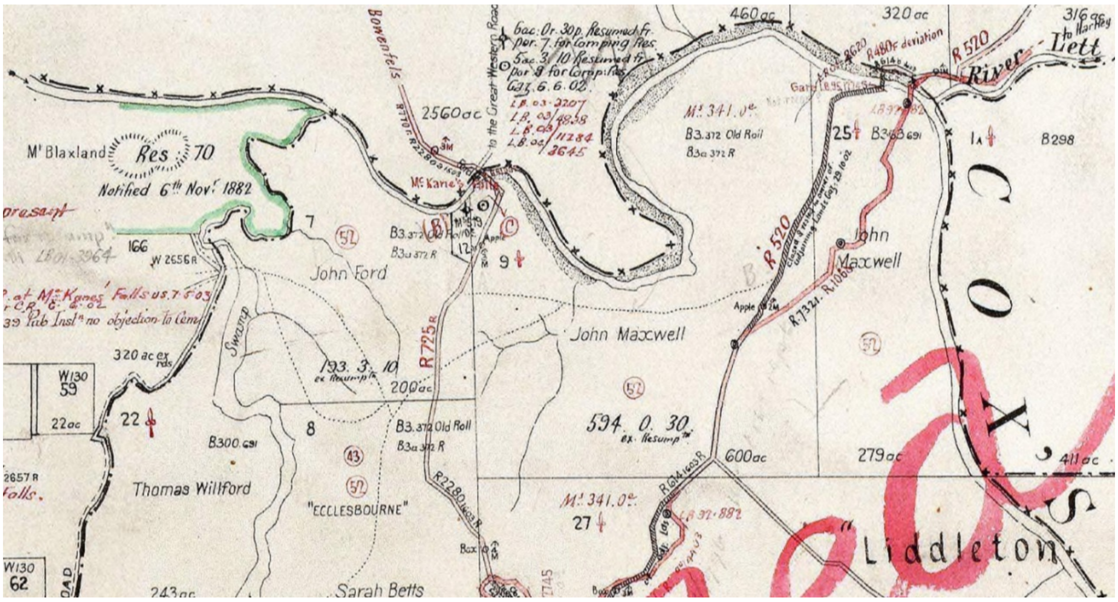


Figure 2-33: Historical Parish Map, County of Westmoreland, Parish of Lowther, Edition 2, 1894.



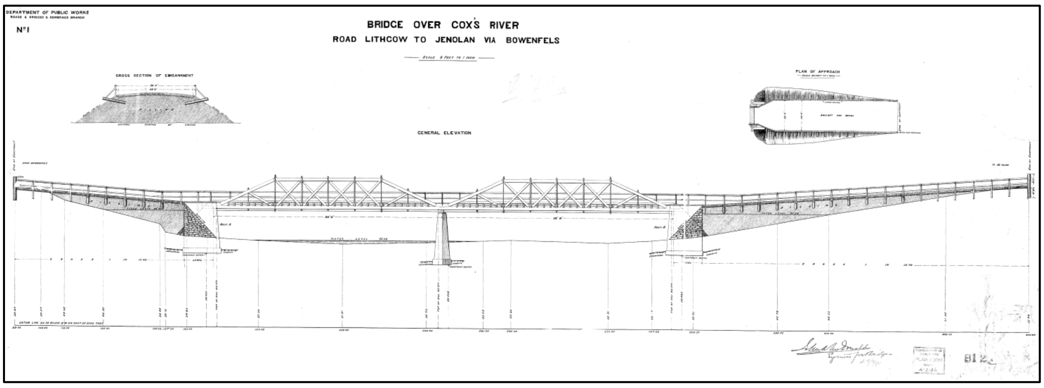
It appears that construction of the timber truss bridge was a response to increases in traffic on the road, and disruption of traffic due to flooding. The need for a bridge may have been highlighted by the death of Bowenfels resident Andrew Sheppeard in 1890. The horse Sheppeard was riding stumbled as he traversed the flooded ford at McKanes Falls. He and the horse were swept away in the floodwaters. Sheppeard grabbed a sapling and held on as his companions tried to throw him a line fashioned from horse bridles. Despite their efforts, he succumbed to exhaustion and cold, and eventually lost his grip on the sapling and was swept away out of sight.[64]

[64] 'Fatalities at Cox's River", *Sydney Morning Herald*, 24 June 1890 p.5 cited in Ray Christison 2017.

2.4.2 The construction of the bridge

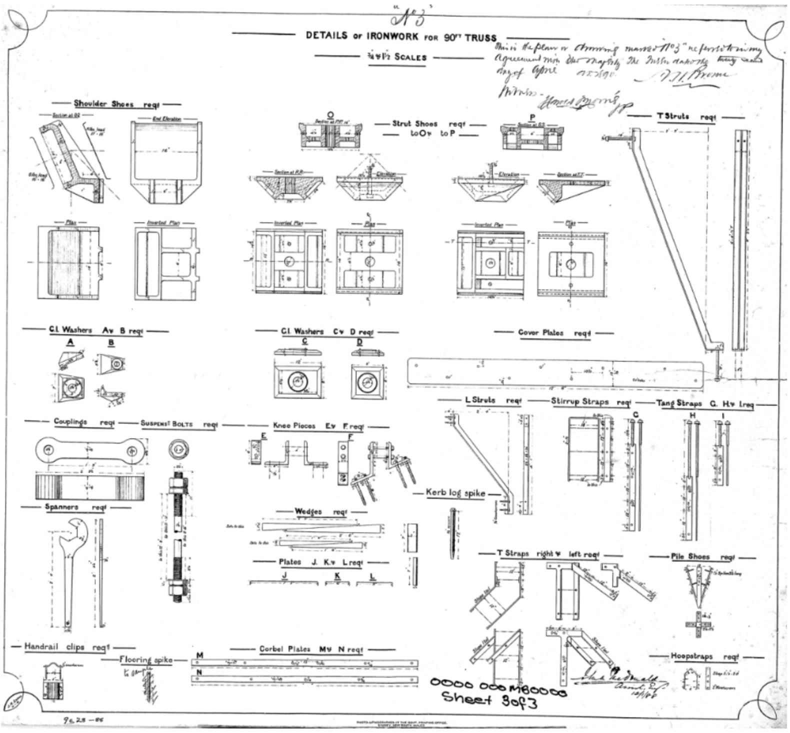
Tenders for construction of a “Timber Truss Bridge over the Cox’s River, on road Lithgow to Jenolan”, were advertised by the Department of Public Works in August and September 1891, and closed on 30 September 1891.[65] A contract for the works was let to Giffard and Matchett in October 1891.[66] The bridge, consisting of two McDonald trusses supported by masonry abutments and a masonry pier, was constructed according to the drawings shown in Figure 2-34 to Figure 2-37.

Figure 2-34: 1st of 3 Original drawings signed by McDonald 1891.



(source: 0000.258 BC 0127 #1)

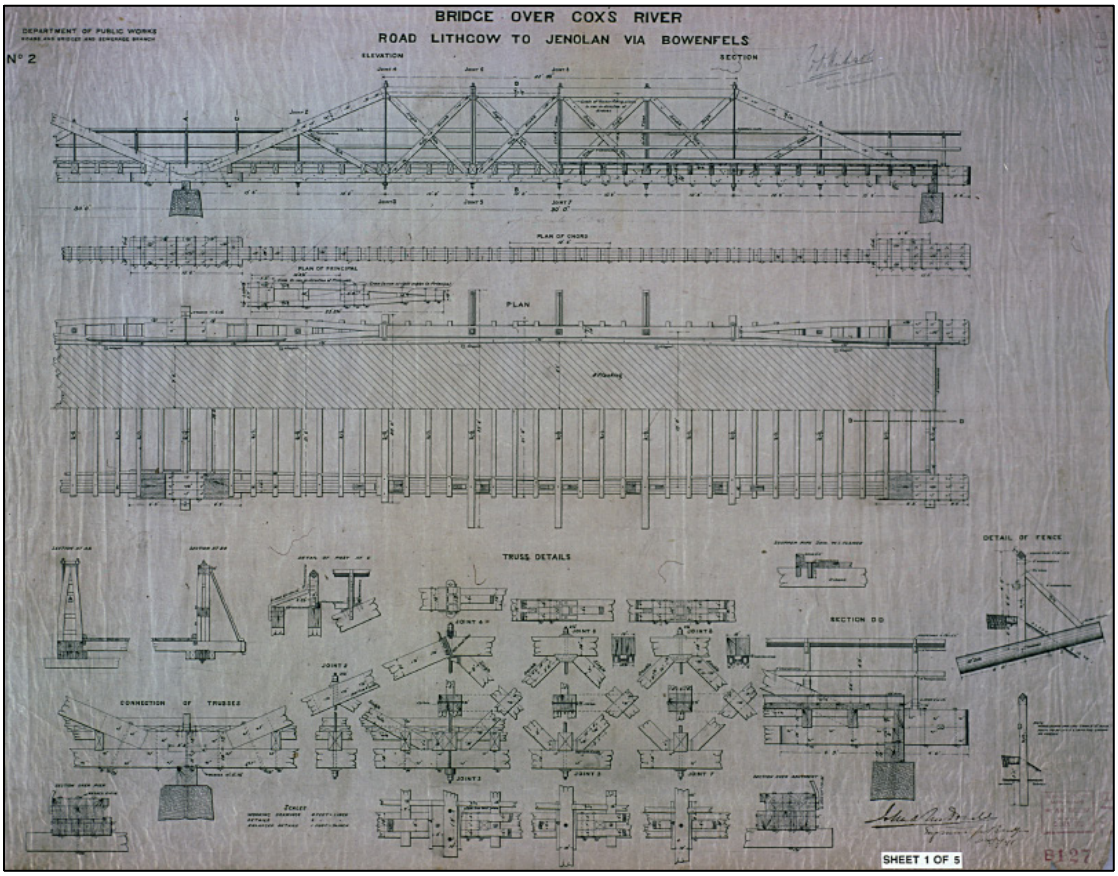
Figure 2-35: Standard design drawing for details of ironwork for 90’ McDonald truss signed by McDonald in January 1888 and used for all 90’ McDonald trusses.



(source: 0005.000 MB 0000)

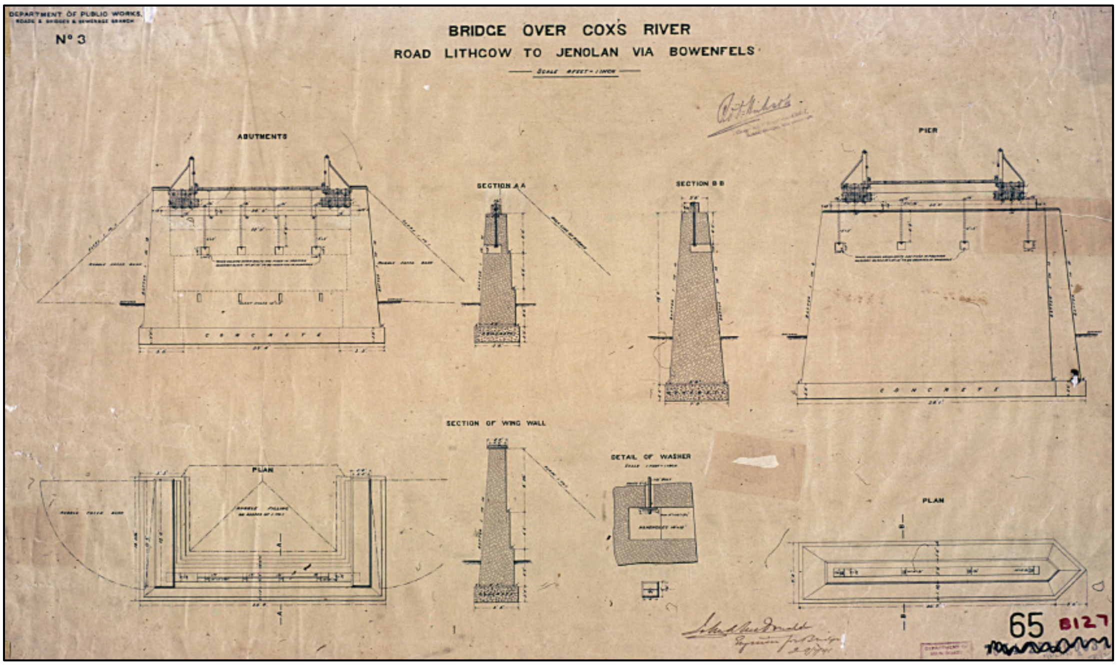
[65] NSW Government Gazette Wednesday 14 August 1891 No.528 p.6292; NSW Government Gazette Wednesday 15 September 1891 No.596 p.7358 cited in Ray Christison 2017.
[66] NSW Government Gazette Wednesday 20 October 1891 No.664 p.8243 cited in Ray Christison 2017.

Figure 2-36: 2nd of 3 Original drawings signed by McDonald 1891.



(source: 0000.258 BC 0127 #2)

Figure 2-37: 3rd of 3 Original drawings signed by McDonald 1891.



(source: 0000.258 BC 0127 #3)

2.4.3 The naming of the bridge

The current SHR listing states that it is most probable that McKanes Falls, McKanes Crossing and McKanes Bridge were named after Archibald McKane. No known evidence has been found to support this. The idea was first reported in a 1998 document without references which stated:

> *The original road westward from Penrith to Bathurst was built by William Cox in 1815. This line of road passed within 1 km of McKane's Falls (then unnamed)… It is most probable that McKane's Falls and subsequently McKane's Crossing and McKane's Bridge, were named after Archibald McKane (or McKain, or McKean). Archibald McKane was born in Edinburgh, Scotland in 1807 and was trained as a joiner and a ploughwright. He was able to read and write. He was tried in Edinburgh, on the 12th of March 1830, for cattle stealing and sentenced to seven years. After arriving in Sydney on the 19th of December 1830, he was appointed to Public Works. On the 25th of May 1833 he was tried by the Supreme Court for larceny (ie theft) and sentenced to another seven years. After many further convictions and finally a run of good behaviour, he was appointed overseer of carpenters in the 1830's. He was involved in expeditions with Mitchell and was granted his certificate of freedom in February 1844. Mitchell commended McKane's contribution and his leadership of the party in his duties of carpenter and carriage of the No.2 barometer. He received, along with his certificate of freedom, a "gratuity" of five pounds under Bourke's direction.*
>
> *A decision was made in the early 1830s to find a more suitable route off the western escarpment of the mountains and after several proposals put to the Governor, it was decided that Mitchell's Line be accepted. This road was constructed, commencing in 1832 and thus put the road further away from McKanes Falls. With the advent of the new road, the village of Bowenfels was surveyed along its route, some 8km from McKane's Falls, which was its closest settlement. The two locations were linked by a rough bush track, which crossed the Cox's River at a place called McKane's crossing, believed to be some 150m downstream from the present bridge. The name McKane is difficult to trace as it does not appear on any documentation or maps that were found…*[67]

While it is clear from Mitchell's writings that a person named Archibald McKane (sometimes spelled McKean) was indeed involved in the expedition with Mitchell to the Darling in March 1836, being a carpenter and barometer carrier, there is no specific mention of him in relation to the Coxs River.[68]

It is mentioned that, on 19 October, when Mitchell's party were crossing the Murray River, Archibald McKane suggested that he take the party's Aboriginal guide, Tommy, and two others to return to the Goulburn River and construct rafts for a party following the main expedition with supplies. McKane's suggestion resolved any problems with the need to return the party's boat a great distance to allow the following party to cross the Ovens and Goulburn Rivers.[69] However, it appears that after various failed experiments trying to construct the rafts, a canoe of very large dimensions paddled by Tommy was discovered and used for the boxes of valuable equipment.[70] Therefore, although it may be possible that the naming of McKanes Crossing has some association with the convict Archibald McKane, the link is rather tenuous and unproven. No record has been found to date of the opening or naming of the McKanes Bridge over the Coxs River.

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[67] Peter Seligman, Heritage Assessment and Conservation Management Plan, McKane's Bridge, November 1998, Hughes Trueman Reinhold for Roads and Traffic Authority, pp 14 -16.

[68] Major T L Mitchell, *Three expeditions into the interior of Eastern Australia, with descriptions of the recently explored region of Australia Felix, and of the present Colony of New South Wales*, Edition 2. London: T. & W. Boone, 1839, Volume 2, Journal of an Expedition to the Rivers Darling and Murray, in the year 1836, p 2.

[69] Mitchell, 1839. *Three Expeditions into the interior of Eastern Australia; with descriptions of the recently explored region of Australia Felix, and of the present Colony of New South Wales*, p 305.

[70] Mitchell, 1839. *Three Expeditions into the interior of Eastern Australia; with descriptions of the recently explored region of Australia Felix, and of the present Colony of New South Wales*, pp 335-336.

2.5 Repair and use of the bridge

Unfortunately, the corporate maintenance files for McKanes Bridge were not able to be retrieved for the preparation of this CMP. They were last borrowed from NSW State Archives in 2010, and have not been returned. The regional files have been used, along with what was summarised from the corporate maintenance files in 2003 CMP which is copied in full here.

Year	Summary of maintenance work undertaken	Cost
1925/25	About 5000 s. ft. of brush box decking laid.	
1926	Outer chords tarred and truss painted.	
1934	Lower chord and substructure re-tarred. Bridge screwed up. Superstructure and approach protection fences painted.	
1935	Repairs to deck and minor repairs to structure.	£165
1941	Dismantling and erecting squared timber, painting tarring, and concrete.	£175
1951/52	Replaced part of bottom chord, tightened, cleaned and painted ironwork black, painted timber white, tarred underside of new decking.	£538
1952/53	Minor repairs, handrails replaced, repainted.	£150
1958/59	At least 120 lin. ft. decking renewed, parts of handrail replaced, some cross girders, inside flitch on lower chord renewed and some painting and creosote applied.	£1,929
1960/62	Minor repairs, some decking replaced, tightened, longitudinal sheeting fitted over whole of deck.	£1,156
1967	Repairs to truss members.	$179
1968/69	Undertook some painting, dismantling and erecting truss members.	$4,025
1975	Painting and cleaning, work on kerbs, decking and handrails.	$3,764
1979/80	Replacement of decking and sheeting recommended. Approval sought to redeck with Lysaght steel deck and cement concrete infill.	
1981/82	Decided to redeck in timber, also some trusses replaced.	
1982/83	Work included construction of concrete floor and walls at the ends of the trusses at both abutments to stop white ant infestation. Replacement of some truss members, pier sill, some butting blocks.	$66,459
1986/87	Extensive flood damage (masonry pier displaced 1m downstream, superstructure twisted, cracking in masonry walls in abutments). Damaged central pier replaced with concrete.	$221,586
1988/89	Routine Maintenance	$54,837
1990/91	$100,000 worth of work, but details not provided	$98,432
1991/92	Termite treatment & minor element replacement	$93,825
1993/94	$50,000 worth of work, but details not provided	$51,452
1994/95	$150,000 worth of work, but details not provided	$138,272
1995/96	Routine maintenance	$11,147

Year	Summary of maintenance work undertaken	Cost
1996/97	Routine maintenance	$9,927
1997/98	Cross girder repairs & replacement	$143,969
1998/99	$250,000 worth of work, but details not provided	$234,448
1999/2001	Major refurbishment & element replacement	$1,729,598

There is very little information on the repair and use of the bridge for the first thirty years while it was under the care of the Department of Public Works until it was handed over to the newly formed Main Roads Board (MRB). The only early information is found in the bridge register, known as the "Blue Book", which is held by Transport for NSW.[71] There are two maintenance actions recorded, "1899: screwed up tarred & painted" and, "1917: keys in bottom chords over piers and abutments tightened and new keys fixed where old ones missing".

Figure 2-38: Earliest photograph found of McKanes Bridge in 1950.

(source: Dubbo File #258.853)

In the 1940s it was noted that some of the large iron washers at the ends of the tension rods had broken, but it was almost ten years before they were finally replaced with new washers. In 1942 a spliced connection was introduced at one of the principals due to difficulties in obtaining timber of the size the original design required. Tenders were invited for the timbers in accordance with the original design dimensions but none were received. The introduced splice with metal splice plate can be seen at the right hand side of Figure 2-38 above. The photograph, taken in 1950, is the earliest photograph of the bridge on record, and was taken immediately after new decking had been provided on one span, a prop had been removed from the truss, the ironwork had been painted with red lead then two coats of black paint and the new deck planks had been tarred.

In the early 1950s, bolting planks were introduced under the timber deck. The camber of the McDonald trusses was originally zero, but in 1951 the camber was measured to be 1¾" (45 mm). Figure 2.38 shows the timber rails extending well past the bridge up the road, but having considerably greater width on the unsealed approach roads than on the bridge. It also shows the original configuration of the kerbs which provided more width at the centre of each span than at the ends of each span due to their curved alignment. The bridge appears to have retained its original black (for metal) and white (for timber) colour scheme at this stage.

[71] The Blue Book, Bridge Engineering Section of Roads and Maritime Services, p 13.

Figure 2-39: McKanes Bridge in 1954.

(source: Dubbo File #258.853)

Figure 2-40: Bridge in 1978 with longitudinal timber sheeting.

(source: Dubbo File #258.853)

In the mid to late 1950s, the trusses (both metal and timber components) were painted grey down to kerb level, with only the rails and kerbs remaining the original white colour (Figure 2-40). The timbers below the level of the kerb (such as the cross girders and bottom chords) were tarred.

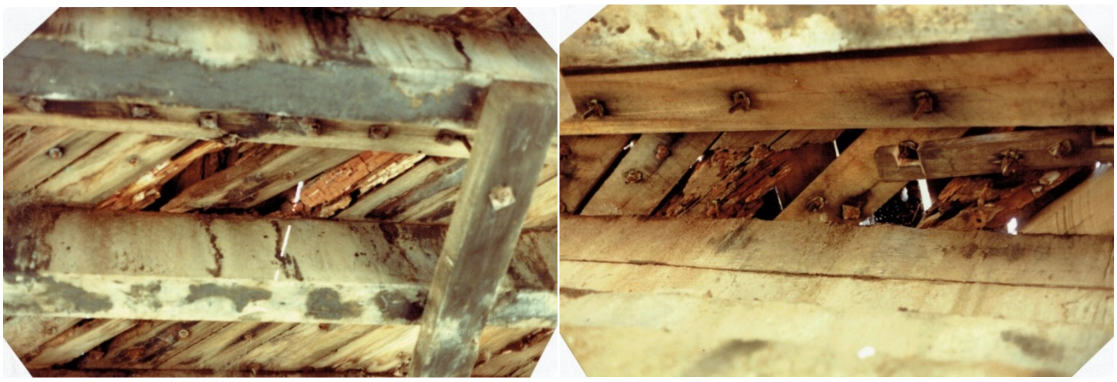
In the early 1960s, 2" (50 mm) thick longitudinal timber sheeting was added to the bridge on top of the 4" (100 mm) thick diagonal decking, and new bolting planks were provided under the deck for the bolted connections that had been introduced to replace the original iron spikes for the deck.

Figure 2-41: First colour photograph of bridge on file, taken 1979.

(source: Dubbo File #258.853)

By the late 1970s, the road either side of the bridge had been sealed, and in 1980 it was decided to replace the deck of the timber truss bridge with a steel decking with concrete infill. The diagonal decking with longitudinal sheeting was in very poor condition by that stage (see Figure 2-42).

Figure 2-42: Poor condition of diagonal decking in 1981.



(source: Dubbo File #258.853)

However, a large quantity of timber decking became available the following year, and it was decided to replace the decking at McKanes Bridge with a single layer of new 200 x 125 mm thick longitudinal decking. This work was carried out in 1982, followed by considerable work continuing until 1984, consisting of replacement of many truss timbers and the construction of concrete floor and walls at the ends of the trusses at both abutments in attempts to stop termite infestation.

Figure 2-43: Photographs showing replacement of principal, 1982.

(source: Dubbo File #258.853)

As can be seen in Figure 2-45, the ends of the bottom chords had suffered a considerable level of deterioration due to rot and termite attack, being unprotected from the soil of the approach roads.

Figure 2-44: Photograph showing replacement of principal in 1982 which required temporary removal of the top levels of stone in the masonry abutment.

(source: Dubbo File #258.853)

Figure 2-45: Photograph showing new principal and butting blocks being installed and connected to deteriorated laminated timber bottom chords in 1982

(source: Dubbo File #258.853)

Flood damage in 1986

Heavy rain in the winter of 1986 resulted in flooding of the Cox's River which peaked on 6 August. Large amounts of debris, including logs of 600 mm diameter, were washed against the bridge. This, together with the scouring of the river bed on the downstream side of the pier, resulted in the pier rotating and moving, taking the superstructure downstream by approximately a metre. The pier was damaged beyond repair (Figure 2-48). The resilient timber superstructure accommodated the distortions although the difference between the upstream and downstream deck levels over the pier was approximately 900 mm (Figure 2-49). The bridge was immediately closed to traffic.[72]

It became apparent in December 1986 that vehicles were still using McKanes Bridge despite the obvious distortion as well as the obstacles (round bridge girders and heaps of coal filing, as shown in Figure 2-46) placed at each end by the bridge gang and Lithgow City Council.[73]

Figure 2-46: Photos of ineffective bridge closure after flood damage.

(source: Lithgow Mercury)

As recorded in the *Lithgow Mercury*, a delegation of concerned residents from the Hampton-Lowther area met with the State Member, Mr Clough in Lithgow to seek urgent priority status for the repairs to the flood damaged McKanes Bridge. The lengthy bridge closure was causing concern particularly to residents and businesses along the Jenolan Caves Road and to bus operators who serviced the area, and was reportedly causing noticeable fall off in tourist traffic.[74]

In order to facilitate the earliest possible reopening of the bridge for the minimum cost, concrete pile caps were constructed above the water level, allowing construction in dry conditions. The river level was subject to rapid fluctuations due to saturated catchment conditions, but a level was determined which required partially exposed pile caps. It was acknowledged at the time that this may detract from the appearance of the new pier, but this aspect of aesthetics was seen to be less of an urgent consideration when compared with the need to construct the new pier expeditiously and at the lowest cost possible.[75] The bridge was re-opened to traffic on 3 July 1987.[76]

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[72] Benjamin Lau, 'McKanes Bridge pier replacement', Proceedings 14th ARRB Conference, Part 6, p 1.
[73] File note on File 258.62 from B Chellingworth to the Works Engineer dated 31 December 1986.
[74] *Lithgow Mercury*, Tues 21 Oct 1986, 'McKanes detour slows tourism: Bridge closure poses as danger.'
[75] File note on File 258.62 from Divisional Engineer to the Cheif Engineer dated 20 November 1986.
[76] Benjamin Lau, 'McKanes Bridge pier replacement', Proceedings 14th ARRB Conference, Part 6, p 4.

Figure 2-47: Photos of flood damage taken 7 August 1986.

(source: RMS File 258.62)

Figure 2-48: Photos of flood damage taken 12 August 1986.

(source: RMS File 258.62)

Figure 2-49: Photograph showing flood damage and distortion

(source: Dubbo File #258.853)

Figure 2-50: 1992 photo of concrete pier as constructed in 1987.

(source: Dubbo File #258.853)

Figure 2-51: Photo showing concrete pier constructed in 1987.

(source: Roads and Maritime)

The first concrete pile cap is shown in Figure 2-50, but this suffered further scour damage, so in 1993 the concrete pier modified by additional concrete and gabion rock baskets to streamline water flow and reduce the risk of future scour damage, as can be seen in Figure 2-51.

Heritage Significance Study 1998

In 1998 Roads and Maritime commissioned a study to assess the heritage significance of the remaining seven McDonald timber truss road bridges in New South Wales.[77] In that assessment, McKanes Bridge was ranked as the second most significant McDonald truss after Junction Bridge.

Figure 2-52: Photo showing bridge in January 1998.

(source: Hughes Trueman Reinhold)

An inspection of McKanes Bridge was undertaken in January 1998 as part of the study. It was noted that the upstream end blocks at the Oberon end had decayed and failed allowing longitudinal movement of the principal. This had required a Tri-shore to be placed under the bottom chord and meant the diagonal principal prop had come loose along with the adjacent suspension rod.

Figure 2-53: Photo of loose members and Tri-shore.

(source: Hughes Trueman Reinhold)

[77] Hughes Trueman Reinhold, McDonald Truss Road Bridges in NSW, Heritage Significance Study.

Figure 2-54: Photos of deterioration and damage in 1998.

(source: Hughes Trueman Reinhold)

It was also noted that one metal washer to the underside of a bottom chord was cracked (top left photo of Figure 2-54), and that some of the vertical timber shear keys at the ends of the bottom chords were either loose (top right photo of Figure 2-54) or missing (bottom left photo of Figure 2-54). The missing shear key caused allowed longitudinal displacement of the bottom chord.

It was noted that the tension rods had differing thread pitches suggesting that some or all of the tension rods were no longer original. In addition to this, the short lengths of some of the tension rods protruding below the bottom chord had been bent slightly, presumably by flood debris. Some of the cross girders exhibited fungal and pipe decay (bottom right of Figure 2-54).

The report noted that two of the McDonald truss bridges (McKanes Bridge over the Cox's River near Lithgow and Pearce's Creek Bridge on the Hornsby to Galston Road) were registered by the Australian Heritage Commission as well as being listed on the State Heritage Register. The report also noted that although McKanes Bridges lies within an area of some historical significance and has items of historical significance nearby, the bridge has only minor connection with the surrounding history compared to its significance in the context of bridges within New South Wales.

The report also notes in the context of the seven remaining McDonald trusses at the time, that, "McKanes Bridge near Lithgow with its reinforced concrete central pier has the most obtrusive and permanent alteration. The crucial point about the pier is that it does not affect the integrity of the trusses and hence does not preclude the bridge from being considered significant." It also stated:

> *The critical point to be recognised when considering integrity is that the timber members undergo continual replacement over the decades of the bridges life. Thus original timbers have mostly been replaced and any unsympathetic repairs to timbers can be rectified when the affected members reach the end of their service life. This replacement of timber does not affect the historical, aesthetic or technical significance (provided McDonald's design in followed) and enhances the social significance by maintaining a community asset.*

Rehabilitation works on DVD in 2001

In 1999 to 2001, major refurbishment was carried out on the bridge, and part of this work was captured on video as part of the Roads and Maritime Oral History Program, which produced a DVD in 2001 entitled “Maintaining the links: Maintenance of historic timber bridges in NSW.”

The video describes the need for the work at McKanes Bridge at that time, “About a year ago a very heavy load went over this bridge and that actually did a lot of damage and distorted the trusses as well as warped them and we’ve had to come in and do a lot of works.” The first step was to install Bailey bridging on all four trusses so that the work could be done on the bridge still open to traffic. The installation of Bailey bridging narrows the carriageway.

Figure 2-55: Timber trusses completely unloaded with Bailey trusses.

(source: Oral History, 2001)

Figure 2-56: Deterioration of timbers removed from McKanes Bridge.

The next step, as described in the oral history, was to conduct test boring of the timber to determine which timbers require replacement, as often the deterioration can be hidden from view. Some of the deteriorated members which were removed from the bridge are shown in Figure 2-56. Deterioration was extensive at the bases of some of the principals, meaning they could no longer carry loads, and there was also rot and termite attack in the bottom chords and cross girders. The ends of the bottom chords were particularly rotted due to accumulation of moisture which flowed down from the road approaches onto the trusses.

(source: Oral History, 2001)

Because the bottom chord is a laminated timber bottom chord continuous over the two spans, the bridge had to be largely disassembled in order to replace the bottom chord. As can be seen in Figure 2-57, all the principals along with the principal props and shorter tension rods had to be removed in order to enable removal and replacement of the deteriorated bottom chord.

Figure 2-57: Disassembly of bridge to replace bottom chords.

(source: Oral History, 2001)

Bottom chord timbers were sourced from Coffs Harbour, and were not available in the original lengths, so relatively consistent lengths of approximately 8m were used with careful staggering of joints as shown in Figure 2-58. After the bottom chords had been replaced, the principals were replaced, and then the deteriorated cross girders and any other deteriorated timbers were also replaced. The new timber railings with posts and kerbs were also installed at this time.

Figure 2-58: Replacement of laminated timber bottom chords.

(source: Oral History, 2001)

Engineers Australia Plaque in 2002

Figure 2-59: Photo of attendees at McKanes Bridge ceremony.

(source: Engineers Australia)

On 21 April 2002, upon completion of the considerable refurbishment works carried out on the bridge, Engineers Australia with Roads and Maritime's predecessor (RTA) installed a plaque at McKanes Bridge to recognise it as a Historic Engineering Marker. Present at the ceremony were representatives from Lithgow City Council as well as the McDonald brothers whose father worked on building McKanes Bridge. The plaque was installed on a large rock placed at the south west end of the bridge, and remains there today.

Figure 2-60: Photo of McKanes Bridge Historic Engineering Marker.

(source: author, 2013)

Unfortunately the Historic Engineering Marker plaque contains a number of errors. The McDonald truss was invented in 1886 not 1884 (as it was based on timber testing only conducted in 1886). Although McDonald trusses were designed to be stronger than the Old PWD trusses, they were not easier to build or maintain. It has also been discovered that some of the bridges originally thought to be McDonald trusses were actually Allan trusses, so there were less than 91 McDonald trusses constructed altogether, with the actual number somewhere between 85 and 90.

Community inconvenience [78]

In February 1982, the Department of Main Roads announced that the bridge would be closed to allow for "urgently needed re-decking". The closure, estimated to take eight to ten weeks, forced local traffic "to take a roundabout route through the Great Western Highway, Hartley and Jenolan Caves Road".[79] Less than five years later, on 7 August 1986, unprecedented rain caused chaos across New South Wales. Many rivers, including Coxs River flooded heavily, and roads were blocked across the Greater Sydney Region. McKanes Bridge was overwhelmed by floodwaters and severely damaged. The principal damage appears have been the displacement of the bridge's central masonry pier, which was caused by erosion of the river bed and flood debris ramming the structure.[80] The force of the unprecedented flood had been exacerbated by the partial failure of the Electricity Commission of New South Wales dam located upstream at Lake Lyell.

Figure 2-61: The bridge photographed during the flood event in August 1986.

(source: Lithgow Regional Library, Lithgow District Historical Society LDHS0650)

In early September 1986, the *Lithgow Mercury* reported that the bridge, "one the biggest in the area", would require major repairs. The newspaper noted that the bridge formed part of a "major arterial road for residents in the Jenolan Caves area and, as such, came under the jurisdiction of the Department of Main Roads (DMR). The DMR Divisional Engineer, Bob Woods had advised the Mercury that he was "working on several ideas on how to go about repairing the bridge. 'It will basically mean rebuilding the centre pier'". When assessing the situation Woods indicated that decisions regarding repair or replacement would be a matter of economics, as a new bridge may cost as much at $1million. "The flood damage came at an

[78] This section on community inconvenience consists of excerpts taken from Ray Christison, McKanes Bridge over Cox's River: Local historical context of the bridge, for Roads and Maritime, 8/11/17, pp 16-19.
[79] "Bridge to be closed" *Lithgow Mercury* 4 February 1982 p.4.
[80] "Damage will be massive" *Lithgow Mercury* 8 August 1986 pp.1-2; "Aldermen to hear cost of old bridge" *Lithgow Mercury* 11 August 1986 pp.1-2; Fraser, D., 2001. Nomination for McKane's Falls Bridge.

inopportune time for the DMR, who had just completed a lengthy and costly repair job on the bridge." Woods estimated that repair of the flood damage would take between two and four months, and possibly cost "about $100,000.[81]

In mid-October, Mr Woods advised local bus operator, Jones Bros Ltd, that the bridge would be out of commission until April 1987 while repairs were undertaken. Work on the difficult repair could not be commenced until the DMR completed repair of another bridge at Glen Davis. As a result works were not expected to commence until January or February 1987. As the bridge awaited repair all road transport was forced to use alternate routes. Many, including heavy vehicles, used the Jenolan Caves Road and the Glenroy bridge to cross Coxs River, while people living at Hampton travelled to Lithgow via the dangerous Hampton Road and Magpie Hollow Road.

The bridge closure particularly inconvenienced the owners of Ecclesbourne and other properties located between the river and Jenolan Caves Road. Many truck drivers refused to negotiate the extremely tight and poorly cambered curve at the intersection McKanes Falls Road and Jenolan Caves Road. This greatly restricted the capacity of landowners to transport cattle and hay. School bus services were also disrupted with 20 minutes added to travel times. Hampton and Lowther residents also expressed concerns about impacts of the closure on tourism, and "vital delays for ambulances and emergency services reaching accidents along the Caves Road".[82]

Repair of the bridge commenced in January 1987 and by April the bridge deck had been jacked into the position to facilitate the construction of a new central pier. The bridge eventually reopened in mid-1987 with a five tonne weight limit.[83] The bridge continued in use until 2 June 1998, when it was closed again. Subsidence, caused by heavy vehicles ignoring the weight restriction, and exacerbated by heavy winter flooding, had led to a more severe weight restriction being imposed on the bridge some weeks prior to the closure. Lithgow Council Engineering Service Manager Iain Stewart advised the Lithgow Mercury that deterioration of the bridge had been largely caused by logging trucks and petrol tankers using McKanes Falls Road as a shortcut between the Great Western Highway and Jenolan Caves Road. He also said that "restriction signs were regularly stolen" from the bridge. After stricter weight limits were imposed in May school buses ferried children to one side of the bridge, with the children alighting and walking across to a bus waiting on the other side. The June closure, forced by additional movement in the bridge, resulted in residents of the Lowther-Hampton district travelling the same alternate routes used in 1986-87.[84]

On 5 June 1998 the RTA advised that it would "construct a Bailey Bridge so that the damaged McKanes Bridge can be re-opened to traffic". The Bailey Bridge was constructed within the existing truss bridge structure in mid-June, the bridge was re-opened with a weight limit of 10 tonnes.[85] The Bailey Bridge remained in place until substantial repairs were undertaken in 2001. Local landholders who were inconvenienced by its closure in 1986 have bemoaned the decision to retain the bridge. With its limited width of carriageway, it is considered by some to be an impediment to traffic using McKanes Falls Road. The five tonne weight limit, imposed between 1987 and 1998, also caused ongoing frustration and inconvenience to anyone requiring heavy road transport.[86] The 4.5 tonne load limit imposed in 2017 has led to difficulties again for the 11 tonne school bus.[87]

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[81] "McKanes Bridge may be saved, but at a cost" *Lithgow Mercury* 4 September 1986 p.1.

[82] "Bridge out until April" *Lithgow Mercury* 14 October 1986 p.1; "McKanes detour slows tourism: Bridge closure poses a danger" *Lithgow Mercury* 21 October 1986 p.3; Pers. Comm. Gregory Monaghan 1 November 2017; Pers. Comm. Kay Shirt 3 November 2017 as cited in Ray Christison 2017.

[83] "Bridge repairs start" *Lithgow Mercury* 17 Jan 1987 p.3; "Short cut to the Caves Road may soon to be re-opened" *Lithgow Mercury* 14 April 1987 p.1; "Bridge opening in late June" *Lithgow Mercury* 30 May 1987 p.2.

[84] "Road closed as bridge shifts on foundations" *Lithgow Mercury* 4 June 1998 pp.1,6.

[85] "Bailey Bridge for McKanes problem" *Lithgow Mercury* 6 June 1998 p.2; "McKanes .. you've done it again!" *Lithgow Mercury* 13 June 1998 pp.1,2.

[86] Pers. Comm. Gregory Monaghan 1 November 2017 cited in Ray Christison 2017.

[87] Community complaint received in 2017 by Roads and Maritime by phone.

Leisure and recreation

In addition to providing a welcome resting place for animals travelling on the road, the reserve located immediately beside the bridge (Figure 2-28) also proved to be a popular picnic spot. It was described as early as 1902 as a favourite resort for holiday picnics from town and an established place of call for driving and cycling parties".[88] During the early to mid-20th century large groups from Lithgow took advantage of the reliable river crossing to organise picnics on the southern side of the river. These picnics occurred either within the camping reserve, or on the adjoining property owned by the Bryant family. Several *Lithgow Mercury* reports describe such events. In December 1933, the Lithgow State Coal Mine held an "outing", attended by 150 people, who were transported to Blaxland Swamp in "three buses and cars". Attendees at the gathering were entertained by the State Mine Band, participated in "community singing, games and dancing on the grass". Competitive races, a popular feature of State Mine picnics, were also held.[89] State Mine picnics were a regular feature of the Lithgow calendar for at least three decades. It appears that this outing, occurring soon after responsibility for the mine was transferred from the Department of Railways to the State Mines Control Board, was the first of these events. In November 1950, the St Patricks Rugby League Club held their annual picnic "at Blaxland Swamp on Mr Bryant's property". On this occasion two busloads of picnickers travelled from Lithgow to attend.[90]

In November 1940, the reserve was listed among picnic spots within the Lithgow district that had become popular with motorists visiting the Blue Mountains. This and other places were noted as "some of the prettiest sites imaginable along the rivers and creeks". At this time, Blaxland Shire Council was considering the erection of fireplaces for picnickers visiting these places.[91] While larger organisations tended to use river-front pastures on Ecclesbourne and Mt Blaxland, smaller groups made regular use of the reserve near the bridge. A large bushfire, which emanated near McKanes Bridge in February 1940, was blamed on "careless picnickers visiting the river".[92]

The reserve today remains a popular place for recreational activities. Coxs River has been identified as one of the most popular trout streams in Central New South Wales. Online fishing guides identify that "a small area of river can be accessed at McKanes Falls Bridge".[93]

The bridge has been on a popular cycling route since it was first constructed. The map on the following page is taken from an 1897 report on favourite cycling routes to visit the Jenolan Caves. In the article it recommends the route down from Mount Victoria through Hartley and mentions the turnoff to Bowenfels, which is the road on which McKanes Bridge is located, but notes that:

> *There is a sign-post at this turn, but, like most of the other signs in the district, it is only a skeleton, and it would take a professor of the dead and forgotten languages to decipher it.*

Although McKanes Bridge this route is not taken on the journey to the caves, it is one of the recommended routes for returning from the caves, where the Mount Victoria route is left at Stony Pinch (Figure 2-62) and the road taken through Bowenfels to Lithgow in order to "save the tremendous pull from Cox's River up to Mount Victoria, which is a climb for about five or six miles".[94]

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88 "Visit of Railway Commissioners" Lithgow Mercury 18 April 1902 p.6 cited in Ray Christison 2017.
89 "Staff picnic. State Mine outing" *Lithgow Mercury* 11 December 1933 p.2 cited in Ray Christison 2017.
90 "St Pat's League Club annual picnic" *Lithgow Mercury* 3 February 1950 p.5 cited in Ray Christison 2017.
91 "Picnic Beauty Spots" *Lithgow Mercury* 29 November 1940 p.2 cited in Ray Christison 2017.
92 "Fire Fiend. Bowenfels again has to fight blaze" *Lithgow Mercury* 26 February 1940 p.2 cited in Ray Christison 2017.
93 Blue Mountains Fishing – Cox's River (Online) Available: http://www.bluemountainsfishing.net/rivers-streams/eastern-streams/coxs/ (2017, October 15) cited in Ray Christison 2017.
94 "The Jenolan Caves", *Daily Telegraph* Saturday 13 November 1897, p 4.

Figure 2-62: Favourite cycling tours of 1897.

(source: Daily Telegraph, Sat 13 Nov 1897, p 4)

McKanes Bridge continues to be a popular route for cyclists today, although unfortunately this is evidenced by accidents and community complaints rather than tourist brochures and articles.

In April 2016 the *Lithgow Mercury* reported that a “36-year-old man was with a group of cyclists crossing the Coxs River bridge on the McKanes Falls Road when it was reported a wheel slipped into a gap in the structure sending him out of control. He fell heavily, suffering a severe impact to his head… He was flown to Westmead Hospital where he was later described in a serious but stable condition suffering head and limb injuries”.[95] There have also been recent community complaints with regard to the poor skid resistance of the smooth timber deck during winter. Apparently in the cold weather ice forms on the deck, and when this is combined with the gaps between timbers it is considered a hazard for motorcycle riders as well as other cyclists.[96]

[95] “Coxs River bridge rut claimed cyclist” Lithgow Mercury, 26 April 2016, Shannon Bellamy, Len Ashworth.
[96] Customer Complaint received by phone call to Roads and Maritime on 27 February 2017.

Top chord replacement in 2010

While the major refurbishment works undertaken around 2000 were captured on video, the works undertaken ten years later were captured by Google, who recorded the bridge in February 2010. In February 2010, only one truss was being carried by Bailey and this was done in order to replace the top chord. When the Google vehicle drove over the bridge, the top chord had been removed, but the new top chord had not yet been installed, and so unique views of the top chord shoes can be seen, as well as something of the methodology used for replacement of top chords. Only the northwest top chord was replaced at that time, and today this top chord can be distinguished from the other top chords by the lack of spacers which had been provided for the installation of flashing.

Figure 2-63: Google street view of McKanes Bridge in February 2010.

(source: GoogleMaps)

Figure 2-64: Top chord shoes of McKanes Bridge with top chord removed.

(source: GoogleMaps)

2.5.1 The bridge today

McKanes bridge is located on a road which is still of substantial importance to the local and regional community. It is used by the school bus, for access to local properties, as a convenient short-cut from the Great Western Highway to the Jenolan Caves Road, as a detour route when required, as well as being of substantial importance as a tourist and recreation route. The reserve next to the bridge continues to be used for various recreational purposes such as fishing.

The bridge was signposted with a 4.5 tonne load limit in 2017 due to concerns about deterioration of timbers and strength of modified bottom chords. This has again caused inconvenience to the community and has limited the usefulness and appreciation of the bridge. After some temporary packing was installed at the ends of the bottom chords, the load limit was increased to 15 tonnes.

Figure 2-65: Load limit and warning signs at bridge approaches.

(source: Road and Maritime)

3. Documentary and physical evidence

3.1 Analysis of the existing fabric

3.1.1 Definitions of condition states for a timber truss bridge

Reference is made in this Section to an inspection carried out by Roads and Maritime on 8 February 2017.[97] This is the most recent of the regular inspections undertaken by Roads and Maritime in accordance with the Bridge Inspection Procedure Manual.[98] In this inspection, each element of a bridge is given a "condition state" and these are defined in the following tables.[99]

Condition State	Timber Elements of Timber Trusses – Condition State Descriptions
1	The timber is in good condition with no evidence of decay. There may be cracks, splits and checks having no effect on strength or serviceability. All connections are in good condition and bolts are tight.
2	Minor decay, insect infestation, splitting, cracking, checking or crushing may exist but none is sufficiently advanced to affect serviceability. Joint connections may be slightly loose but does not affect the serviceability.
3	Medium decay, insect infestation, splitting, cracking or crushing has produced loss of strength of the element but not of a sufficient magnitude to affect the serviceability of the bridge. Joint connections may be slightly loose but the serviceability of the bridge is not significantly affected.
4	Advanced deterioration. Heavy decay, insect infestation, splits, cracks or crushing has produced loss of strength that affects the serviceability of the bridge. Connections are very loose causing large movements, bolts are corroded and ineffective or missing, and the serviceability of the bridge is affected.

Condition State	Metal Tension Rods in Timber Trusses – Condition State Descriptions
1	The camber of the bottom chord is correct. There is no evidence of section loss.
2	The camber of the bottom chord is correct. Surface rust or minor pitting has formed or is forming. There is no measurable loss of section. There may be minor deformations that do not affect the integrity of the element.
3	Tension rods may need to be tightened to restore camber of bottom chords. Heavy pitting may be present. Some measurable section loss or necking is present locally. There may be missing locknuts but all connectors are in sound condition.
4	Tension rods may need to be replaced to restore camber of bottom chord. Significant section loss may be present. The tension rods may have stretched.

[97] Roads and Maritime, Bridge Inspection Report – Level 2 – Bridge No 1302, 8 February 2017 (BIS).
[98] Roads and Maritime, *Bridge Inspection Procedure Manual*, second edition, June 2007.
[99] Roads and Maritime, *Bridge Inspection Procedure Manual*, 2007, chapter 4 (Timber), pp 2, 24, 36.

Condition State	Metal Shoes in Timber Trusses – Condition State Descriptions
1	There is no evidence of section loss or damage or cracks.
2	Surface rust or minor pitting has formed or is forming. There is no measurable loss of section. There may be minor deformations that do not affect the integrity of the element. There are no cracks in the metal. All connectors are in sound condition.
3	Heavy pitting may be present. Some measurable section loss is present locally. There may be minor cracks and/or deformations in the steel or welds. All connectors are in sound condition.
4	Significant section loss may be present. There may be cracks and/or deformations in the steel or welds. There may be numerous failed connectors.

3.1.2 Definition of heritage integrity for a timber truss bridge

Heritage integrity (sometimes called intactness) in the case of a timber truss bridge is best defined as the extent to which the existing elements are consistent with the original design in form, fabric and function.

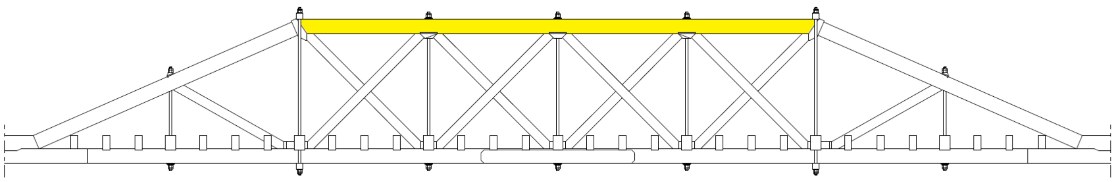
- The **form** includes the general shape of the truss as viewed from a distance as well as the shapes and sizes and interactions of the various components of the truss viewed close up.
- The **fabric** includes the type of material as originally specified, whether it be New South Wales hardwood, metal, masonry or concrete (not necessarily the age of the material).
- The function includes the general use of the bridge to carry traffic, enable industry, open up land and connect communities as well as the particular structural function of an element (eg, compression or bending member, shear connection, etc.).

For this reason, in order to assess the heritage integrity of this timber truss bridge, the following pages examine each element as it compares with the original. For each element, there is a detailed description of the original and a description of how the existing varies from the original due to modifications, and comments on condition. A summary of the condition and integrity of each element is given in Section 3.2.

3.1.3 Top chords

The timber top chords are highlighted in Figure 3-1 below.

Figure 3-1: Original 90' McDonald design with top chords highlighted.



(source: author)

Original Design

The original dimensions of the top chord timbers were 14” x 16” x 42’8½” (356 x 406 mm x 13 m). Each of these timbers was originally a single solid piece of timber, most probably ironbark.

Existing Condition

None of the top chord timbers are original fabric, but they are NSW hardwood. According to the most recent inspection (Figure 3-3) two of the four top chord timbers in condition state 1, one in condition state 2 and one as condition state 3. This indicates variable condition of the timbers.

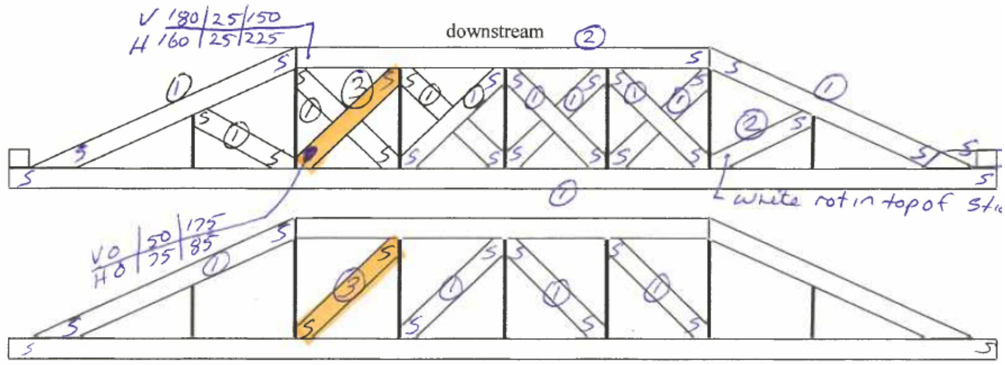
Analysis of Modifications

All of the top chord timbers consist of single solid timbers as per the original design. No additional splices have been introduced and all connections to the bottom chord appear to comply with the original design. The only modification is that on three of the four top chords, there are timber packers which were installed in 1987 after the flood damage when metal flashing was added to all the top chords and principals. Flashing has since been removed from all top chords (probably because it was found to be ineffective) and one of the top chords was replaced in 2010.

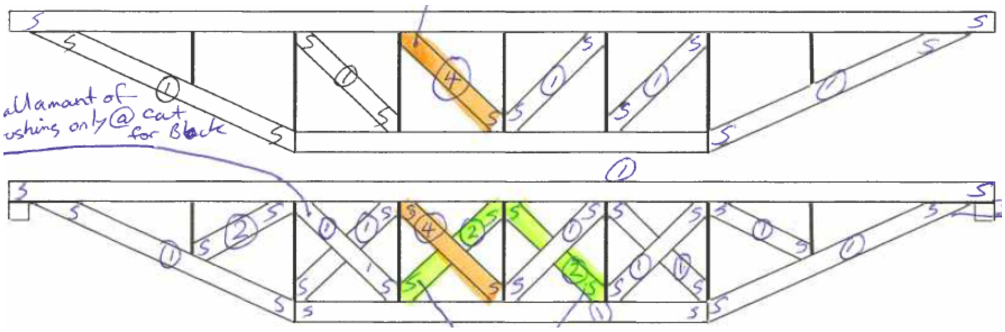
Figure 3-2: Photo of top chords with packers on top for metal flashing.

(source: author 2013)

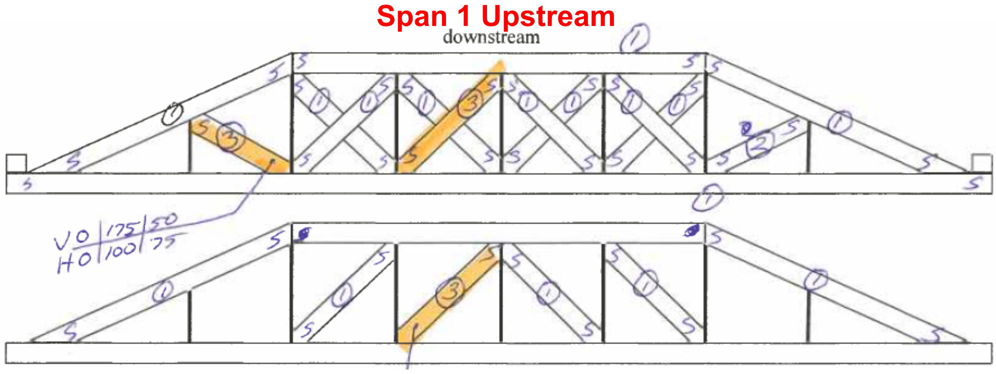
Figure 3-3: 2017 inspection condition ratings for truss spans.



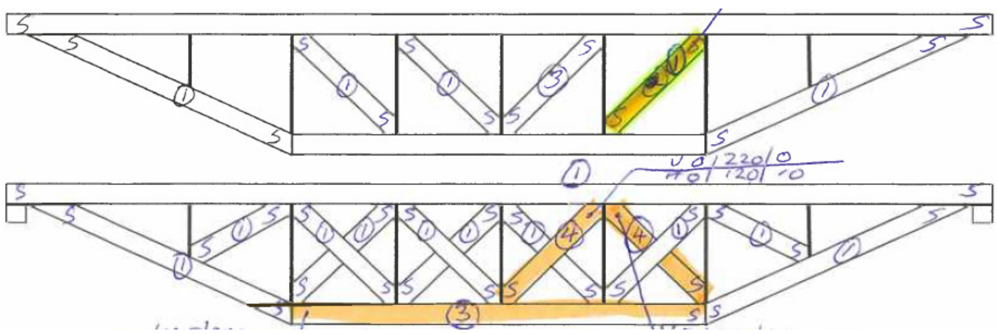
Span 1 Downstream



Span 1 Upstream



Span 2 Downstream



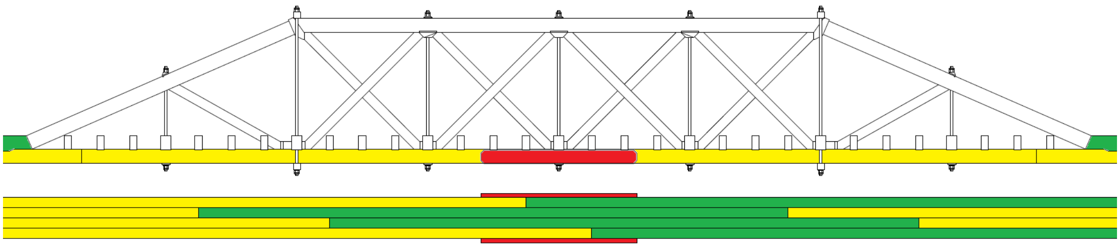
Span 2 Upstream

(source: Roads and Maritime)

3.1.4 Bottom chords and butting blocks

The bottom chord and butting blocks are shown in elevation (top) and plan (Figure 3.11). The timber laminates are highlighted in yellow on the elevation and the butting blocks are highlighted in green on the elevation. The metal splice plates are highlighted in red. In the plan, the bottom chord laminates are highlighted in yellow and green to indicate the location of original butt joints.

Figure 3-4: Original 90' McDonald design with laminate layout of bottom chord.



(source: author)

Original Design

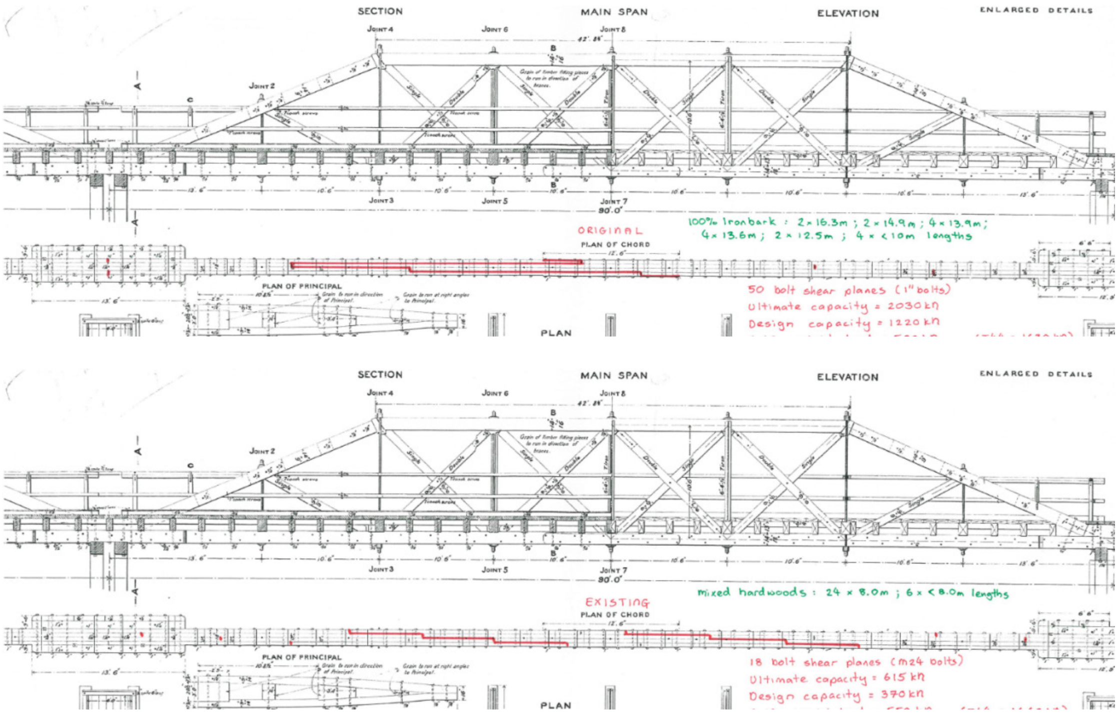
The original bottom chords consisted of four rows of timber laminates each 14" x 4½" (356 x 114 mm) bolted together to form a continuous timber bottom chord across both truss spans of 14" x 18" (356 x 456 mm). Joints in the timber laminates occurred only at the locations indicated in Figure 3-4 above, and external joints were provided with long metal splice plates. Additional outer laminated were added at the ends of each span. Butting blocks provide the primary load path between the principals and the bottom chords, and consisted of three solid pieces of timber each 15" x 12" (380 x 304 mm) notched 2" (50 mm) into the timber bottom chord laminates.

Existing Condition

The bottom chord contains no original fabric, either of timber or of metal. All bottom chord and butting block timbers were given a condition rating of 1, having been replaced last in 1999-2000.

Analysis of Modifications

Figure 3-5: Comparison of original (above) with existing below) failure mode.



(source: author)

The laminated timber bottom chord arrangement has been modified such that the existing bottom chord capacity is less than one third of the original capacity. This means that now the bottom chords are theoretically overstressed. In a McDonald truss, visual indications of overstress in the bottom chord generally include opening of joints and loss of alignment. The two photographs in Figure 3-6 show both opening up and movements of butt joints, with the gap measured at 15mm.

Figure 3-6: Signs of distress in modified laminated timber bottom chords.

(source: author, 2017)

Figure 3-7 shows loss of vertical and horizontal alignment of the McKanes Bridge bottom chords.

Figure 3-7: Signs of distress in modified laminated timber bottom chords.

(source: author, 2017)

The most heavily stressed connection in the McDonald truss is the connection between the butting block and the bottom chord, which is a simple timber to timber connection. At the pier, the bottom chord is beginning to show signs of failure by crushing at this butting block connection detail.

Figure 3-8: Crushing of timber at bottom chord to butting block connection.

(source: author, 2017)

Because the laminate layout was so substantially modified from the original when the bottom chords were replaced in 1999-2000, the original metal splice plates were also removed. The original wrought iron splice plates, shown in the top photo of Figure 3-9 below, were 12'6" (3.81 m) long, 13" (330 mm) wide and ⅜" (10 mm) thick, having ten 1" (25 mm) holes for tightly fit bolts.

Figure 3-9: Comparison of bottom chord in 1998 (above) and 2013 (below) with no splice plate.[100]

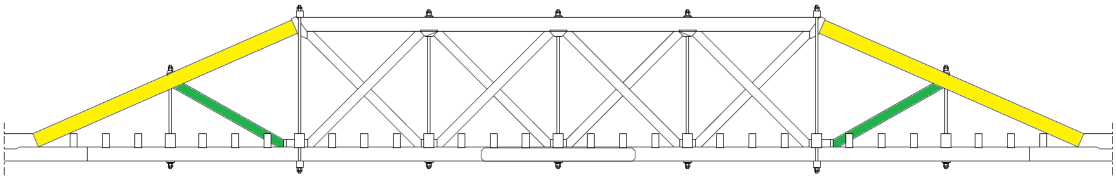
The other modification to the bottom chords, which occurred sometime after the 1986 flood, is the loss of notching at primary cross girder locations. All of these modifications combined detract substantially from the heritage integrity as well as the structural robustness of the bottom chords.

[100] Source for top photo is Hughes Trueman Reinhold 1998, source for bottom photo is author 2013.

3.1.5 Principals and diagonal props

The timber principals (yellow) and diagonal props (green) are highlighted in Figure 3-10 below.

Figure 3-10: Original 90' McDonald design with principals and props highlighted.

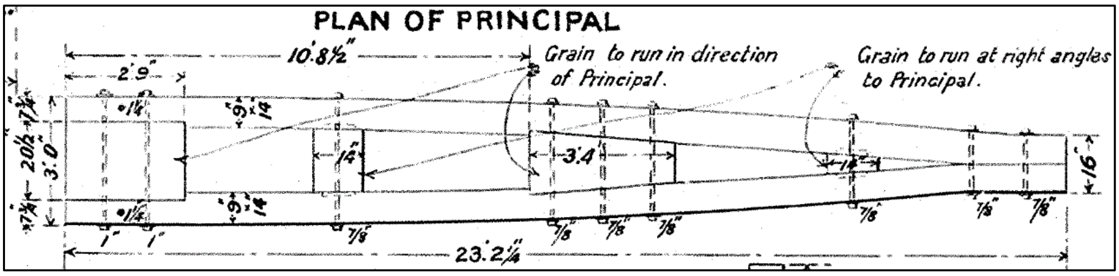


(source: author)

Original Design

The original principals consisted of pairs of 9" x 14" x 23'2¼" (230 mm x 356 mm x 7 m) timbers bowed around four very carefully detailed timber spacers to give a total width of 3'0" (914 mm) at the base and 16" (406 mm) at the top. All four timber spacers were notched into the bowed flitches, with the two larger spacers notched in for the full thickness of the spacer and oriented with grain parallel to the grain in the flitches, and the two smaller spacers oriented with grain perpendicular to the flitches and having hidden mortise and tenon joints. The assembly was held together by nine bolts, the bottom two being 1" (25 mm) and the rest being ⅞" (22 mm) in diameter.

Figure 3-11: McDonald's original drawing showing details of principal.



(source: 0272.032 BC 0102)

Each diagonal prop (green in Figure 3-10) was a single timber being 9" x 9" (230 x 230 mm), notched into one of the larger spacers of the principal, through which a tension rod also passed.

Existing Condition

None of the principals or diagonal props are original fabric, but they are NSW hardwood. According to the most recent inspection (Figure 3-3) all the principals are rated as condition state 1, although a site inspection has revealed considerable evidence of deterioration in some principals. The diagonal props are in varying conditions states 1, 2 and 3, indicating some deterioration.

Analysis of Modifications

The principals in three out of the four trusses have modified with the replacement of the bottom timber spacer with two pieces of timber due to difficulties in obtaining large timbers (Figure 3-12).

This modification to the principals means that the existing capacity of the principals is only approximately half of the original capacity. This means that now the principals are theoretically overstressed for vehicles over 20 tonnes. In a McDonald truss, visual indications of overstress in the principals would generally include damage at the interface of the flitches with the spacers and loss of alignment of the top chords at the ends. Figure 3-13 shows clear evidence of rot of both flitches at the interface with the timber spacer, and Figure 3-12 shows damage at the interface of the flitches with the spacers at the notching location (which is the most highly stressed area).

Evidence of loss of alignment includes the opening up of joints in the principals, shown in Figure 3-14. Of considerable concern it the evidence of habitat within the principals, probably exacerbated by the presence of metal flashing, and certainly causing deterioration. Although all flashing has been removed from the top chords, parts of it remain on some of the principals.

Figure 3-12: Typical bottom spacer in principal replaced with two timbers.

(source: author, 2013)

Figure 3-13: Deterioration of flitches of principals at spacer location.

(source: author, 2017)

Figure 3-14: Opening of joints and loss of alignment in principals.

(source: author, 2017)

Figure 3-15: Splitting of timber at top of principals and loose fit into shoe.

(source: author, 2017)

Figure 3-16: Crushing of timber spacer in principal at tension rod location.

(source: author, 2017)

Figure 3-17 shows misalignment of the top chords which is due to the modifications and the deterioration of the principals. Movements are also indicated by loss of sway brace connectivity.

Figure 3-17: Loss of alignment of the trusses due to modifications.

(source: author, 2017)

The modifications to the bottom timber spacers and the presence of flashing therefore detract substantially from the heritage integrity as well as the structural robustness of the bottom chords.

However, all of the other detailing of the principals can still be seen, including the general shape of the principals, the detailing of most of the timber spacers (including original direction of grain). Some of the bolted connections are not in their original locations (lining up with the centreline of the principal), but many are in their original locations so the original design can still be understood.

Metal packing plates have been introduced at the bases of almost all of the principals, probably to take up the slack due to modified bottom chord being subject to excessive elongation. These metal packing plates are an intrusive addition because they blur the distinction between the Old PWD truss (which had cast iron shoes at this location) and the McDonald truss, where McDonald chose to do away with the metal connection and have a simple timber to timber interface.

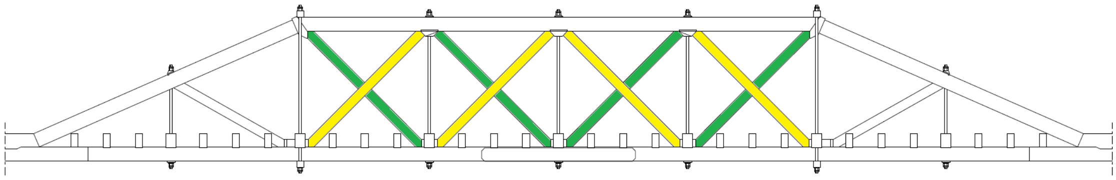
Figure 3-18: Metal packing plates introduced at the bases of principals.

(source: author, 2017)

3.1.6 Diagonals

The double (yellow) and single (green) timber diagonals and are highlighted in Figure Figure 3-19 below.

Figure 3-19: Original 90' McDonald design with diagonals highlighted.



(source: author)

Original Design

The original diagonals all consisted of 9" x 6" (230 x 52 mm) timbers. Each of the central panels of the truss has a double diagonal in one direction counterbraced with a single diagonal in the opposing direction. The double diagonals are bowed about the single diagonal, and have 2'0" (610 mm) long timber spacers notched 1" (25 mm) into the flitches at each end. The spacers at the top of the double diagonals are 9" x 5" (230 x 127 mm), and those at the bottom are 9" x 7" (230 x 178 mm). The double spacers have two bolts at each end through the spacers and a single bolt in an oversize hole (to allow for future adjustments) at the intersection of the single and double diagonal.

Existing Condition

None of the timbers in the diagonals or props are original fabric, but they are still NSW hardwood. According to the most recent inspection (Figure 3-3), most (25 out of 32) diagonals were given a condition rating of 1, but others varied from 2 to 4, indicating that some are in very poor condition.

Analysis of Modifications

All of the diagonals appear to closely reflect the original design, having excellent heritage integrity.

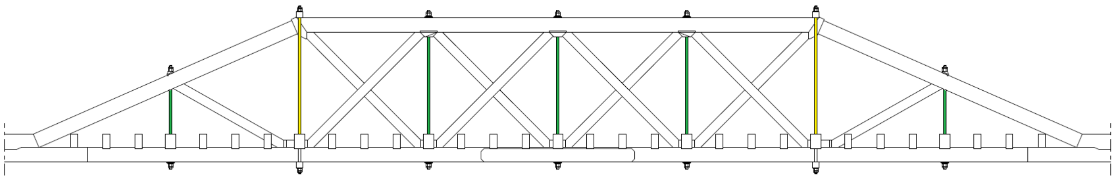
Figure 3-20: Photograph showing single and double diagonals as original.

(source: author, 2013)

3.1.7 Tension rods

The tension rods of the McDonald truss are highlighted in Figure 3-21 below. The single tension rods are highlighted in green and the double tension rods are highlighted in yellow.

Figure 3-21: Original 90' McDonald design with tension rods highlighted.

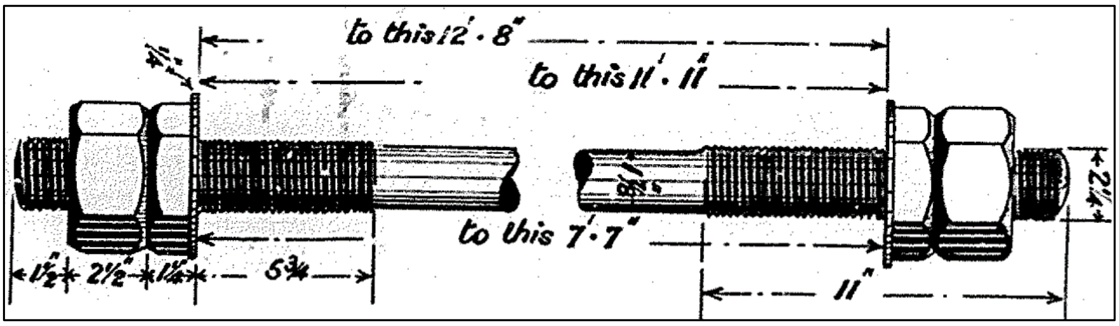


(source: author)

Original Design

The original wrought iron tension rods were 2¼" (57 mm) diameter at the threaded ends and 1⅞" (48 mm) diameter between. The tension rods came in three lengths. The double tension rods (at locations highlighted in yellow in Figure 3-21 above) were the longest at 4.13 m as they connect to iron saddles above the top chord and below the bottom chord. The three central single tension rods were the next longest at 3.90 m, and the outer short single tension rods were 2.58 m.

Figure 3-22: McDonald's original drawing with details of tension rods.



(source: 0000.259 BC 0026)

The long tension rods are connected to an iron saddle top and bottom. The central tension rods have cast iron washer plates top and bottom, and the shorter tension rods have little cast iron tapered washers with shear keys at the top and simpler cast iron plate washers at the bottom.

Existing Condition

As was noted in 1998, the tension rods have differing thread pitches, suggesting that some or all of them are not original. According to the most recent inspection, half the tension rods are in condition state 2 and the rest are in condition state 3, all of them suffering a level of corrosion.

Cast iron components are susceptible to brittle fracture, and some of the original washers have broken, but appear to have been replaced with new elements fabricated to the original design.

Analysis of Modifications

Most of the tension rods appear to be of dimensions close to the original, and some clearly have the upsized ends for the threaded portion (see Figure 3-26) as per the original design.

The loss of nuts is particularly problematic on the McDonald and Allan trusses where the thin nut was originally installed before the main nut (see Figure 3-22 above), so that if the main nut falls off, only the thin nut with very limited capacity remains. Bennett, de Burgh and Dare therefore had the main nut first and the thin nut afterwards, the thin nut being only a precautionary measure to reduce the risk of nut loosening. At McKanes Bridge, most nuts have been installed in reverse order when compared with the original design, and some thin nuts are missing (Figure 3-23 and Figure 3-25). At least one instance exists where the nuts have been installed in the order specified in the original design, but the nut is so close to the end of the thread that it is at risk of falling off (Figure 3-24).

Figure 3-23: Photograph of typical arrangement of nuts with one missing.

(source: author, 2017)

Figure 3-24: Photograph with nut order as designed but close to falling off.

(source: author, 2017)

Figure 3-25: Photograph of top of short tension rod with thin nut missing.

(source: author, 2013)

Figure 3-26: Photograph top of tension rod showing upsized threaded end.

(source: author 2013)

Figure 3-27: Photograph showing paint loss and corrosion of tension rod.

(source: author 2013)

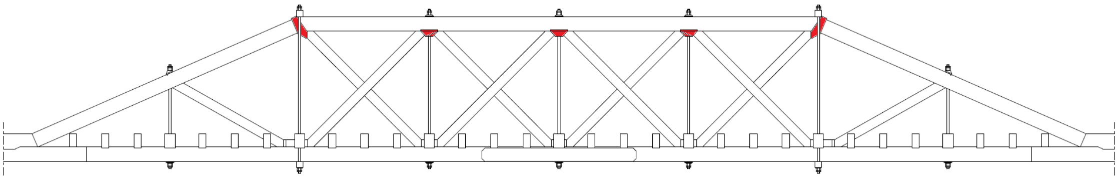
Figure 3-28: Photograph showing corrosion at tops of tension rods and nuts.

(source: author 2017)

3.1.8 Cast iron shoes

The cast iron shoes of the McDonald truss are highlighted in red in Figure 3-29 below.

Figure 3-29: Original 90' McDonald design with cast iron shoes highlighted.

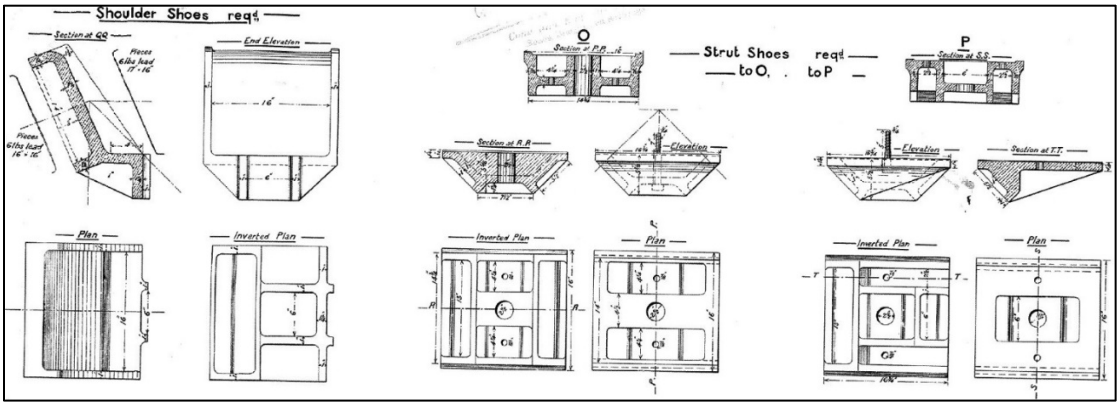


(source: author)

Original Design

There are three different types of cast iron shoes in the 90' McDonald truss as shown in Figure 3-30. The first type is called the "shoulder shoe" by McDonald and there are two on each truss, one at each end of the top chord. The other two types are both called "strut shoes" by McDonald and they occur at the intersections of the diagonals with the top chords, the different types being required depending upon whether a single and a double diagonal are meeting the top chord, or whether two double diagonals are meeting the top chord (as occurs at the centre of the truss).

Figure 3-30: McDonald's original drawing detailing cast iron shoes.



(source: 0000.259 BC 0026)

Figure 3-31: Photograph of cast iron shoe with single and double diagonal.

(source: author 2013)

Existing Condition

Cast iron components are susceptible to brittle fracture, so some of the original shoes have probably broken in the past but appear to have been replaced with new elements fabricated to the original design. The most recent inspection rated all cast iron shoes as condition state 1.

Figure 3-32: 1998 Photograph of cast iron shoe with two double diagonals (similar today).[101]

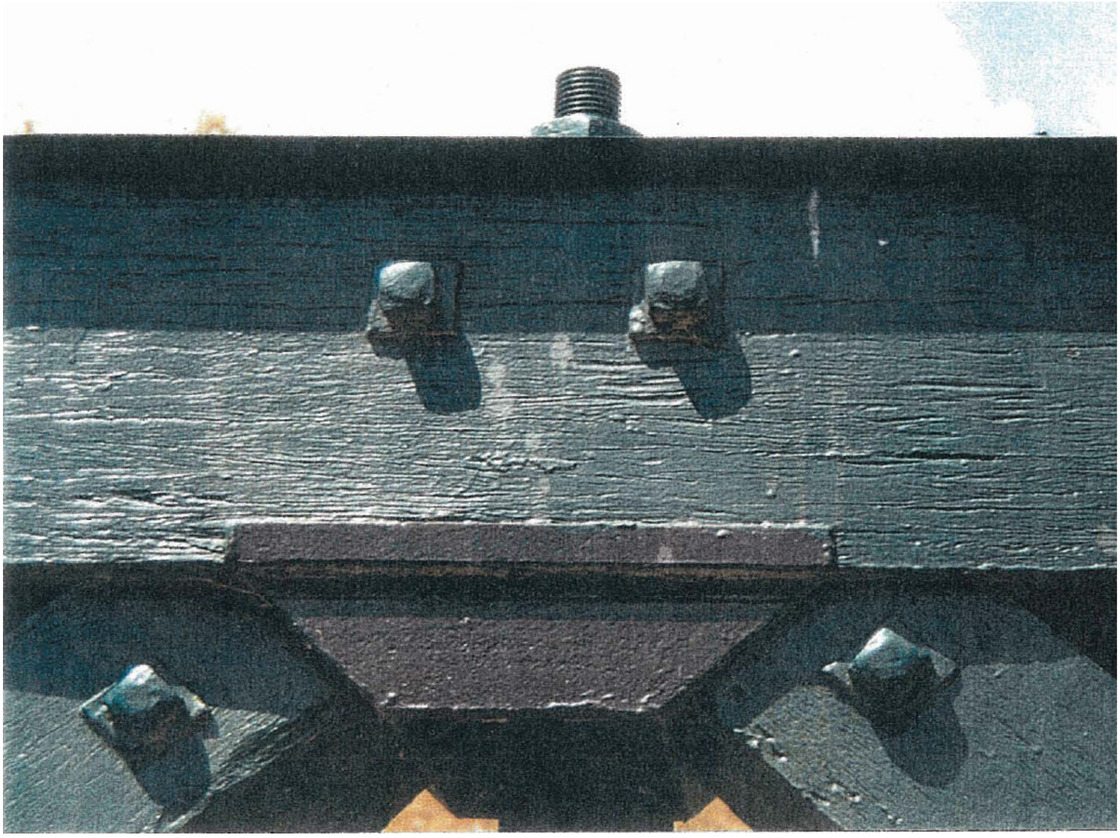


Figure 3-33: Photographs of typical cast iron shoulder shoe.

(source: author 2013)

Analysis of Modifications

All cast iron shoes appear to closely reflect the original design, having excellent heritage integrity.

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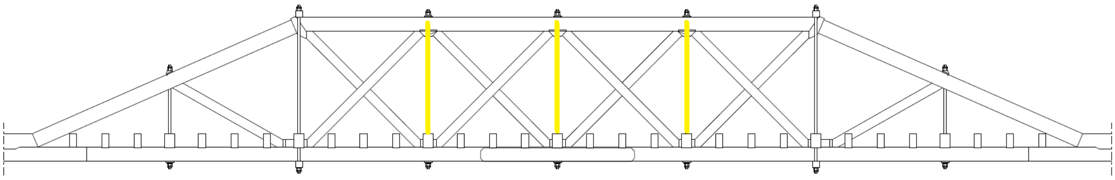
[101] Source for photograph is Hughes Trueman Reinhold, 1998.

3.1.9 Sway braces

The sway brace locations of the McDonald trusses at McKanes Bridge are highlighted in Figure 3-34.

Figure 3-34: Original 90' McDonald truss design with sway braces highlighted.



(source: author)

Original Design

Sway braces consist of T Irons 6" x 4" x ½" (152 x 102 x 12 mm) bent at each end to be attached to the cross girders with two bolts and attached to the top chord with another two bolts.

Existing Condition

The sway braces at McKanes Bridge appear to be of the original design dimensions and detailing, and they are located in their original locations (ie. no additional sway braces have been added, and sway braces have not been lengthened as has been attempted on other bridges). The most recent inspection has rated all the sway braces as condition state 1, although inspection has revealed that all the sway braces are suffering from various levels of corrosion, especially around connections.

Figure 3-35: Photograph of base of typical sway brace at McKanes Bridge.

(source: author 2017)

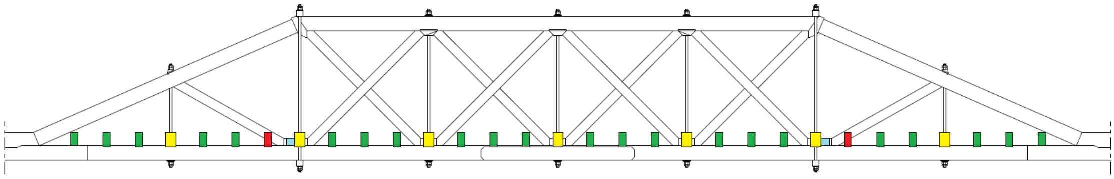
Analysis of Modifications

All sway braces appear to closely reflect the original design, having excellent heritage integrity.

3.1.10 Cross girders

The cross girders are shown in Figure 3-36, with primary cross girders (10" x 14" or 254 x 356 mm) highlighted in yellow and secondary cross girders (7" x 14" or 178 x 356 mm) highlighted in green. Two of the secondary cross girders (highlighted in red) have considerable notches cut out of them.

Figure 3-36: Original 90' McDonald design with cross girders.



(source: author)

Original Design

The original cross girders consisted of single solid timbers 14" (356 mm) deep of varying lengths. The long primary cross girders were the central three at sway brace locations, and these were originally 29'6" (8.99 m) long. The primary cross girders under the ends of the top chords were 23'0" (7.01 m) long to accommodate the double tension rods, and the primary cross girders at the short tension rods were 21'6" (6.55 m) long, the same length as the secondary cross girders.

All the secondary timber cross girders were originally notched 1" (25 mm) over the bottom chords to keep them in place in the lateral direction. The primary cross girders were notched into the bottom chord by 1" (25 mm). To further assist keeping the cross girders in place in the longitudinal direction, two rows of timber stringers were provided 6" (152 mm) deep notched into the sides of the cross girders so that the tops of the stringers were flush with the tops of the cross girders. These were located just inside of the line of the truss, and also supported the edge of the deck. This type of stringer is common to the Old PWD and McDonald truss, and performed a very different function to the stringers in later truss types (such as Allan, de Burgh and Dare trusses).

The central three primary timber cross girders have pairs of metal wedges each side where the diagonals meet the cross girders. The primary cross girders located under the ends of the top chords also have pairs of metal wedges each side of the cross girders, but on the outer side of the span they also have 8" (204 mm) thick timber packing to ensure correct member alignments.

Existing Condition

It is possible that some or all of the metal wedges are original fabric, with all suffering corrosion. None of the timbers in the primary or secondary cross girders are original fabric, but they are all still NSW hardwood. While the original timber used would have been sourced from old growth timbers, the existing timber cross girders are sourced from timbers available today. These timbers, sourced from younger trees, are significantly more susceptible to shrinkage than the original.

According to the most recent inspection most of the cross girders (primary and secondary) have a condition rating of 1 or 2, indicating that the timber is in reasonable condition, but four of the cross girders have a condition rating of 3 and require replacement primarily due to rotting from the ends.

Analysis of Modifications

The original number of cross girders remains and the distinction between primary and secondary cross girders also largely remains in that the primary ones are bigger than the secondary ones.

Much of the original detailing has been lost. There is no notching of the bottom chords at primary cross girder locations and there is only very limited notching of secondary cross girders. There are no stringers keeping cross girders in position and the dimensions of the cross girders are not original in cross-section or in length. Part of the reason for this would be the excessive shrinkage of available timber making these original details ineffective. Another reason for these modifications is simply ease and cost of maintenance. The fact that the primary cross girders are no longer adequately secured in position has contributed to the loss of geometry of the trusses as a whole.

Figure 3-37: View of larger primary and smaller secondary cross girders.

(source: author 2013)

Figure 3-38: Extra timber packing to make up for shrinkage of cross girder.

(source: author 2013)

Figure 3-39: Considerable notching of cross girder as per original design.

(source: author 2013)

Figure 3-40: Part of secondary cross girder missing due to failure at notch.

(source: author 2013)

Figure 3-41: Photo of irregular and non-original lengths of all cross girders.

(source: author 2013)

Figure 3-42: Photograph of typical metal wedges next to cross girders.

(source: author 2017)

These modifications mean that the current cross girders do not reflect the original aesthetic or design intent and detract from the structural integrity and the heritage integrity of the trusses.

3.1.11 Decking

Original Design

The original decking consisted of tarred 4” (100 mm) thick timber planking laid diagonally on the timber cross girders. Eight scuppers were provided per span, each consisting of a 3” (76 mm) diameter pipe with a wrought iron flange. The fact that the original designers even considered providing drainage for timber decks should alert us to the fact that leaky timber decks today are very different to the timber decks originally provided on timber truss bridges.

Although we do not have any original specifications for a McDonald truss, we do have an original specification for a Dare truss, and photographic evidence indicates that similar specifications applied to all five types of timber truss bridges when it came to the timber deck. Following are excerpts from an original specification for the construction a timber truss bridge:

> *Timber employed to be…. Tallow-wood, white mahogany, grey gum, red gum, grey box, blackbutt, or brush box, at option of Contractor, for the planking… All to be of approved quality, sound, straight, free from sapwood, large or loose knots, wanes, shakes, gum-veins, cores, or other defects; to have clean sharp arrises, and to be of the full dimensions shown or specified… Sawn timber to be absolutely free from heart, and to be so fixed that the surface which was farthest from the heart of the tree will be the outermost in the work other than planking, and uppermost in the planking… The flooring planks, which laid, to receive on the upper surface between kerbs one coat, composed of 7 parts coal tar, 4 parts of Stockholm tar, and 1 part of pitch, thoroughly melted together, and applied hot; to be well sprinkled with a layer of clean sharp sand and lime…. All tarring to be completed before painting is commenced, and no tar is to be applied during or immediately after wet weather, or while surface of timber is wet…. Floor to consist of 4-in. sawn planking, from 6 in. to 10 in. wide, laid transversely, as shown. All planks to run the entire width of bridge in one length; to be laid flush and close, and secured to girders and stringers by ⅜-in. square spikes, 7 in. long, two spikes at each intersection; heads of spikes to be drifted down ¼ in., and surface of the floor left smooth, all inequalities being adzed down…*[102]

The primary difference between the above specification and the McDonald truss deck is the direction of the decking, which was originally diagonal in the Old PWD and McDonald trusses.

The primary function of the deck is to carry traffic. Originally a tarred surface was provided in order to minimise the slipperiness of the exposed timber deck so that vehicles and cattle could cross safely as well as to provide a protection against water to maximise the durability of the timber deck. Much care was taken to achieve a smooth safe deck surface. This means that the aesthetic of the original bridge was considerably less determined by the timber deck (which was smooth and dark and visually recessive) and considerably more focused on the truss with its white-painted timber.

Figure 3-43 gives an indication of the original aesthetic of timber decks on timber truss bridges. The photograph was taken in 1894 and shows a new McDonald truss bridge, which would have been under construction at the same time as McKanes Bridge, and therefore the truss spans at McKanes bridge would have originally looked very similar to those in the photograph. The smoothness of the deck as well as the dark colour of the deck indicates that a similar specification was used in 1894 as was used 35 years later when the specification mentioned above was written. The fact that these timber deck details were used with very little modification (the earlier two designs had flat decks with diagonal planks, whereas the later three designs had cambered decks with transverse planks and generous scuppers) by all five timber truss designers indicates that the details worked well at the time in which they were used. This is a testament to the quality of the timber which they were using, as the timber available today does not achieve the same results.

[102] Dept. Public Works, NSW Harbours, Roads and Bridges Branch, Contract for construction of a composite truss bridge over Wakool River, at Gee-Gee Crossing, Swan Hill to Deniliquin Road, Specification, 1928.

Figure 3-43: Original timber deck on McDonald truss bridge, Darling River at Wentworth, 1894.[103]

Existing Condition

None of the deck is original fabric. According to the most recent inspection, most timber decking is rated as condition state 3, with some in 1 and 4, indicating that the decking is in poor condition.

Analysis of Modifications

The decking has been considerably modified so that it does not reflect the original design intent or the original aesthetic of the McDonald trusses. The heritage integrity is very poor with intrusive modifications. The decking currently consists of longitudinal timber decking approximately 125 mm thick, bolted to a system of transverse and longitudinal bolting planks introduced under the deck. The decking has been coated with a bituminous spray seal incorporating aggregate to provide a wearing surface, except for more recently replaced timbers which have not yet been sealed.

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[103] Source: NSW Legislative Assembly: Report of the Dept. of Public Works for Year Ended 30 June, 1894.

Figure 3-44: View of existing timber decking as seen from above.

(source: author 2017)

Figure 3-45: View of existing timber decking system as seen from below.

(source: author 2013)

3.1.12 Railing

Original Design

The original timber railing had no real structural capacity and was not intended to be a traffic barrier for vehicles, but was intended to delineate the sides of the bridge and to prevent horses, bullocks, sheep and cows (who were the most frequent bridge users) from falling off the bridge. When McKanes Bridge first opened in 1893, the automobile had only recently been invented, and still by 1908 there were estimated to be only 1,000 motor cars in New South Wales (with 600 chauffeurs employed).[104] The roads were such that vehicles travelled much more slowly than they do today, and vehicles were much lighter than today. The first speeding fine handed down in Australia was in 1897, when George Innes of Sydney was fined ten shillings for travelling at 8 m/hr (13 km/hr).[105] Released in 1909, a Report of the Royal Commission for Improvement of the City of Sydney and its Suburbs did not include any strategies specifically geared towards the motor car because most people believed the car had no future beyond its function as a recreational toy.[106]

The original timber railing designed by McDonald for his trusses was somewhat similar to Bennett's design for the Old PWD truss in that there were no posts in front of the trusses, but simple rectangular timbers were attached directly to the truss. In the McDonald truss, there were always two rails, each 4" x 3" (102 x 76 mm). The timber rails were painted white, the same colour as the trusses, and so they were visually recessive against the background of the trusses. A photograph of a typical McDonald truss bridge during construction is given in Figure 3-46, showing how the trusses were originally the dominant visual feature, with the railings being almost insignificant.

Figure 3-46: View of typical original McDonald truss.

(source: NSW State Archives 6/17284/91)

[104] Rosemary Broomham, *Vital Connections: a history of NSW roads from 1788*, Hale & Ironmonger in association with the Roads and Traffic Authority NSW: 2001, pp 100-102
[105] Bill Harrison, A History of the Department, an article for the DMT staff newsletter dated 30 April 1982, p 2.
[106] Rosemary Broomham, *Vital Connections: a history of NSW roads from 1788*, pp 103-104.

Existing Condition

None of the railing is original fabric. According to the most recent inspection, all timber railings are in condition state 2, the timber being in relatively good condition but requiring repainting.

Analysis of Modifications

The railing has been modified so that it does not reflect the original design intent or the original aesthetic of the McDonald trusses. The heritage integrity is very poor with intrusive modifications, and the structural integrity is also poor, being inadequate for current vehicles.

Figure 3-47: Photos showing railing against different truss colours in 1986 (left) and 1998 (right).[107]

As can be seen in Figure 3-47 above, in 1986 when the flood damage occurred, the colour of the trusses had been changed from white to peach, while the timber railings remained white. This had the effect of making the railings more of a visual feature than had been the case originally. After the flood damage, the trusses were painted dark green with dark green flashing also introduced to the top chords and principals. The timber railings, however, were still painted white, so that by this time, the timber handrails were the most dominant visual feature of the bridge (Figure 3-47).

Figure 3-48: Photo of new railing installed after major works in 2001.

(source: Glenn Rigden, 2002)

[107] Source for photo on left is RMS File 258.62, source for photo on right is Hughes Trueman Reinhold 1998.

As part of the major refurbishment works undertaken between 1999 and 2001, new timber railings were installed on the bridge using detailing which is more typical of later truss types (Figure 3-48). Timber posts were introduced along the length of the bridge so that the rails no longer connected directly to the trusses. The top rail was changed from a rectangular rail to a diamond shaped rail, with black metal straps used to attach these new top rails to the new posts. Also at this time, large end posts with black round hoop straps at the tops were introduced at each end of the bridge. Gaps were introduced in the kerbs, and the kerbs were installed in a straight alignment along the length of the bridge rather than the original curved alignment of McDonald's kerb design.

Along with the longitudinal timber decking that was added to the bridge before the flood, these new kerbs and railings introduced a strong visual effect from the continuous longitudinal lines, and thereby draw visual attention away from the trusses. Because the flashing obscures much of the detailing of the McDonald trusses (especially the splayed principals), and the dark green colour of the trusses makes them blend into the background, these bright white timber posts and rails with the black straps and bolts not only visually dominate, but now completely overwhelm the trusses.

Figure 3-49: Photo showing new thrie beam guardrail on road approaches.

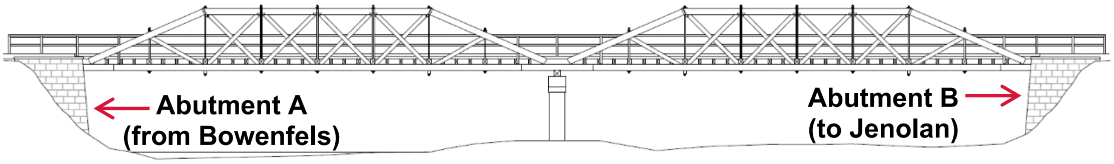
(source: author, 2013)

The original design for McKanes Bridge showed the timber railings extending well beyond the bridge to the ends of the road embankments on the approaches on both sides (see Figure 3-26). This timber rail appears to have been removed at some stage, and was first replaced with W-beam guardrail, and then more recently with thrie beam guardrail transitioning to W-beam further from the bridge. While this thrie beam looks quite solid, it is largely ineffective due to the fact that this type of guardrail relies on structural continuity for its effectiveness, and so at the point of greatest need (just where the bridge begins) the guardrail is least effective as it has nothing to connect to (the large timber end post having no capacity to resist loads). The galvanised metal guardrail so close to the bridge also detracts somewhat from the timber truss, being visually incompatible.

3.1.13 Abutments

The original masonry abutments for McKanes Bridge are as indicated in Figure 3-50.

Figure 3-50: General arrangement of McKanes Bridge showing abutments.



(source: author)

Original Design

The original abutments consisted of masonry retaining wall type abutments founded on 2'0" (610 mm) deep unreinforced concrete footings which were recessed into decomposed granite approximately 1 m below ground level. Behind the abutments, a rubble fill was provided. The function of the abutments is to retain the approach embankments and support the truss spans.

Existing Condition

Both abutments appear to retain their original configuration and are largely original in fabric. According to the most recent inspection both abutments are in good condition, having a rating of 1. The abutments did suffer some damage in the 1986 flooding, including cracking of some stone and movements of part of the side walls in both Abutment A and Abutment B. Due to the configuration of the original design, part of the masonry has to be removed in order to replace timber elements resting on the abutment, so it is possible that some damage has also occurred during repair works.

Analysis of Modifications

Both abutments appear to closely reflect the original design, having excellent heritage integrity. Concrete walls have been added behind both abutments in attempts to provide a termite barrier.

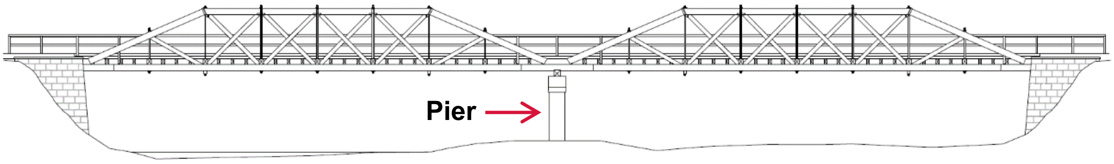
Figure 3-51: Photograph of masonry abutment largely as original.

(source: author, 2014)

3.1.14 Pier

The existing concrete pier constructed in 1987 at McKanes Bridge is indicated in Figure 3-52.

Figure 3-52: General arrangement of McKanes Bridge showing existing pier.



(source: author)

Original Design

The original pier was a masonry wall founded on a 2’0” (610 mm) deep unreinforced concrete footing which was recessed into decomposed granite approximately 1 m below ground level.

Existing Condition

The original pier was destroyed in the 1986 flood and was replaced with a new concrete pier. According to the most recent inspection the pier is in good condition, having a rating of 1.

Analysis of Modifications

The existing pier bears no resemblance to the original except that it is in the original location.

Figure 3-53: Photo of new pier taken between 1987 and 1999.

(source: Roads and Maritime)

While the new concrete pier on the large concrete footing is visually incompatible with the historic timber trusses and the masonry abutments, and is also completely lacking the attractiveness of the original masonry pier, this concrete pier does assist in telling part of the story of this bridge, which is when it was almost completely lost in the flood of 1986. The design does evoke the sense that this work was done in an emergency, and might be seen as part of the history of the bridge.

3.2 Summary of physical condition and heritage integrity

The bridge as a whole is in variable physical condition and some elements of the bridge have been substantially modified so that it also has variable heritage integrity, while still being able to demonstrate many of the most important aspects of the original design at the detailed level. McKanes Bridge is certainly recognisable as a McDonald type timber truss bridge, and still retains the form of most of the distinguishing features of the McDonald design as outlined in Section 2.4.3.

The fact that the bridge is currently load limited means that it cannot fully demonstrate the strength of the original design or the strength of the original NSW hardwoods with which it was constructed.

Elements	Condition	Integrity (ie: ability to demonstrate original design)
Top chords	Variable	Good: Timber is not original fabric, but sizes and configurations and detailing largely as original, recognisable as McDonald truss, packers added for flashing are reversible in that when top chord timbers are replaced, these will be removed.
Bottom chords and butting blocks	Good	Poor: Timber is not original fabric, configuration is not original, dimensions are not original, connections are not original, structural detailing and strength has been lost.
Principals and diagonal props	Variable	Variable: Timber is not original fabric, much of the original detailing, configurations and dimensions are as original, but many critical bottom timber spacers have been modified.
Diagonals	Variable	Good: Timber is not original fabric, much of the original detailing, configurations and dimensions are as original.
Tension rods	Fair	Fair: Some tension rods may be original fabric but some are not, order of nuts has been modified throughout, dimensions of tension rods appear to be largely as original.
Cast iron shoes	Good	Good: Probably contains some original fabric, but some may have been replaced with new shoes cast to the original design.
Sway braces	Good	Good: Possibly original fabric, no visible modifications.
Cross girders	Variable	Poor: Timber is not original fabric, configuration is not original, dimensions are not original, connections are not original, structural detailing has been lost and geometry has been lost.
Decking	Poor	Poor: Timber is not original fabric, configuration is not original, detailing is not original, dimensions are not original, connections are not original, structural and aesthetic detailing has been lost, intrusive additions viewed from any angle.
Railing	Good	Poor: Timber is not original fabric, detailing is not original but modified which blurs the distinctions between truss types, modified railings visually dominate over the truss.
Abutments	Good	Good: Masonry is largely original fabric to original design. Minor modifications (buried concrete barriers) are clearly new works and do not detract from the masonry abutments.
Pier	Good	Poor: Bears no relationship to original masonry pier.
Visual setting and context	Good	Fair: Approach roads are in poor condition, vegetation is overgrown in the vicinity of the Engineers Australia plaque, opportunities to improve viewing areas and interpretation.

4. Analysis of significance

4.1 Existing statement of significance

The NSW SHR statement of heritage significance for McKanes Bridge currently reads,

> *This bridge is a McDonald timber truss road bridge. Timber truss road bridges were extensively used in New South Wales because of the high quality of local hardwoods and the shortage of steel during the early decades of settlement of the state. The timber truss was highly developed for bridges in New South Wales, perhaps more so than anywhere else in the world at that time. The McDonald truss is a significant evolutionary link in the development of timber road bridges in New South Wales and has three standard span lengths, 65'/19.96m, 75'/22.86m and 90'/27.43m. At March 1998 there were seven McDonald truss road bridges remaining in New South Wales, McKanes Falls Bridge being one of two with a 27.43m span and one of two in a double span configuration. The bridge has been assessed as having State significance.*[108]

This statement was derived from the 1998 heritage significance study of McDonald truss bridges.[109]

Considering the major changes that have taken place across the timber truss bridge population since then and new historical evidence as a result of further research, it is necessary to reassess whether this statement continues to adequately reflect the heritage significance of the bridge.

4.2 Comparative analysis

Of approximately 90 McDonald type timber truss bridges constructed in NSW, only four remain today. All four were opened in 1893 at the end of the McDonald truss era (1886 to 1893) but unlike the other four truss types, the McDonald trusses were constructed to a suite of standard designs which did not change between the earliest trusses constructed and the latest. The four remaining McDonald truss bridges as listed below are in the care of Roads and Maritime.

Bridge	Year	Spans	Listings		
			SHR	S170	LEP
Bridge over Tunks Creek at Galston Gorge	1893	1-65'	Yes	Yes	Yes
Crankies Plains Bridge over the Coolumbooka River	1893	2-75'	Yes	Yes	Yes
Junction Bridge over the Tumut River near Tumut	1893	3-75'	Yes	Yes	Yes
McKanes Bridge over Cox's River near Lithgow	1893	2-90'	Yes	Yes	Yes

The following table gives a brief summary of the heritage integrity of the remaining McDonald truss bridges. This information is based primarily on inspections undertaken by the author to all remaining timber truss road bridges between 2013 and 2017, and is subject to constant change (many modifications are reversible) and so is provided here as an indicative summary only.

[108] SHR listing for McKanes Bridge over Karuah River from Heritage NSW website (accessed 16/09/17): http://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=5051377.
[109] Hughes Trueman Reinhold, McDonald Truss Road Bridges in NSW, Heritage Significance Study, 1998.

Bridge	Comments on Heritage Integrity
Galston Gorge	Only remaining example of the standard 65' McDonald truss. Shortest span remaining timber truss bridge of any type in New South Wales. Original colour scheme largely intact with white timber and black metal components. Timber bottom chords strengthened with external steel plates. Diagonal timber decking used, but very different from original decking. Timber rails replaced with galvanised metal W-beam guardrail. Curved timber kerbs replaced with straight timber kerbs. Maintenance access monorail added under the deck behind bottom chords. Bottom spacers of principals replaced with double spacers with shear keys. Most thin nuts replaced with large nuts so double large nuts on tension rods.
*Crankies Plains	Original colour scheme largely intact with white timber and black metal components. Some but not all timber bottom chords strengthened with external steel plates. Metal flashing added to all top chords. Diagonal timber decking replaced with longitudinal decking with spray seal. Curved timber kerbs replaced with straight timber kerbs and timber rails replaced with new Allan-style rails with posts for length of bridge. Various metal brackets and plates added to connect diagonals to bottom chords. Order of nuts on tension rods largely reversed but inconsistent.
Junction Bridge	Original colour scheme largely intact with white timber and black metal components. Single solid top chords replaced with two timbers bolted together, bolting arrangement on principals modified. Laminated timber bottom chords have internal steel plates introduced with various other modifications required to accommodate, including loss of continuity over piers. Modified diagonal decking with longitudinal sheeting and spray seal. Some cast iron shoes replaced with welded steel replicas, new steel traffic barrier with straight steel kerbs on all spans, additional sway braces added with associated modifications to cross girder lengths, primary cross girders replaced in steel. Maintenance access monorail added under the deck behind bottom chords. Flashing added to top chords and principals. Approach spans and piers modified with concrete introduced.
McKanes Bridge	Only remaining example of the standard 90' McDonald truss, the longest span of McDonald trusses built. Modifications as described in this CMP.

** indicates this bridge is listed as a bridge to be demolished under the Roads and Maritime Strategy.*

4.3 Assessment of significance

4.3.1 Criterion A – Historical

An item is important in the course, or pattern, of NSW's cultural or natural history.

Guidelines for INCLUSION

- *shows evidence of a significant human activity*
- *is associated with a significant activity or historical phase*
- *maintains or shows the continuity of a historical process or activity*

Guidelines for EXCLUSION

- *has incidental or unsubstantiated connections with historically important activities or processes*
- *provides evidence of activities or processes that are of dubious historical importance*
- *has been so altered that it can no longer provide evidence of a particular association*

McKanes Bridge is the longest span surviving McDonald truss bridge in New South Wales. The excellence in design of the McDonald truss is historically significant as the second of five stages of timber truss road bridge design in New South Wales, showing the growing knowledge of timber as a structural material, and also the increasing vehicle weights requiring stronger bridges than before. McKanes Bridge is one example of the McDonald design which performed well beyond the expectations of the original designer, with four still remaining today after almost 125 years. The bridge is therefore able to demonstrate the State historical theme of "Technology".

McKanes Bridge provided an essential link for the safe and reliable transport of produce and stock as well as enhancing a popular tourist and recreational route. It is historically significant through its association with the expansion of the New South Wales road network, and the contribution of that road system to settlement, development and economic activity throughout New South Wales. The bridge is therefore able to demonstrate the State historical theme of "Transport".

As noted by Dare, the hardwood timbers used were second to none in Australia, and indeed compared favourably, both for strength and durability, with any timbers in the world. The original design demonstrates a time long gone when large dimensioned quality hardwood timber was plentifully available, and the later history of the bridge demonstrates the diminishing resource.

McKanes Bridge therefore meets this criterion at a State level.

4.3.2 Criterion B – Associative

An item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history.

Guidelines for INCLUSION

- *shows evidence of a significant human occupation*
- *is associated with a significant event, person, or group of persons*

Guidelines for EXCLUSION

- *has incidental or unsubstantiated connections with historically important people or events*
- *provides evidence of people or events that are of dubious historical importance*
- *has been so altered that it can no longer provide evidence of a particular association*

As a McDonald truss, McKanes Bridge has strong associations with John Alexander McDonald, a very capable engineer and the designer of this truss type. McDonald contributed to a great variety of engineering works not only in New South Wales, but also in Western Australia, New Zealand, South Africa, England and the United States, including timber, metal and concrete bridges, moveable span bridges as well as harbour and water conservation works, mining and electric lighting. McKanes Bridge therefore meets this criterion at a State level.

4.3.3 Criterion C – Aesthetic / Technical

An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW.

Guidelines for INCLUSION

- *shows or is associated with, creative or technical innovation or achievement*
- *is the inspiration for a creative or technical innovation or achievement*
- *is aesthetically distinctive*
- *has landmark qualities*
- *exemplifies a particular taste, style or technology*

Guidelines for EXCLUSION

- *is not a major work by an important designer or artist*
- *has lost its design or technical integrity*
- *its positive visual or sensory appeal or landmark and scenic qualities have been more than temporarily degraded*
- *has only a loose association with a creative or technical achievement*

McKanes Bridge fits neatly into the rural landscape, being aesthetically pleasing in scale, proportion and materials used. The aesthetic significance is somewhat diminished by the fact that the colour scheme has been changed so that the original landmark qualities have been largely lost.

However, it is the excellence in engineering design which is particularly notable in the McDonald trusses, and this engineering excellence is seen, not primarily in the general shape of the trusses, but in their details, the flow of forces, the connections and the structural rigidity. The bridge exhibits the technical excellence of its design, as many of the structural details which distinguish it as a McDonald truss design are clearly visible, considerably assisted by the fact that the bridge is relatively low to the ground and there are no fences preventing public access to below the bridge. Simply by walking around bridge, excellent views can be obtained of almost all of the structural design details (general truss geometry, bowed paired principals and diagonals, single solid top chords, laminated timber bottom chords, metal tension rods, cast iron shoe connections etc.). The technical significance is somewhat diminished by the fact that modifications have been made to the bottom chords, principals, decking, cross girders and railings without these being clearly new work.

The masonry abutments are aesthetically pleasing and contribute substantially to the aesthetic significance of the bridge, being constructed from sandstone masonry, and comprising well finished, hammer dressed sandstone blocks which are largely original in form, fabric and function.

The central concrete pier, on the other hand, is visually intrusive, detracting from the aesthetic significance of the bridge, though forming part of the historical significance of the bridge, demonstrating something of the resilience of the timber trusses in surviving the 1986 flood.

McKanes Bridge therefore meets this criterion at a State level.

4.3.4 Criterion D – Social

An item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons.

Guidelines for INCLUSION

- *is important for its associations with an identifiable group*
- *is important to a community's sense of place*

Guidelines for EXCLUSION

- *is only important to the community for amenity reasons*
- *is retained only in preference to a proposed alternative*

McKanes Bridge was constructed in the early 1890s to improve communications between Bowenfels and Hampton / Lowther. The bridge and adjacent camping reserve rapidly became a destination for picnickers and tourists. The reserve continues to provide access to Coxs River for fishers and tourists. As such, McKanes Bridge has played a significant role for those people living, working and holidaying throughout the surrounding area. The bridge is readily accessible from Sydney and the nearby Blue Mountains, situated in attractive rural setting over the Cox's River.

The bridge forms part of the local school bus routes and consequently is well known to the children of the wider community. McKanes Bridge is listed on the Local Environmental Plan of Lithgow Council, and has also been plaqued by Engineers Australia. Despite some local disquiet regarding limitations to road transport due to regular maintenance closures and load limitations, the bridge is recognised as an important element of Lithgow's extensive heritage inventory.

McKanes Bridge therefore meets this criterion at a local level.

4.3.5 Criterion E – Scientific / Archaeological

An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history.

Guidelines forINCLUSION

- *has the potential to yield new or further substantial scientific and/or archaeological information*
- *is an important benchmark or reference site or type*
- *provides evidence of past human cultures that is unavailable elsewhere*

Guidelines for EXCLUSION

- *the knowledge gained would be irrelevant to research on science, human history or culture*
- *has little archaeological or research potential*
- *only contains information that is readily available from other resources or archaeological sites*

McKanes Bridge contains some metal elements which are probably original fabric, including cast iron shoes and wrought iron tension rods. These provide a future opportunity for materials testing and analysis to yield further information about the properties of iron used in bridges in the late 1800s. McKanes Bridge also contains original masonry fabric on both abutments, which may provide a future opportunity to yield further information about masonry construction in the late 1800s. However, the information gained by this analysis would not be substantial, and would also be available elsewhere. There is no known archaeological potential in the vicinity of the bridge. McKanes Bridge therefore does not meet this criterion.

4.3.6 Criterion F – Rarity

An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history.

Guidelines for INCLUSION

- *provides evidence of a defunct custom, way of life or process*
- *demonstrates a process, custom or other human activity that is in danger of being lost*
- *shows unusually accurate evidence of a significant human activity*
- *is the only example of its type*
- *demonstrates designs or techniques of exceptional interest*
- *shows rare evidence of a significant human activity important to a community*

Guidelines for EXCLUSION

- *is not rare*
- *is numerous but under threat*

McKanes Bridge is rare as one of only four remaining McDonald truss bridges of approximately 90 constructed and as the only remaining example of a 90' McDonald truss bridge.

McKanes Bridge therefore meets this criterion at a State level.

4.3.7 Criterion G – Representativeness

An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments.

Guidelines for INCLUSION

- *is a fine example of its type*
- *has the principal characteristics of an important class or group of items*
- *has attributes typical of a particular way of life, philosophy, custom, significant process, design, technique or activity*
- *is a significant variation to a class of items*
- *is part of a group which collectively illustrates a representative type*
- *is outstanding because of its setting, condition or size*
- *is outstanding because of its integrity or the esteem in which it is held*

Guidelines for EXCLUSION

- *is a poor example of its type*
- *does not include or has lost the range of characteristics of a type*
- *does not represent well the characteristics that make up a significant variation of a type.*

McKanes Bridge is representative at the State level as a fine example of a McDonald truss bridge, including all of the principal characteristics of the 90' McDonald truss design and outstanding due to its size, being the longest of the standard McDonald truss designs constructed and having two adjacent spans with a continuous bottom chord. The bridge largely performs the function for which it was originally designed, which was to carry traffic, although the road is currently load limited. The bridge meets this criterion at a State level.

4.4 Revised statement of significance

McKanes Bridge is of State significance as the longest span McDonald truss surviving in New South Wales. It is rare and representative as the only remaining example of a 90' McDonald truss and as one of only four remaining examples of McDonald truss bridges of approximately 90 built.

The excellence in design of the McDonald truss is historically significant as the second of five stages of timber truss road bridge design in New South Wales, showing the growing knowledge of timber as a structural material, and also the increasing vehicle weights requiring stronger bridges. It is historically significant through its association with the expansion of the State road network, and the contribution of that road system to settlement, development and economic activity.

As a McDonald truss, McKanes Bridge has strong associations with John Alexander McDonald, a very capable engineering and the designer of this truss type. McDonald contributed to a great variety of engineering works both in New South Wales, throughout Australia and overseas.

The historical context for the original design and construction of McKanes Bridge was plentiful New South Wales hardwoods, particularly that large and long old growth timbers were readily available and vast numbers of bridges were being built, but budgets were tight and skilled workmen were few. The New South Wales hardwood timbers used were second to none in Australia, and indeed compared favourably, both for strength and durability, with any timbers in the world. The design is an example of innovative and practical engineering in a time when large and long old growth timbers were readily available and vast numbers of bridges were being built with a tight budget.

McKanes Bridge fits neatly into the rural landscape, being aesthetically pleasing in scale, proportion and materials used. The timber trusses and original masonry abutments contribute substantially to the aesthetic significance of the bridge, while the central concrete pier detracts somewhat from the aesthetic significance. The bridge largely performs the function for which it was originally designed, which was to carry traffic, although the road is currently load limited.

4.5 Grading of significant components

The OCMP sets out the methodology and approach taken here to grading of significant components. The table below provides a summary of the grading of significant components.

Elements	Significance	Summary of justification for significance
Top chords	Exceptional (State)	Although the timber top chords do not contain original fabric and are deteriorated, original design remains largely intact.
Bottom chords and butting blocks	Moderate	Modifications to these elements are substantial, causing structural deficiencies and undermining interpretation, however, some of the original design detailing remains intact.
Principals and diagonal props	High (State)	Alterations detract from aesthetics and only partially reflect the original design intent and original strength and robustness.
Diagonals	Exceptional (State)	Although the timber diagonals do not contain original fabric and are deteriorated, original design remains largely intact.
Tension rods	Moderate	Possibly includes original fabric, but condition deteriorated and details common, not directly contributing to significance.
Cast iron shoes	High (State)	Probably includes some original fabric but susceptible to brittle

Elements	Significance	Summary of justification for significance
		fracture, so some parts may have been reconstructed.
Sway braces	High (State)	Possibly includes original fabric, and configuration is as original.
Cross girders	Little	Details common, and do not directly contribute to significance, have been substantially altered, undermining interpretation.
Decking	Intrusive	Modifications to these elements are so substantial that these elements are now damaging to the item's heritage significance, causing structural deficiencies and undermining interpretation.
Railing	Little	Details very common, and do not directly contribute to significance, have been substantially altered, difficult to interpret.
Abutments	High (State)	Masonry is largely original fabric to original design. Minor modifications do not detract from the masonry abutments.
Pier	Little	Modern pier does not fulfil any criteria for significance.
Visual setting and context	Moderate	The visual setting and context has been modified over the decades, but still contributes to overall significance. The colour scheme of the bridge is not original and so the trusses do not stand out in the landscape as they originally would have done.

5. Constraints and opportunities

As operational infrastructure, timber truss bridges function as part of the State's road network. Transport for NSW must ensure that the bridge is able to function appropriately. The bridge must also comply with statutory heritage constraints to ensure that its significance is conserved. In order to formulate appropriate conservation policies for the bridge and its environs, the requirements that will have an impact upon the future management of the bridge have been investigated and are summarised below.

5.1 Constraints and opportunities arising from significance

The following statements are not conclusions or recommendations but, rather, observations relevant to the circumstances of the site and matters that require consideration and resolution.

5.1.1 Criterion A – Historical

The historical context of this bridge is the availability of high quality (strong and durable) New South Wales hardwood. The significance of the truss is so closely related to the New South Wales hardwoods, these being the very reason for the design and vast use of this form of construction, that its conservation should prioritise the continued the use of these hardwood timbers. The availability of high-quality hardwood timber required for heritage timber truss bridges is a substantial concern. It is an increasingly scarce resource, and is valuable as part of our natural heritage, as well as for its usefulness in carrying heavy vehicles over heritage timber truss bridges.

Although at least two pieces of heart-free sap-free bridge timber should be able to be recovered from a single log, in practice (on average) less than a single piece per log meets the requirements for use in most heritage timber truss bridges.[110] This increases the responsibility of those caring for the bridge to ensure that all works maximise the durability of timber in order to minimise the need to cut down old growth forests, which are part of the valuable natural heritage of this country.[111]

Timber truss bridges have strong associations with the expansion of the road network and economic activity throughout NSW so the conservation of this bridge should retain its use as a vital part of the NSW road infrastructure, which may necessitate some elements being strengthening. Careful consideration should also be given to replacing timber with modern materials where the heritage significance of the fabric of the particular element is little or moderate, and where the introduction of modern materials would not substantially affect the heritage significance.

5.1.2 Criterion B – Associative

As a McDonald truss, McKanes Bridge has strong associations with John Alexander McDonald and has the opportunity to demonstrate the engineered design details of a very capable engineer. Although the bridge as a whole is in variable physical condition and has been modified in some details, there remains sufficient evidence of the original design in the original drawings of the 90' McDonald trusses and early photographs to allow restoration and reconstruction within the bounds of Articles 19 and 20 of the *Burra Charter*. The conservation of this bridge should seek to apply engineering excellence so as not to obscure the work of one of Australia's eminent engineers.

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[110] J. Bowden, 'A Bridge Too Far: major shortage of big section hardwoods', *inwood magazine*, Iss. 78, p 28.

[111] There are 19 listed World Heritage Places in Australia, 16 of which are natural heritage such as rainforests, wilderness areas and national parks. A large proportion of places on the National Heritage List consist of natural rather than built heritage. This indicates the importance of conservation of natural heritage.

Because the original design made use of and relied upon old growth ironbark timber not available today, it is not possible to completely restore all of the original details completely in form, fabric and function. Some of the original sizes of timbers are no longer available today, and some of the original properties (especially shrinkage properties) are unavailable. Consideration must therefore be given to making necessary modifications to demonstrate the old design in the current context.

5.1.3 Criterion C – Aesthetic / Technical

As a timber truss bridge, McKanes Bridge is aesthetically distinctive and has some landmark qualities, but these could be greatly enhanced by restoring the original colour scheme. There are also opportunities to improve aesthetics by regular removal of excessive vegetation in the area.

However, it is the innovative and practical engineering which is particularly notable in the McDonald trusses, and this engineering excellence is seen, not primarily in the general shape of the trusses, but in their details, the flow of forces, the connections and the structural rigidity. Some of these important details have been lost due to modifications, but there is opportunity to pursue restoration and reconstruction within the bounds of Articles 19 and 20 of the *Burra Charter*.

Article 22.1 of the *Burra Charter* states that, “New work such as additions or other changes to the place may be acceptable where it respects and does not distort or obscure the cultural significance of the place, or detract from its interpretation and appreciation.” The design of this truss type was the inspiration for further technical innovation in the four following truss types. The conservation of this bridge, therefore, should not obscure the culturally significant original details, and should not obscure the differences between the McDonald truss and the other four truss types.

5.1.4 Criterion D – Social

Despite some local disquiet regarding limitations to road transport due to regular maintenance closures and load limitations, as well as some concerns about the safety of the timber deck, the bridge is recognised as an important element of Lithgow’s extensive heritage inventory and is also recognised by Engineers Australia as an important example of a McDonald truss bridge.

The best way to conserve a heritage structure is to ensure that the local community continues to value it. A bridge that looks like it is the result of Band-Aid solutions or poor workmanship, left to deteriorate until traffic restrictions are put in place to carry out repairs is less likely to be valued by the community. A community is more likely to value a bridge if it has an element of beauty or elegance to it. It is also more likely to value a structure if convenience is maximised and inconvenience minimised. Community sentiment can be assisted by education through interpretation, but if the bridge does not safely and efficiently perform its primary intended function as a transport link across the river, then the social significance is substantially diminished.

Article 3.2 of the Burra Charter states that, “Changes to a place should not distort the physical or other evidence it provides, nor be based on conjecture.” Similarly, the ICOMOS Principles for Historic Timber Structures emphasise the importance of authenticity and load-bearing function. Therefore, any new works required that might be required for strength or safety should be able to be interpreted as such, and the original design intent should not be obscured in the process.

Any conservation works on the bridge should aim to increase its social significance by community focused design. A community focused design will include, but not be limited to, the following:

- Elegance in Design: The bridge, and any additions to it, should be in keeping with the elegance and simplicity of the original, with any additions designed to be visually recessive;
- Road Safety: The Bridge should be safe for vehicles and for pedestrians where appropriate. This may require sensitively upgraded barrier rails, alignments and approach treatments;
- Transparency in Design: Design should enable the inquisitive to determine the original details, fabric and form where possible by not obscuring this by changes and additions;
- Durability in Design: The design should be detailed to maximise service life so that community impact of traffic diversions due to bridge closures is minimised;
- Strength for Modern Vehicles: The bridge should be strengthened to carry today's vehicles so that inconvenient load restrictions are minimised, and community benefit maximised;
- Interpretation: Information on the bridge and its history should be made readily available, and where appropriate, included in the vicinity of the bridge.

5.1.5 Criterion E – Scientific / Archaeological

There is no known archaeological potential in the vicinity of McKanes Bridge. Any archaeological resources or collections of artefacts and records discovered should be protected and conserved.

5.1.6 Criterion F – Rarity

McKanes Bridge is the only remaining example of a 90' McDonald truss and one of only four remaining examples of McDonald trusses of any span so the trusses should be conserved.

5.1.7 Criterion G – Representativeness

McKanes Bridge is representative as a fine example of a McDonald truss bridge outstanding due to its size, being the longest of the standard McDonald truss designs constructed and having two adjacent spans with a continuous bottom chord. The bridge largely performs the function for which it was originally designed, which was to carry traffic, although the road is currently load limited.

The representativeness could be enhanced by restoring original details which have been modified, as there remains sufficient evidence of the original design to provide the opportunity for restoration and reconstruction of the trusses within the bounds of Articles 19 and 20 of the *Burra Charter*.

5.2 Constraints and opportunities from current listings

5.2.1 Summary and assessment of current listings

The *Environmental Planning & Assessment Act 1979* gives local governments the power to protect places of heritage significance through local environmental plans (LEP), which include provisions for development controls and identify any incentives that council may offer. McKanes Bridge is listed on the schedule of heritage items in the Lithgow Local Environmental Plan 2014.[112]

Section 170 of the *Heritage Act 1977* requires government agencies to identify, conserve and manage heritage assets owned, occupied or managed by that agency. It also requires that the

[112] Lithgow LEP 2014 https://www.legislation.nsw.gov.au/#/view/EPI/2014/824 (accessed 19/09/17)

government agencies keep a register of heritage items. The progress of agencies in preparing registers and managing their heritage assets is monitored by the Heritage Council. In accordance with the Heritage Act, Roads and Maritime has established a Heritage and Conservation Register to record all heritage items in its ownership or under their control, including McKanes Bridge.

The NSW Heritage Council developed seven criteria gazetted under section 4A (3) of the *Heritage Act 1977* to help guide decisions about whether an item is of State heritage significance. McKanes Bridge has been assessed against these criteria above and five of the seven criteria are satisfied at a State level. Section 33 (3) of the Heritage Act 1977 states that, in general, two or more criteria need to be satisfied for the Heritage Council to recommend State listing. McKanes Bridge clearly meets the criteria for listing and so is rightly listed on the State Heritage Register.

A summary of the statutory and non-statutory listings of the bridge is provided in the following table.

Register / List	Brief Explanation	Meets Criteria	Listed
World Heritage List	Properties forming part of the cultural and natural heritage which the World Heritage Committee considers as having outstanding value.	No	No
Commonwealth Heritage List	A list of natural, indigenous and historic heritage places owned or controlled by the Australian Government.	No	No
National Heritage List	Places of outstanding heritage significance to Australia, including natural, historic and indigenous places of outstanding value.	No	No
State Heritage Register	A list of places and objects of particular importance to the people of New South Wales, including items in both private and public ownership.	Yes	Yes
Section 170 Heritage Register	Lists Roads and Maritime's assets which have been identified as having State or local heritage significance	Yes	Yes
LEP Heritage Schedule	List with maps in principal legal document for controlling development and guiding Council's planning decisions.	Yes	Yes
Register of National Trust	Non-Statutory register identifies historic places of national and local significance through expert committees.	-	No
Engineers Australia plaque	McKanes Bridge was plaqued with by Engineers Australia with a Historic Engineering Marker in 2002, recognising it as a significant piece of engineering heritage	Yes	Yes
Register of Australian Historic Bridges	Colin O'Connor published a register of Australian Historic Bridges in 1983 with Engineers Australia and the Australian Heritage Commission	Yes	Yes

5.2.2 SHR listing and Heritage Council of NSW Approvals

The SHR is a list of heritage items of particular importance to the people of New South Wales. It includes items and places of State heritage significance endorsed by the Heritage Council of NSW and the Minister. The SHR is established under Section 22 of the *Heritage Act 1977,* and pursuant to Section 57(1) of the Act, the approval of the Heritage Council of NSW is required for any proposed development within the site including subdivision, works to the grounds or structures or disturbance of archaeological 'relics'.

The *Heritage Act 1977* requires minimum standards of maintenance and repair for items on the SHR to ensure heritage significance is retained. These standards are set out in the *Heritage Regulation 2012*.

5.2.3 Exemptions from *Heritage Act 1977* approval

Section 57(2) of *the Heritage Act 1977* provides for a number of exemptions to Section 57(1) approval requirements, meaning that a Section 60 approval does not need to be sought. Routine maintenance and minor repairs consistent with standard exemptions would not require Heritage Council approval before commencing. Other works including minor structural alteration, major refurbishment, safety and operational upgrades, would require approval of the Heritage Council of NSW, either as a Section 57 exemption or a Section 60 application. Details of typical works are provided in Appendix A.

5.2.4 Archaeology

The *Heritage Act 1977* affords automatic statutory protection to 'relics'. The Act defines a 'relic' as:

> *"any deposit, artefact, object or material evidence that:*
>
> *a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement and*
>
> *b) is of State or local heritage significance."*

Any excavation or works to a site listed on the SHR likely to disturb relics would require an approval to carry out a Section 57(1) activity, except in accordance with a gazetted exemption.

In the event that substantial or unexpected archaeological relics are encountered within the curtilage, the Department of Premier and Cabinet should be notified, pursuant to Section 146 of the *Heritage Act 1977*. Further assessment, and possibly further approval, may be required at the discretion of the Department of Premier and Cabinet. The Transport for NSW archaeological protocols cover the process to be followed in such circumstances.

5.2.5 Aboriginal heritage

Legislative protection of Aboriginal objects and places is provided by the *National Parks and Wildlife Act 1974* (NPW Act). It is an offence under the NPW Act to undertake any action that causes harm to an Aboriginal object or Aboriginal Place without the express permission of the Chief Executive of Heritage NSW. Part 6 of the NPW Act provides statutory protection for all Aboriginal objects (comprising any deposit, object or material evidence of the Aboriginal occupation of NSW) and for 'Aboriginal places' (areas of special cultural significance to the Aboriginal community that have been gazetted as such under Section 84 of the NPW Act). All Aboriginal objects are afforded automatic statutory protection in NSW, as are Aboriginal Places. It is an offence to undertake any action that causes harm to Aboriginal objects and Aboriginal Places in New South Wales without prior consent. The NPW Act defines harm as any act or omission that destroys, damages or defaces the object or place.

5.2.6 State owned Heritage Management Principles

The State Owned Heritage Management Principles were issued in 2004 under Section 170A (2) of the *Heritage Act 1977*. The Heritage Asset Management Guidelines were issued in 2004 under Section 170A (3). Items particularly relevant to this bridge are tabulated below.

Table 5-1: Summary of relevant provisions of the *State-owned Heritage Management Principles*

Citation	Quotation	Implication
3. Lead by Example	State agencies should lead by example by adopting appropriate heritage management strategies, processes and practices. The public sector should set the standard for the community in the management of heritage assets.	Conservation should be of the highest standard.
4. Conservation Outcomes	Heritage assets should be conserved to retain their heritage significance to the greatest extent feasible. State agencies should aim to conserve assets for operational purposes or to adaptively reuse assets in preference to alteration or demolition.	Significance should be conserved to the greatest extent feasible.
8. Maintenance of Heritage Assets	Heritage assets are to be maintained in a manner which retains heritage significance, with the objective of preventing deterioration and avoiding the need for expensive "catch-up" maintenance and major repairs.	The bridge should not be allowed to fall into disrepair.
9. Alterations	Alterations should be planned and executed to minimise negative impacts on heritage significance, and appropriate mitigating measures should be identified.	Any alterations should minimise heritage impacts.

Table 5-2: Summary of relevant provisions of the *Heritage Asset Management Guidelines*

Citation	Quotation	Implication
2.2 Adoption of the *Burra Charter* (p 17)	State agencies should adopt the *Burra Charter* for the making of management decisions for heritage assets. In accordance with the *Burra Charter*, management decisions should also consider other factors affecting the future of a heritage asset such as the owner's needs, resources, external constraints and its physical condition.	Management decisions need to be made in accordance with the *Burra Charter*.
3.6 Interpretation of Heritage Significance (p 20)	The heritage significance of many heritage assets is not readily apparent and should be explained by interpretation, in accordance with the document, Heritage Interpretation Guidelines. Interpretation should enhance understanding and enjoyment, and be culturally appropriate.	A Heritage interpretation strategy should be prepared for the bridge.
3.27 Contemporary & Design Excellence of New Additions (p 25)	New additions to heritage assets, including new constructions in the vicinity of heritage significance, should be identifiable as having been designed and built in the present. New additions are to include contemporary design and materials as appropriate, as well as being sympathetic to identified heritage values. Designs should be executed with appropriate materials and finishes.	Any new work on the bridge must exhibit engineering excellence and be sympathetic to heritage value.
3.29 Removal of Intrusive Elements (p 25)	Wherever practical, elements identified as being "intrusive" to the heritage significance of a heritage asset should be removed.	Intrusive elements should be removed.

5.2.7 State Agency S170 Heritage and Conservation Registers

Section 170 of the *Heritage Act 1977* requires that all Government departments or agencies maintain a Heritage and Conservation Register, which includes all assets owned or in the care and control of the relevant department or agency that are of State or local heritage significance. Under Section 170A of the *Act*, 14 days prior notice to the Heritage Council of NSW is required in the event that Transport for NSW:

a) removes any item from its register under Section 170; or

b) transfers ownership of any item entered in its register; or

c) ceases to occupy or demolishes any place, building or work entered in its register.

5.2.8 Local Environmental Plan Listing and Local Council Approvals

The Lithgow Local Environmental Plan 2014 (LEP) aims to make local environmental planning provisions in accordance with the relevant standard environmental planning instrument under Section 33A of the *Environmental Planning and Assessment Act 1979*. One of the stated aims of the LEP (Clause 1.2 - 2 (c) vii) is to manage, facilitate and encourage sustainable growth and development that protects and enhances places and items of environmental, archaeological, cultural or heritage significance, including Aboriginal relics and places.

Although the bridge is listed on the LEP as a State significant heritage item, this does not restrict or prohibit any development by Roads and Maritime Services, as Clause 5.12 states that,

Infrastructure development and use of existing buildings of the Crown

1) *This Plan does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development, under State Environmental Planning Policy (Infrastructure) 2007.*

2) *This Plan does not restrict or prohibit, or enable the restriction or prohibition of, the use of existing buildings of the Crown by the Crown.*

The State Environmental Planning Policy (Infrastructure) 2007, Clause 94 (1) states that,

> *Development for the purpose of a road or road infrastructure facilities may be carried out by or on behalf of a public authority without consent on any land.*

5.2.9 Total Asset Management

The NSW Government has established various requirements and standards for the delivery of government services and infrastructure in NSW. The Government's 'Strategic Management Framework' summarises and defines the various processes which NSW Government agencies are required to use in order to plan activities and services, to allocate resources and to report on performance. Total Asset Management (TAM) is a part of the framework. With constant reference to whole-of-government planning, the agency's Corporate Plan, and its Service Delivery Strategy, the TAM approach requires asset managers to assess what assets are needed to support successful service delivery. It then calls for detailed plans for the management of those assets which are to be acquired, maintained or disposed of. The Total Asset Management approach provides an overarching context for decisions in relation to this bridge.

5.2.10 Obligations from non-statutory listings

McKanes Bridge is listed by Engineers Australia in the form of a plaque is an indication of the technical engineering significance of the bridge which also should be conserved and enhanced.

The Engineers Australia plaque should be maintained and included in the interpretation strategy.

Figure 5-1: Engineers Australia plaque in slightly overgrown setting.

(source: author, 2013)

5.3 Constraints and opportunities from operational requirements

As part of its road network management responsibilities, Roads and Maritime manages almost six thousand bridges and major culverts. The Roads and Maritime 2020 Strategic Plan (August 2015) outlines strategic priorities, and conforming to these strategic priorities is a requirement for all Roads and Maritime activities, including maintaining timber truss bridges as operational assets.

The Roads and Maritime Strategic Priorities are:

- Making safety paramount
- Delivering our infrastructure program
- Meeting customer and community needs
- An organisation that delivers
- Enhancing economic and social outcomes.

Making safety paramount

The *Work Health and Safety Act 2011* and the *Work Health and Sa*fety Regulation 2011 are administered by SafeWork NSW, and aim to secure the health and safety of workers and workplaces, which includes construction or maintenance people working on bridges.

Work Health and Safety (WHS) legislation in New South Wales emphasises the need for employers to provide a safe working environment for their employees or contractors. The safety risks of maintenance at McKanes Bridge are significant, including working at heights, working near traffic, working near overhead powerlines, working over water, working with hazardous materials (timber preservatives, termite treatments and possibly lead paint) and manual handling. In order to meet legislative safety requirements, sometimes traditional methods of construction and repair are not feasible, and so changes must be introduced to facilitate safe maintenance of the bridge.

In the NAASRA (National Association of Australian State Road Authorities) Highway Bridge Design Specification of 1965, there are design requirements for roadway railings on bridges, for footway railings on bridges, and for “crash resisting railings” on bridges. Even in 1965, barriers were only designed to actually resist impact loads from vehicles on, “bridge structures carrying traffic over busy thoroughfares", otherwise design loads were approximately 2 kN/m. In 1992, the AUSTROADS Bridge Design Code came into effect, and barrier loads increased to 90 kN. In 2004 a new Australian Standard for Bridge Design, AS 5100 introduced a design load up to 500 kN to resist heavy vehicles. In the 2017 revision, that design load has further increased to 600 kN.

Timber rails do not have any ability to prevent a vehicle from falling off the bridge. On the contrary, timber rails are a spearing risk to errant vehicles and their passengers. There have been a number of instances of vehicles driving off the sides of timber truss bridges in NSW, with some fatalities. Photographs below are typical of what happens when a car loses control at a timber truss bridge.

The likelihood of accidents on timber bridges is accentuated by the slippery timber decks. It is therefore likely that a traffic barrier and new deck will be required at McKanes Bridge in the future.

Figure 5-2: Vehicle recovery after crash on timber truss bridge.

(source: Roads and Maritime)

Delivering our infrastructure program

In 2012, Roads and Maritime and the NSW Heritage Council agreed upon a strategy for the future management of the forty-eight timber truss bridges then controlled by Roads and Maritime. This strategy recognised Roads and Maritime's role as the custodian of the heritage significance of the population of timber bridges as well as its responsibility to provide safe road infrastructure at reasonable cost in an environment of increasing vehicle size and growing traffic volumes. In accordance with the endorsed Strategy, a number of timber truss bridges, including McKanes Bridge, are to be conserved by having them upgraded to carry live loads equivalent to current heavy vehicle requirements by the application of several proven upgrade procedures.[113]

Addressing the State's deficient rural bridges is a key priority for NSW Government investment. A new and dedicated infrastructure development program was set up in 2012 to fund the necessary upgrade of the network. Two high priority strategic program investment areas were identified, the first being Higher Mass Limit bridge restrictions and the second, heritage timber truss bridges.[114]

This initiative, called Bridges for the Bush, is a commitment from the NSW Government to improve road freight productivity by replacing or upgrading bridges at key locations in regional NSW. The NSW road network is critical to the movement of freight in Australia. Half the nation's road freight and three quarters of all interstate road freight journeys are on NSW roads. With the road freight task predicted to nearly double by 2030, significant investment in the NSW road network is required to meet the demand for increased access of larger, safer and heavier freight vehicles.[115] McKanes Bridge was included as a bridge to be upgraded in Tranche 1 of this initiative (Figure 5-3).

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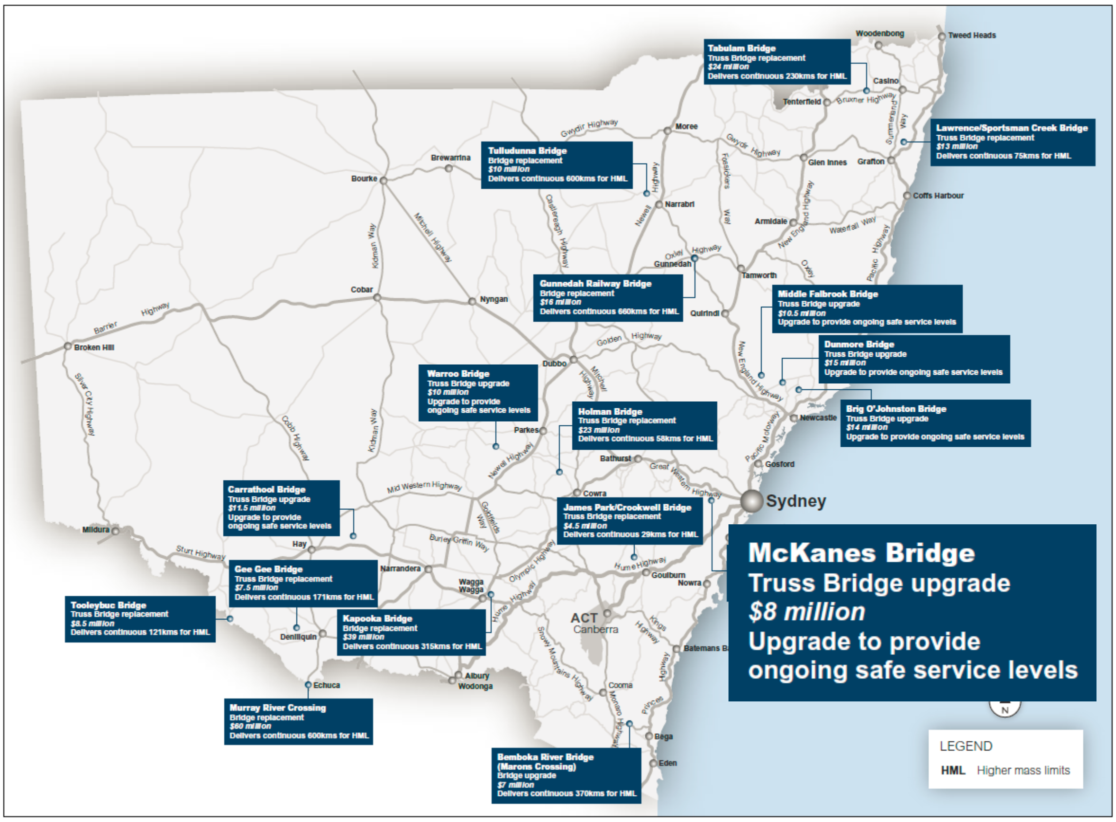
[113] Roads and Maritime, *Timber Truss Bridge Conservation Strategy*, Aug 2012, ISBN 978-1-922194-17-6.
[114] http://www.rms.nsw.gov.au/projects/freight-regional/bridges-for-bush.html (accessed 06/06/17)
[115] http://www.rms.nsw.gov.au/documents/projects/freight-regional/bridges-for-the-bush-mr-fact-sheet.pdf

Figure 5-3: Bridges for the Bush projects including McKanes Bridge



(source: Roads and Maritime)

Meeting customer and community needs

The bridge is currently esteemed only by parts of the local community primarily because its load limits have created operational and logistical difficulties for residents and businesses in the district.

The primary needs of the local community for the crossing are for passenger vehicles and cyclists (particularly tourists but also locals), the school bus, the ambulance in case of emergencies, as well as the local farmer's requirements for transport. These community needs are not dissimilar to the needs of the community in the late 1800s which caused the bridge to be constructed in the first place. Particularly, the bridge was originally constructed to meet the needs of local and regional farmers to be able to safely and efficiently transport their goods and stock. It is therefore very appropriate that the bridge be repaired in such a way to continue this use for which it was built.

One of the original uses of the bridge was to support the regional tourism industry, which continues to be a very suitable use for a heritage timber truss bridge. There are opportunities to further enhance this use with interpretation so the bridge itself can be appreciated as a tourist destination.

Another of the original uses of the bridge was for cyclists, which also continues to be a very suitable use for a heritage timber truss bridge. However, modifications would be required to ensure this use is safe given that the current deck is not as safe for cyclists as the original.

There is an unfortunate history in New South Wales of building new concrete bridges next to existing timber truss bridges, and then demolishing the timber bridge when it becomes too hard to maintain. Efforts have been made in the past to find adaptive reuse for such bridges. In 1990, a single span of the unique bowstring timber truss over the Lachlan River at Cowra was reconstructed in an adjacent riverside park as a landmark of engineering heritage.[116] Although this project was originally heralded as a great success, within ten years, the reconstructed bridge had been so damaged by termites that it had to be demolished due to safety concerns. A bridge that had lasted almost a century under traffic including heavy loads did not last a decade without traffic.

Another adaptive reuse that has been tried is using a bridge to carry utilities. This was the case for de Burgh's bridge over the Lane Cove River. Built in 1900, it was the longest span timber truss built. A new concrete bridge was constructed for traffic in 1967, and ownership of the bridge was transferred to the Sydney Water Board because the bridge was being used to carry a water main.[117] The water main was decommissioned and the bridge burned down in a bushfire in 1994. Timber truss bridges on the road network have sometimes been damaged by fires (McKanes Bridge has suffered fire damage in the past), but never destroyed because the fire is quickly extinguished. If the bridge had still been in use then it is unlikely it would have been destroyed.

There is often an idea that timber bridges could be adaptively reused to take pedestrians and cyclists. Although this may be suitable for other bridge types, the timber decking typical of timber truss bridges causes hazards for cyclists and pedestrians.[118] Again, this has been attempted unsuccessfully a number of times, the worst example being an Allan truss in Glebe (Figure 5-4).[119]

Timber bridges need to be regularly inspected and maintained to protect against rot and termite attack, and pedestrian bridges do not receive sufficient use or funding, which means that such bridges deteriorate very quickly. In an ideal world, perhaps funding would be made available, but experience has shown that even with the best of intentions from all parties, this does not happen.

Figure 5-4: Johnston's Creek Bridge, failed pedestrian bridge at Glebe.

(source: J. McPhail, 2005)

[116] D.J. Fraser, *Cowra Bridge – Preservation of a Unique Structure*, Sixth National Conference on Engineering Heritage 1992, Hobart 5 – 7 October 1992, p 1.
[117] R. Mackay, Conservation and Industrial Archaeology: Recent Work by the National Trust (NSW), *Australian Historical Archaeology*, Vol 4, 1986, p 15.
[118] For example, *Sydney Morning Herald* article on 14 July 2013, "Bridge fall highlights maintenance crisis".
[119] J. McPhail, *Timber/Concrete Composite Module, Testing and Performance*, Australian Small Bridges Conference, October 2005, p 6.

Since experience has shown that these structures are very rarely successfully preserved by removing vehicular traffic and adaptive reuse, it is imperative that McKanes Bridge remains open to traffic. This will necessitate new work to ensure that the bridge is strong enough for the vehicles which will use the route in the future, it may require upgrades to the deck and rails to provide adequate safety and slip resistance, and it may require other modifications to minimise bridge closures and also in order to maximise the sustainability of the timber so it is available for the truss.

An organisation that delivers

Roads and Maritime have invested heavily into understanding timber truss bridges in the modern context so that a representative population can be conserved into the future. With almost 160 years of experience and over 400 timber truss bridges constructed, operated and maintained, there is a wealth of corporate knowledge within Roads and Maritime which cannot be found elsewhere.

Bridge rehabilitation generally, and in particular rehabilitation design for timber bridges, was recognised as an area to be strengthened in the Strategic Directions paper for Roads and Maritime's Technical Capability in 2008. As a result of this perceived skills shortage, sponsorships were offered to Roads and Maritime employees to undertake a Master of Engineering under Professor Keith Crews, a recognised leader in the area of timber structures, as well as a Master of Heritage Conservation to better understand the interrelationship between engineering and heritage. Furthermore, Roads and Maritime have been instrumental in the development of new Australian Standards on the design and rehabilitation of timber bridges, working with experts from industry and academia as well as other road authorities in other States and countries to ensure that the structural behaviour, risks and performance of timber bridges are accurately understood. This corporate knowledge and new research have been used to develop proven method for conserving timber truss bridges as part of the operational road network of New South Wales.

Enhancing economic and social outcomes.

An intangible economic benefit of the timber truss bridges is their heritage value, and conserving McKanes Bridge in a way which meets operational needs enhances the bridge's heritage value.

5.4 Constraints and opportunities from condition and integrity

Elements	Constraints	Opportunities
Top chords	Timber is not original fabric and cannot be returned to original fabric. Increasingly difficult to obtain timber.	Condition and integrity improved by replacing with new hardwood timbers of original dimensions and detailing.
Bottom chords and butting blocks	Timber is not original fabric and cannot be returned to original fabric. Current configuration less strong than original and intrusive to significance. Original design cannot be reinstated because of very long lengths of timber used.	Condition and integrity improved by replacing with new hardwood timbers of original dimensions and detailing where possible. Strength improved by well-designed new work in line with Burra Charter principals for new work.
Principals and diagonal props	Timber is not original fabric and cannot be returned to original fabric. Termite and rot necessitates replacement.	Condition and integrity improved by replacing with new hardwood timbers of original dimensions and detailing.
Diagonals	Timber is not original fabric and cannot be returned to original fabric. Termite and rot necessitates replacement.	Condition and integrity improved by replacing with new hardwood timbers of original dimensions and detailing.
Tension rods	Some tension rods may be original fabric in poor condition. Some are not original fabric or design, inconsistent.	Condition and integrity improved by replacing with new metal components of appropriate dimensions.
Sway braces	N/A	N/A
Cross girders	Timber is not original fabric and cannot be returned to original fabric. Original detailing of primary cross girders cannot be effectively reinstated due to shrinkage. Timber primary cross girders cannot accommodate a complying traffic barrier.	Condition and integrity of secondary cross girders improved by replacing with new hardwood timbers of original dimensions and detailing. Condition and integrity of primary cross girders improved by replacing with steel cross girders of original dimensions.
Decking	Timber is not original fabric and cannot be returned to original fabric. Original detailing cannot be effectively reinstated due to shrinkage of currently available timber and WHS hazards associated with original materials (tar).	Decking is currently intrusive but if it were reconstructed exactly to its original design, it would still only have moderate significance. Opportunity exists to enhance social significance by improving safety and durability.
Railing	Timber is not original fabric and cannot be returned to original fabric. Current configuration is not original. Termite and rot necessitates replacement. Railing does not meet minimum safety requirements for heavy or light vehicles, cyclists or pedestrians.	Railings have little significance and if they were reconstructed exactly to their original design, they would still only have little significance. Opportunity exists to enhance social significance by improving safety.
Abutments	N/A	N/A
Pier	N/A	There may be opportunity to reduce the visual impact of the pier by restoring original colour scheme to the truss and painting the pier dark grey.
Visual setting and context	Differing land ownerships limit the influence that Roads and Maritime might have on any changes to the visual setting outside of the curtilage.	The visual setting and context for the bridge could be enhanced by vegetation control and by further interpretation.

6. Development of conservation policies

6.1 Current management context

The timber in McKanes Bridge is currently in variable condition but the geometry of the trusses is distorted from its original so that it is not possible to repair the bridge piece by piece. In order to restore the original design and original strength, the trusses must be completely reconstructed. Some elements can be reconstructed exactly to their original design, but other elements cannot either due to unavailability of materials, impossible physical constraints or WHS legislation. Some elements as originally designed are capable of taking todays heavy loads while others are not, and so strengthening of some form must be introduced prior to the bridge being reopened.

Natural Heritage Principles is a document prepared by OEH in recognition that the environmental heritage of NSW includes natural as well as cultural heritage, and that the recognition of the value in conserving our remaining natural heritage is vital in order to kerb the accelerating rates of extinctions of plants and animals, and of modifications to the natural environment.[120]

Although McKanes Bridge is not in a natural heritage area, it was originally constructed with timber obtained from old growth hardwood forests in NSW, which were even then becoming endangered. The timbers originally used would have been derived from 200 year old trees in order to achieve the necessary strength, stability, durability and dimensions. Unfortunately, the timber in the bridges does not last as long as it takes to grow a new tree of the appropriate species and age.

While Allan introduced a number of initiatives in his 1893 design to maximise durability of timber in timber truss bridges, the earlier Old PWD and McDonald trusses have timbers in shapes (large sections containing heart) and configurations (laminated timber bottom chords and heavily notched diagonals susceptible to splitting) which are inherently less durable. Originally, the primary timber components in McDonald type timber truss bridges sometimes lasted up to 50 years, whereas today those same components rarely last more than 25 to 30 years. The primary difference is the quality of timber available today. Another contributing factor is that the timber truss bridges were often constructed after the entire surrounding area had been cleared of trees (either for farming or sometimes in order to construct the bridge), thereby reducing the termite risk at the bridge.

There are some very clever modern engineered wood products available today which provide substantial strength and durability using imported sustainably grown preservative treated softwoods combined with glass-aramid or carbon-aramid fibres glued together with modern epoxies. However, these are not as strong or as durable as the original ironbark timbers used, and their use would detract substantially from the heritage value of the bridge, a large part of which is the incredible NSW hardwoods which are the very reason for the bridges being constructed.

The elements which demonstrate the unique strength and durability of the New South Wales hardwoods are the primary load bearing truss elements (top and bottom chords, principals, diagonals and butting blocks). Timber cross girders, decking and railings have been used in bridges all around the world making use of many different species (both hardwoods and softwoods) which are considerably less strong and less durable than the NSW hardwoods. These elements therefore do not demonstrate the unique strength and durability of the New South Wales hardwoods, and do not contribute substantially to the cultural significance of a timber truss bridge.

[120] *Natural Heritage Principals*, Heritage Information Series, NSW Heritage Office, 2000

In order to achieve a balanced approach to conserving both natural and cultural heritage, and to maximise future stocks of NSW hardwoods available for maintaining timber truss bridges, it is appropriate to consider replacing timbers of little heritage value with other materials such as steel.

6.2 Routine repair works

Routine repair and maintenance works generally required on timber truss bridges are included in the table on the following page. Regular inspections, tightening of bolts, termite treatments and upkeep of good quality protective paint systems are essential for long term conservation.

In the McDonald truss, some connections are susceptible to damage from overstress. These include the cast iron shoes which are susceptible to sudden brittle fracture without warning. The bolted connections in the laminated timber bottom chord are generally also overstressed, and signs of overstress include longitudinal gaps opening at laminate butt joints or sagging of the truss. The keyed connections between the butting blocks and bottom chords are also highly stressed and initial signs of failure would generally include splitting of the timber along the shear plane.

Timely replacement of deteriorated timber elements is also necessary in order to keep the bridge in a safe and serviceable condition and minimise spread of deterioration to other elements. The primary natural agencies causing the deterioration of timbers include rot, termites and fire.

Rot is largely inevitable in timbers containing heart, and many of the timbers in the McDonald truss contain heart today because timber of the required dimensions without heart is not available. Rot occurs in trusses most frequently where water accumulates. In the McDonald truss the following areas are particularly susceptible to rot in addition to heart rot and inspections should focus here:

- Tops of top chords and butting blocks if water is allowed to pond on horizontal surfaces
- Interface between butting block and bottom chords especially near notched connections
- Interfaces between timbers in the laminated timber bottom chord
- Interfaces between diagonals where they connect in the centre
- Bases of principals at interface with butting blocks and bottom chords
- End grain of all large timbers containing heart

The best prevention of rot is use of well-seasoned NSW hardwood timbers (excluding heart where possible) with the highest levels of natural durability and to apply frequent and careful painting.

Termites are major destroyers of timber. It can take three to five years for a new colony of termites to become established enough to damage bridges, but termite colonies are extremely difficult to locate at this early stage. In order for termites to establish a colony, they require food (decaying timber), shelter and moisture, and so moist timber or timbers in moist ground are favoured nesting areas for new termite colonies. Large bridge timbers containing heart (such as truss span cross girders, top chords and principals) that have deteriorated are excellent sites for termite nest establishment, especially those that have formed large checks in the top surfaces causing them to become water reservoirs. It is practically impossible to eliminate all termites from a timber bridge, so the aim is to contain termite activity to a level considered economically acceptable by:

- Annual inspections of the bridge for active termites conducted between October and December, and including treatment of any active termites found in the timber members.
- Follow-up inspections before April of the following year focusing on those members treated to ascertain the success of that treatment and to apply additional treatment where required.
- All inspections and treatment of termites conducted by a suitably experienced and qualified person who is familiar with the tell-tale signs of active termite activity and the likely locations for such activity, who can distinguish between destructive and harmless termite species, who can correctly and appropriately install and monitor termite monitoring dowels and termite baits, who can correctly and appropriately apply termite dust, and who can accurately and clearly record and report on termite activity, locations and treatments.

Fire damage is relatively rare on timber truss bridges, and the hardwoods generally used are slow to burn so that only very few timber truss bridges have been lost due to fire. However, many have been damaged due to fire, requiring temporary closures and significant maintenance work, and the risk of this can be reduced by vegetation control in the vicinity of the bridge to form a fire break.

	Every year	Every three years (in addition to every year)	Additional works (as required or specified)
Site & general	Remove any debris and rubbish from the site Clear any vegetation in the area that contributes to a fire hazard or obstructs views Inspect all timber and treat any active termites		Check camber of trusses and re-camber as necessary
Truss timbers containing heart	Remove any accumulations of dirt or fauna (with appropriate environmental approvals)	Check for paint damage, clean and repaint as necessary Tighten all bolts	When timber requires replacement due to deterioration (approx. 25-30 years), replace with new timber sized according to original design drawings
Cross girders containing heart	Remove any accumulations of dirt or fauna (with appropriate environmental approvals)	Check for paint damage, clean and repaint as necessary Tighten all bolts	When timber requires replacement due to deterioration (approx. 20-25 years), replace with new timber sized according to original design drawings
Truss span metal components		Check for paint damage, clean and repaint as necessary	If damage occurs to original fabric then new metal components should be fabricated to precisely match originals

	Every year	Every three years (in addition to every year)	Additional works (as required or specified)
Timber decking	Sweep bridge if required	Tighten all bolts Reseal if necessary	When timber requires replacement (approx. 10-20 years), replace with new timber
Timber railings	Ensure good delineation is maintained by reflectors and paint Check for incident damage, repair and report as necessary	Check for paint damage, clean and repaint as necessary Tighten all bolts	When timber requires replacement (approx. 10-15 years), replace with new timber
Timber sills at pier and abutments	Remove any accumulations of dirt or fauna (with appropriate environmental approvals)	Tighten all bolts	When timber requires replacement due to deterioration (approx. 20-25 years), replace with new timber sized according to original design drawings and installed with connections as per original drawings (partial temporary removal of masonry at abutment required for this work)

6.3 New work

The variable condition, distorted geometry and modifications which have been made to the bridge in the past negatively affect both cultural significance and capacity. The purpose of this section is to explain and demonstrate how the various constraints and opportunities interact with the statement of significance, and how these in turn influence the policy approach to be taken. A range of conservation options are canvased, with the most desirable being highlighted, and then a summary of heritage implications of the most preferred option is provided at the end of this section.

Clause 22.1 of the Burra Charter states that, “New work such as additions or other changes to the place may be acceptable where it respects and does not distort or obscure the cultural significance of the place, or detract from its interpretation and appreciation” and notes that new work should respect the significance of a place through consideration of its siting, bulk, form, scale, character, colour, texture and material. Clause 22.2 states that, “New work should be readily identifiable as such, but must respect and have minimal impact on the cultural significance of the place.”

Original feature	Consideration of options
Truss geometry	Existing truss span lengths and locations are close to original, original to be restored. Existing truss geometries differ slightly from the original due to deterioration, loose joints, simplification of original carpentry detailing (with loss of structural capacity), replacement of elements and shrinkage of timber. Original truss geometries to be restored rather than conserving a deteriorated geometry.
Cast Iron Shoes	Some of the cast iron shoes and washer plates on the truss spans appear to be original, although some have been replaced with replicas. Original cast iron shoes and washer plates in McDonald trusses are brittle and subject to sudden failure (as shown in photographs) and therefore pose an unacceptable safety risk.   Options considered for replacement of shoes include welded steel replicas and ductile cast iron replicas. Although ductile cast iron replicas are significantly more expensive than welded steel, they are seen as a better heritage outcome and are therefore proposed for this bridge. All work on Transport for NSW timber truss bridges is completed in accordance with the relevant specifications and for ductile cast iron components, this is QC Specification 2386. The washer plates are to be replaced with machined steel plates to match the original dimensions of the iron washer plates.
Wrought Iron Tension Rods	 Some of the tension rods appear to be original wrought iron tension rods, although some have been replaced with steel. The tension are all suffering from corrosion at the threaded ends (which is the most highly stressed and fatigue susceptible location and the hardest to paint), and some tension rods have been damaged due to loss of truss geometry (see photo of bent tension rod). It is proposed to replace all the tension rods with new steel tension rods of the same size as the original wrought iron tension rods. On this bridge the original diameters of the tension rods are sufficient, so no upsizing is required.

Original feature	Consideration of options
Truss timbers	The timber top chords at McKanes Bridge consist of single solid timbers in excess of 13 m long with cross sectional dimensions 406mm x 356mm. The bottom spacers in the timber principals at McKanes Bridge originally consisted of single solid (heart free) timbers with cross sectional dimensions 520mm x 356mm. Timber of this size is notoriously difficult to obtain, and so in many bridges the single solid top chord has been replaced either 2 full length timbers bolted together (such as on Junction Bridge, a smaller span McDonald truss) or replaced with a laminated timber top chord consisting of 2 rows of shorter timbers bolted together (such as on Clarence Town Bridge, an Old PWD truss which originally had the same top chord design as McKanes Bridge). Also, the bottom timber spacer in the principal (which is critical for providing lateral support to the top chord) is often replaced with two smaller pieces of timber (such as is presently the case at McKanes Bridge). These changes from single solid large pieces of timber to multiple smaller pieces of timber bolted together significantly reduce the capacity of the bridge, making the top chord more susceptible to buckling. There is also a heritage impact due to this modification, because the change from a single solid member to multiple smaller members introduces a large number of bolted connections which are visually prominent, and confuses the interpretation of the McDonald truss (and Old PWD trusses) which were designed specifically due to the abundance of large long sections of timber available in the mid-1800s.   Due to the known difficulty in obtaining this timber, the project team worked with the RMS procurement section early in the concept design phase to determine what timber would be available for this bridge. It was confirmed that heart free timber is not available in these sizes, but it was also confirmed that these sections could still be obtained in the appropriate species containing boxed heart.  Timber containing boxed heart is considerably less durable than heart free timber, because termites and rot tend to spread from the heart in the centre of the timber where the timber lacks natural resistance to rot and termite attack (see photo). Timber containing heart is also more susceptible to small splits and checks opening up on the surface of the timber, which can damage protective paint systems and allow premature rot also on the top surface which is exposed to UV and rain water. Despite these durability issues, in the absence of heart free timber, it was determined that boxed heart timber was the most suitable alternative, being almost as strong as heart free timber, and looking most like the original design. The other options considered involved the bolting of multiple smaller timbers together to form the same outward section size as the original top chord (similar to what has previously been done at Junction and Clarence Town), but these were found to have insufficient strength for the design loads (and significantly less strength than the original design) and were no more durable than boxed heart due to the fact that timber to timber interfaces are also susceptible to rot and termites.

<table>
<tr><th>Original feature</th><th>Consideration of options</th></tr>
<tr><td>Bottom Chords</td><td>
The bottom chords of the McDonald trusses were originally constructed in-situ as a continuous length approximately 55m long of four rows of timber laminates continuous over the central pier. This is typically how Old PWD and McDonald trusses were constructed, whereas the later truss types (such as Allan trusses) could be lifted into place individually with cranes (as was done at Pyrmont).

In recent Roads and Maritime timber truss bridge capacity upgrade projects, either whole trusses or whole spans have been prefabricated and lifted in place with very large cranes (after the old trusses have been lifted away with the same large cranes) as shown in the photograph. The advantages of this method of work include:

- Minimise bridge closures by maximising construction off site
- More accurate truss fabrication in a more controlled environment
- It is a safer work environment for workers, avoiding risks of working at height, working over water, and working near traffic.

This construction methodology would not allow a continuous bottom chord. The McDonald truss, with its unique splayed principals, very thick laminated bottom chord and no corbels is the most difficult to strengthen unless the bottom chord can be constructed as continuous over however many truss spans there are.

Considerable work was therefore done at an early stage to determine what construction methodologies are possible for the McKanes Bridge. If there was no possible way to construct a continuous bottom chord (given current restrictions for worker safety and minimising bridge closures and working away from waterways) then an alternative bottom chord would have to be designed, which would necessarily be very different to the original laminated timber bottom chord.

Two viable alternatives were developed which would allow a continuous bottom chord. One option was to construct the new timber truss bridge immediately adjacent to the existing bridge on temporary piers and then demolish the existing bridge and slide the new strengthened bridge into position with jacks and strands. Another option was to close the road for an extended period of time (6 to 12 months) and reconstruct the existing bridge from scratch in-situ on temporary falsework, in a somewhat similar (but safer) fashion to how it was originally constructed. The second option is preferred on safety grounds, and the temporary works have been designed sufficiently to prove the concept

This early work on construction methodologies was further confirmed at a regional constructability and safety in design workshop held in Lithgow and on site on 21 October 2015 with a large group of stakeholders where different opportunities and constraints were discussed. Confidence was gained that continuous laminated timber bottom chords could be conserved at McKanes Bridge.

However, it was understood that this is only part of the problem – the other part of the problem is that the original timber laminate lengths and butt joint configuration cannot be achieved due to the lack of availability of long enough timber.
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<table>
<tr><th>Original feature</th><th>Consideration of options</th></tr>
<tr><td>Bottom chords</td><td>Original bottom chords were designed to take the load of a 16 tonne traction engine, which is significantly less than today’s legal heavy vehicles. Furthermore, the original bottom chord consisted of a number of different lengths of timber, including four pieces of timber with lengths exceeding 16m, and another four of approximately 15m length with most timbers in the bottom chord exceeding 13m in length. The maximum length of timber (of the required cross section, heart free and sapwood free) available today is approximately 10m. The use of shorter timbers in the laminated timber bottom chord significantly decreases capacity (approx. 50% loss), and so strengthening is required in order to make up for the capacity that has been lost due to the use of shorter lengths of timber. A number of options were considered, with the final options being preferred.
<table>
<tr><th>Option</th><th>Capacity</th><th>Constructability</th><th>Heritage</th></tr>
<tr><td>Retain original 4 rows laminated timber 114x356</td><td>Fail – insufficient capacity.</td><td>Fail – cannot obtain required timber.</td><td>Good.</td></tr>
<tr><td>Increase size 4 rows laminated timber 114x400</td><td>Fail – insufficient capacity due to connections and also encroaches into flood waters.</td><td>Fail – cannot obtain required timber, and increased depth clashes with pier and abutments</td><td>Fail – loss of form due to change in depth of chords, introducing eccentricity.</td></tr>
<tr><td>Engineered wood products, LVL and glulam</td><td>Fail – products use softwood not hardwood and require significant increases in size.</td><td>Fail – cannot find supplier in Australia and cannot transport long lengths from O/S.</td><td>Fail – use of NSW hardwood (not softwood) timber is fundamental to the design for trusses.</td></tr>
<tr><td>Strengthening with internal steel plates</td><td>Fail – inserting steel means timber laminates are no longer acting as a unit and cannot carry load.</td><td>OK – has been done before, but with difficulty (Junction Bridge, McDonald truss).</td><td>Fail – timber in bottom chord becomes non-structural facia and so heritage significance is lost.</td></tr>
<tr><td>Strengthening with internal steel box replacing central laminate</td><td>Fail – end principals are splayed and require support at outer edges of bottom chord.</td><td>OK – has not been done before, and would be difficult due to numerous connections.</td><td>Fail – timber is purely facia and so heritage significance is lost.</td></tr>
<tr><td>Under-trussing with steel rope or Carbon FRP</td><td>Fail – thermal movements in steel, lack of stiffness in FRP make these ineffective – also flood debris trap.</td><td>OK – has been done before, but difficult to maintain.</td><td>Fail – significant visual impact causes loss of clarity and difficulty in interpretation.</td></tr>
<tr><td>Strengthening with external steel plate keeping original dimensions</td><td>OK</td><td>OK – has been done before (Galston Bridge - another McDonald truss)</td><td>OK – timber remains structural and retains original cross sectional dimensions.</td></tr>
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</td></tr>
</table>

<table>
<tr><th>Original feature</th><th>Consideration of options</th></tr>
<tr><td>Cross Girders</td><td>
The primary cross girders in McDonald trusses have insufficient capacity to carry today’s loads. The loss of geometry due to shrinkage (a big problem with the Old PWD truss cross girders) is largely mitigated by McDonald’s use of iron wedges to take up the slack, but still causes difficulties and looseness of connections, as can be seen in the photographs of Junction Bridge (another McDonald truss) below.

The timber cross girders also incapable of supporting a complying traffic barrier. In order for a traffic barrier to be effective, it must have strong connections, and it is not possible to achieve a strong enough and rigid enough connection in timber.
Furthermore, the timber cross girders are unable to provide a sufficiently strong connection to the metal sway braces to enable the sway braces to be used to provide lateral stability to the top chord of the truss. While this additional stability is unnecessary for 16 tonne loads, it is necessary for larger loads, and records of top chords being out of alignment show that this is an issue at McKanes.
Options considered for truss span cross girders are as follows:

Restore original timber cross girder design (discounted due to issues above).
Install timber cross girders of larger cross section in order to have sufficient capacity to carry today’s loads (discounted because increasing the size of the cross girders would necessarily change the geometry of the whole truss in order to fit. A significant difference between the Old PWD and McDonald trusses is that McDonald eliminated all eccentricities in his truss geometry.
Strengthen original timber cross girder design with external steel plates somewhat similar to what is being proposed for the bottom chord strengthening (discounted because previous attempts on other bridges have proved to be ineffective because cross girders are stressed primarily in bending whereas bottom chords are stressed primarily in tension).
Strengthen original timber cross girder design with transverse under-trussing (discounted because previous attempts on other bridges have proved to be ineffective due to the tendency for under-trussing to loosen and fall off).

It is proposed to replace the timber primary cross girders with steel box sections of the same dimension as the original. By doing this, the strength is sufficient, the shrinkage is done away with, the traffic barrier and sway braces have something to connect to, and the form and function of the original primary cross girders is preserved, as well as the form, fabric and function of all other truss members.
With the introduction of an SLT deck, there is no need to make any modifications from the original design for the timber secondary cross girders. The existing timber secondary cross girders are in good condition, but they are not of original geometry, and they are missing the original detail of notching over the bottom chord. All secondary cross girders will therefore be replaced with new timbers of original dimensions in original locations as marked in the original design drawings.
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Original feature	Consideration of options
Sway Bracing	While the Old PWD had timber sway bracing to resist lateral buckling of the top chord, later trusses do not. McDonald, Allan, de Burgh and Dare designed top chords to have sufficient capacity to resist buckling even without sway bracing, and supplied only very slender, low capacity metal sway bracing to limit vibrations (or "sway"). In McDonald trusses, the lateral stability of the top chord is entirely dependent upon the splaying of the principals. However, splayed principals do not have sufficient strength or stiffness to prevent the top chord from lateral movement when vehicular loads exceed approximately 16 tonnes or when timber principals or butting blocks begin to rot, and so these trusses are also subject to horizontal misalignment as can be seen in the photograph to the right. A number of options were considered, the final option is preferred. 

Option	Capacity	Constructability	Heritage
Retain existing	Fail	OK	Good
Upsize principals and top chord	OK	Fail – cannot obtain required timber, as the timber is already very large section timber.	Fail – would require change in size not only to principals but also bottom chord & abutments.
Provide overhead portal bracing	OK, but increased risk of impact from over-height vehicle	OK, has been used in the past on other timber truss types	Fail – visually intrusive from all viewing angles.
Provide additional sway braces	Fail	OK, has been used in the past on other McDonald trusses	Fail – requires modifications to cross girders and introduction of eccentricities or awkward angles.
Provide additional sway braces and replace existing with longer sway braces	Fail	OK, has been used in the past on other timber trusses	Fail – requires modifications to all primary cross girders as well as eccentricities or awkward angles.
Replace sway braces with new strengthened sway braces in original locations only	OK	OK	OK – minimal visual impact when compared with alternatives and still reflects original design locations.

<table>
<tr><th>Original feature</th><th>Consideration of options</th></tr>
<tr><td>Diagonal Decking</td><td>
The original deck on McKanes Bridge consisted of tightly spaced diagonal decking 100mm thick, supported on primary and secondary timber cross girders and sandwiched between curved spiking planks and kerbs at each end.
The original timber deck has insufficient capacity to carry the design loads.

Significant modifications to the deck have occurred over time, with the deletion of the spiking planks, the straightening and enlargement of the kerb (with associated modifications to the timber rails and posts), the replacement of iron spikes with steel bolts, the reorientation of the planks from diagonal to longitudinal, the increase in thickness from 100 mm to 125mm, and the covering of the deck with a sprayed seal.
In addition to the modifications which are visible from the road level, there have been significant modifications to the deck from beneath including transverse bolting planks located between each cross girder and large section longitudinal bolting planks located under the cross girders for the length of the bridge. These give a messy view under the bridge but are necessary to keep the deck tight.

Even with all these modifications, the current timber deck is still problematic:
Insufficient lateral stiffness to keep bottom chords and trusses aligned
Insufficient lateral stiffness to provide load path for traffic barrier impact
Insufficient strength to span between primary cross girders, thereby necessitating upsizing or other strengthening of secondary cross girders.
Safety issues for vehicles due to slipperiness and protruding loose bolts
Significant safety issues for cyclists due to shrinkage gaps and roughness
Community inconvenience due to regular bridge closures required to maintain deck, including full deck replacement approximately each 10 years.

For these reasons, a stress laminated timber (SLT) deck is preferred. Original diagonal decking cannot be retained under SLT decking as the weight of two decking systems overloads the truss and is problematic for SLT deck connections.
An SLT deck not only provides a safe surface for bridge users and minimised community inconveniences due to maintenance closures, but it also obviates the need for other changes which would otherwise be necessary on the truss spans.
Without an SLT deck, underdeck steel bracing would have to be introduced to provide lateral stiffness, and this would add significant weight to the bridge.
The provision of an SLT deck obviates the need to strengthen secondary cross girders by either upsizing or (more likely) by replacement with steel cross girders.
Because the SLT deck provides lateral stiffness, there is no need to make other modifications to the bottom chord, which would be necessary if a separate bracing system had to be introduced in order to provide lateral stiffness.
The retention of the laminated timber bottom chord (strengthened with steel plates) is structurally dependent on the decking system providing lateral stiffness.
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</table>

Original feature	Consideration of options
Railings	On the contrary, timber rails are a spearing risk to errant vehicles and their passengers. There have been a number of instances of vehicles driving off the sides of timber truss bridges, with some fatalities. Roads and Maritime has a responsibility for the safety of the travelling public and it is therefore necessary that Roads and Maritime do what it can to mitigate this well known risk. A number of different approaches to barrier rail design have been investigated in attempts to minimise the visual impact and obtrusiveness on heritage bridges. The barrier designed for McKanes Bridge was first developed for Monkeai Bridge (an Old PWD type timber truss bridge), and has not been designed to meet the current Australian Standard (AS 5100-2004), but the previous standard (AUSTROADS-1996). The geometrical requirements and the design loads are significantly less stringent in AUSTROADS 96, which is the absolute minimum required to keep a small errant vehicle safe. A large range of options were considered to reduce the visual impact of the barrier. All options were designed for a 0.8 tonne small car and a 2.0 tonne utility vehicle travelling at 50km/hr. Roads and Martime engaged an architect to work with internal engineers to design an aesthetically suitable traffic barrier for timber truss bridges. A barrier was designed for Monkerai Bridge, which is a particularly short truss (10’ high). Since McKanes is also a short truss and rather similar in geometry, this traffic barrier developed for Monkerai is also considered suitable for McKanes Bridge. • A number of urban design principles were applied to this design including: • Integrate barrier to create a unified composition • Work toward decluttering the appearance of the bridge • Use a matt grey paint finish to contrast with the white truss A number of concepts were developed and tested using photo montages and 3D computer models to assess the visual impact, and ‘Option H’ was the option which performed best because (see photograph below), even though it provides less visual permeability, it makes the truss more legible by allowing the two horizontal traffic barrier rails to read as a single element. The result simplifies the composition by reducing the complexity, making the truss more dominant.[121] 

[121] For full report on the development of this option, see *Monkerai Bridge Urban Design Study*, Nov 2016.

7. Conservation policies

The policies in this section provide for the care and management of the bridge to ensure its conservation as a State Heritage item. The policies provide for the retention and enhancement, through appropriate conservation and interpretation, of the heritage values of the bridge, its setting and its ongoing operations.

The OCMP contains policies designed to guide and manage the entire population of timber truss bridges to be retained by Transport for NSW. These general polices identify the broader principles and practices that are to be undertaken and may not specifically apply to an individual bridge. For clarity these policies have been omitted from this bridge specific CMP. Policies from the OCMP that apply to this bridge (Policies 1–10) and additional policies relating to significant elements (Policies 11–22) are included here.

7.1 Best practice in heritage management

The policies in this CMP provide for the care and management of the bridge to ensure its conservation as a State Heritage item. The policies provide for the retention and enhancement, through appropriate conservation and interpretation, of the heritage values of the bridge including its setting and ongoing use.

Policy 1: Retention of the cultural significance of the bridge

a) The bridge is a place of exceptional cultural significance and will be maintained and conserved in such a way which protects or enhances its cultural significance.

b) Conservation of the bridge will accord with the definitions and principles of The Burra Charter: the Australia ICOMOS Charter for Places of Cultural Significance and include all significant components and attributes of the place and its setting.

c) All current and future owners, managers and consent authorities responsible for the management of the bridge and/or its setting will be jointly responsible for the conservation of the significance of the bridge.

d) The conservation management of the bridge will be undertaken in consultation with heritage practitioners with relevant expertise and experience working in collaboration with structural engineers with relevant expertise and experience as required.

Policy 2: Adoption, implementation and review of the CMP

a) The conservation policies set out in this document will be formally adopted by Transport for NSW as a guide to future conservation and development of the bridge.

b) Transport for NSW will make resources available for the implementation of these polices during any works to the bridge or its setting, including routine maintenance.

c) Transport for NSW will ensure this document is both available for, and understood by staff coordinating and undertaking the ongoing maintenance of the bridge.

d) This CMP will be made available to the public. Copies will be lodged with all relevant administrative, maintenance, heritage and archival bodies/agencies, as well as being held by Transport for NSW, and be readily available for public reference.

e) This CMP will be reviewed every five years to incorporate changes in conservation methodology or practice, changes in legislation or user requirements, and any new historical evidence that comes to light. The effectiveness of conservation treatments will also be considered and if required, corrective action recommended. The reviewed CMP will be submitted to the Heritage Council for endorsement.

7.2 Ensuring bridges have a role and use in life of communities

The continued use of the bridge as a functioning crossing for vehicles is integral to its cultural significance and survival. New work will be required to adapt the bridge to changing transportation needs.

Policy 3: Use of the bridge

a) Transport for NSW will continue to engage with local communities to ensure that the bridge is retained and managed in a way that meets community needs.

b) The bridge will be used for vehicular traffic. The continued use of this bridge as a functioning crossing for vehicles, pedestrians and cyclists is integral to its cultural significance.

c) Unacceptable uses of the bridge include any uses or activities that may cause or accelerate damage to the fabric or to the views to and from the bridge (e.g. utilities).

d) Transport for NSW will consider arranging for the removal and relocation of existing utilities from the bridge if possible and if opportunity arises.

Policy 4: Maintenance and repair

The timber in timber truss bridges is generally not original fabric. The removal of deteriorated timber and its replacement with new timber fabric of suitable species is essential for the conservation of the bridge.

a) Ongoing repair and maintenance will be carried out to ensure that the minimum standards of maintenance under the *Heritage Act 1977* are met, and that each significant element in the bridge retains its level of significance. Works will be undertaken by suitably skilled workers with proven expertise in the relevant field and under adequate supervision.

b) Transport for NSW will prepare an Incident Response Plan for the bridge to minimise the risk and duration of emergency works, and manage such works so that the public and the bridge is kept safe, and so that works do not impact significant fabric.

c) The bridge is located on a public road and must not create a public safety hazard, but will be maintained both to support its ongoing functionality and its significant form.

d) The bridge will be regularly inspected by specialists for the integrity of the structure. Any issues affecting public safety, if found, will be addressed by appropriate methods.

e) A separate specialist will be engaged twice a year to inspect for and treat any termites.

f) In order to carry out maintenance and repair work safely, various support structures may be necessary including Bailey bridge (or equivalent), temporary props and access scaffolding. These structures are temporary in nature, and will be removed when no longer required.

Policy 5: New work

New work will be required to adapt the bridge to changing transportation needs. The endorsed Strategy and OCMP acknowledged the need to use modern materials to ensure the bridges have sufficient strength and safety for modern vehicles. These policies aim to ensure that new works and new materials are not damaging to heritage significance, but are comparable with the old in quality and do not dominate the trusses in bulk, scale or character. Appropriate design using modern materials and techniques can be an effective way of distinguishing new work from original if it is used with care and design excellence.

a) Elements of the bridge will be conserved in accordance with their level of significance.

b) The bridge will continue to carry traffic appropriate to its place in the road network. The bridge may be adapted to ensure its continued serviceability provided this does not compromise its heritage significance. Subject to relevant approvals, this may include introducing new materials to meet load, safety and durability requirements.

c) Transport for NSW will match the excellence of the originals in the quality of design and construction of any modifications or new works.

d) For works not covered by Standard or Specific Exemptions or by exemptions identified in an endorsed bridge specific CMP, applications to the Heritage Council for approval for specific works will be submitted, accompanied by a statement of heritage impact (SOHI) and, if required, the relevant statutory application under the *Heritage Act 1977*. The approval and decision making process for structural upgrades is given on the following page.

Figure 7-1: Approval process for structural upgrades and new work

INDENTIFY	• Identify and justify need for upgrade works • Determine bridge heritage listings status (SHR/S170/LEP)
APPROVAL PATHWAY	• Determine required approval pathway • Obtain advice from environment / heritage manager
SCOPE WORKS	• Consult this CMP and develop scope of works in collaboration with Environment, Bridge Engineering, Bridge Maintenance Planner, Bridge Works Manager, Community Stakeholder & Engagement Section and Transport for NSW Heritage Specialist
CONCEPT DESIGN	• Develop heritage concept options and heritage concept sketches in collaboration with OEH as well as Environment, Bridge Engineering, Bridge Maintenance Planner, Bridge Works Manager, Community Stakeholder & Engagement Section and Transport for NSW Heritage Specialist
IMPACT ASSESSMENT	• Prepare Statement of Heritage Impact (SOHI) • Undertake internal and external review of SOHI
S60 APPLICATION	• Prepare and submit S60 application to OEH • Respond to any inquiries or requests for more information
APPROVAL	• Receive works approval notification or review application if not approved • Review conditions of approval and incorporate into works program
COMPLETE WORKS	• Undertake works in accordance with any conditions of approval
UPDATE DATA	• Update heritage registers and inform OEH • Update relevant internal systems, databases or documents.

Source: Adapted from Roads and Maritime, NSW Timber Truss Road Bridges, Overarching CMP, February 2018, p 36.

7.3 Interpretation and appreciation of timber truss bridges

There are some misconceptions with regard to heritage timber truss road bridges (e.g. they are inherently too weak for modern vehicles, they are inherently unsafe, they are inherently noisy, heritage listing inherently prohibits any change). This not only means that the bridges are not fully appreciated, but it can also lead to local communities lobbying for a new concrete bridge, often wishing to conserve the timber bridge off line only when it is too late. Accurate, interesting and relevant interpretive material is critical for assisting local communities to appreciate their bridge, which will then assist with conservation.

Policy 6: Interpretation

a) The heritage significance of the bridge will be communicated through effective heritage interpretation.

b) Interpretation will be based on the historical themes and analyses documented in this CMP.

c) Interpretation will conform to Heritage NSW's Interpreting Heritage Places and Items Guidelines and with Transport for NSW's Heritage Interpretation Guideline.[122]

Policy 7: Protection and enhancement of visual setting

a) Any development proposed for the land adjacent to the bridge, whether inside or outside the curtilage, should be considered carefully to ensure that it does not have an unacceptable visual impact which could cause a reduction in the aesthetic significance of the bridge.

b) Signage in the vicinity of the bridge should be minimised to what is necessary for safety and identification so that it does not create visual clutter and block views.

c) Vegetation in the vicinity of the bridge should be kept to a minimum. Weeds should be removed, and vegetation clearance should be regularly undertaken with a view to improving the visual setting, and to reduce the risk of fire by creating a cleared area that acts as a fire break.

d) Any relevant planning and statutory controls must be adhered to when considering development or works adjacent to the bridge.

[122] NSW Heritage Office, Heritage Information Series, Interpreting Heritage Places and Items Guidelines, 2005; NSW Roads and Maritime, Heritage Interpretation Guideline, Draft February 2016.

7.4 Documentation and approvals

Well managed records are important as they enhance the understanding of the heritage item, its significance and the impact of change as part of the conservation and management process.

Policy 8: Archival recording

a) The records created by Transport for NSW relating to the bridge are recognised as an integral part of the heritage portfolio. They will be managed to ensure permanent retention as State records, but must also be made available so that they can be readily accessed by relevant stakeholders where required.

b) Immediately before, during and after any works being undertaken on the bridge, an inspection will be completed, detailing and photographing the condition and defects of all elements.

c) A complete archival recording will be undertaken of the bridge including 3D mapping (laser scanning).

d) All methods and materials used during any work done to the bridge will be fully documented with written information and appropriate photographs. Records, reports and photographs of any work carried out on the bridge will be placed in a permanent archive to enable retrieval of information afterwards.

e) A representative sample of any original fabric assessed to be of heritage significance (such as cast iron shoes), but to be removed from the bridge will be suitably archived and recorded on the Transport for NSW Section 170 Heritage and Conservation Register unless similar samples are already archived. This will include:

   – Three different types of original top chord shoes from a 90' McDonald truss

   – One of each of the original tension rod connectors (ie: saddle plates and washer plates)

Policy 9: Archaeology

a) Transport for NSW will consult with relevant Aboriginal stakeholders about any proposed project or works that may impact on areas of Aboriginal archaeological potential or cultural significance. Wherever harm to Aboriginal relics is considered likely in the course of works, an AHIP shall be obtained, in accordance with Section 90(1) of the NPW Act 1974.

b) Any subsurface disturbance of land that may have archaeological potential will be carried out in accordance with the Transport for NSW Cultural Heritage Guidelines and the archaeological provisions of the *Heritage Act 1977*. A Due Diligence Assessment will be provided for any works which disturb the land outside of an AHIP area (including, cutting, filling, ground penetration, stockpiles, mounds, etc). The Assessment shall be in accordance with the Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW 2010).

c) The Transport for NSW *Unexpected Heritage Items Heritage Procedure* (current edition 02, November 2015), must be followed to manage the discovery of all unexpected heritage items (both Aboriginal and non-Aboriginal) that are discovered during Transport for NSW activities.

Policy 10 – Exemptions and approvals

a) Routine maintenance works identified in Table 1 of Appendix A can proceed without requiring notification to the Heritage Council.

b) Works identified in Table 2 of Appendix A will need approval / consent advice sought regarding the nature/type of approval required prior to works being planned.

7.5 Additional policies for significant elements

Policies related to fabric use words specifically defined in the *Burra Charter* as follows:

***Fabric** means all the physical material of the place including elements, fixtures, contents and objects.*

***Conservation** means all the processes of looking after a place so as to retain its cultural significance.*

***Preservation** means maintaining a place in its existing state and retarding deterioration.*

***Restoration** means returning a place to a known earlier state by removing accretions or by reassembling existing elements without the introduction of new material.*

***Reconstruction** means returning a place to a known earlier state and is distinguished from restoration by the introduction of new material.*

***Adaptation** means changing a place to suit the existing use or a proposed use.*

***Interpretation** means all the ways of presenting the cultural significance of a place.*

7.5.1 Policy 11 – Top chords (exceptional significance)

The timber fabric is not original and is subject to deterioration from rot and termite attack. Metal flashing is visually intrusive and ineffective in prolonging the life of the timber top chords.

a) Top chords will be reconstructed to their original design dimensions and detailing using NSW hardwood of suitable strength and durability and steel splice plates.

b) The timber of the top chords, once reconstructed, will be preserved for as long as practical by ensuring that the protective coating (breathable white paint) is reapplied as necessary and that termite inspections and treatments are undertaken regularly.

c) They will be replaced before deterioration affects safety or serviceability of the bridge.

7.5.2 Policy 12 – Bottom chords and butting blocks (moderate significance)

The timber fabric is not original and is subject to deterioration from rot and termite attack. The original design is not capable of carrying current vehicular loads and the original lengths of timber are not available today. The current bottom chord timbers are approximately half the lengths of originals and have only a small fraction of the capacity of the originals. The bottom chords therefore require some adaptation which is visually recessive and allows as much as possible of the original details of the bottom chord to be understood, but providing sufficient strength for loads.

a) Bottom chords and butting blocks will be reconstructed to their original design dimensions and detailing as much as possible, using NSW Hardwood of suitable strength and durability, with suitably designed strengthening provided to allow the bridge to carry modern vehicles and to make up for the loss of capacity inherent in using shorter timbers. External steel plates have been determined to be the most appropriate option in this case.

b) The timber of the bottom chords and butting blocks, once reconstructed, will be preserved for as long as is practical by ensuring that the protective coating (breathable white paint) is reapplied as necessary and that termite inspections and treatments are undertaken regularly, and that the bolts in the bottom chord are kept tight.

c) They will be replaced before deterioration affects safety or serviceability of the bridge.

7.5.3 Policy 13 – Principals and diagonal props (high significance)

The timber fabric is not original and is subject to deterioration from rot and termite attack. Alterations detract from aesthetics and strength, but the original design can be reconstructed.

a) Principals and diagonal props will be reconstructed to their original design dimensions and detailing using NSW hardwood of suitable strength and durability.

b) The principals and diagonal props, once reconstructed, will be preserved for as long as is practical by ensuring that the protective coating (breathable white paint) is reapplied as necessary and that termite inspections and treatments are undertaken regularly.

c) They will be replaced before deterioration affects safety or serviceability of the bridge.

7.5.4 Policy 14 – Diagonals (exceptional significance)

The timber fabric is not original and is subject to deterioration from rot and termite attack.

a) Diagonals will be reconstructed to their original design dimensions and detailing using NSW hardwood of suitable strength and durability.

b) The diagonals, once reconstructed, will be preserved for as long as is practical by ensuring that the protective coating (breathable white paint) is reapplied as necessary and that termite inspections and treatments are undertaken regularly.

c) They will be replaced before deterioration affects safety or serviceability of the bridge.

7.5.5 Policy 15 – Tension rods (moderate significance)

Some of the tension rods may be original fabric, but are in poor condition and some are modified.

a) Tension rods should be reconstructed to their original design dimensions and detailing with new metal components. They should be painted black to preserve the original aesthetic.

7.5.6 Policy 16 – Cast iron shoes (high significance)

Some of the cast iron shoes are original fabric, but are subject to sudden brittle failure.

a) Cast iron shoes should be reconstructed in ductile cast iron to their original design dimensions and detailing. They should be painted black to preserve the original aesthetic.

7.5.7 Policy 17 – Sway braces (high significance)

Sway braces are significant in McDonald trusses because this detail was introduced by McDonald as a distinguishing feature of the McDonald truss different to the Old PWD truss, but incorporated into the later timber truss types. As originally designed they do not provide lateral restraint to the top chord, but for modern heavy loads it is necessary to modify the sway braces to provide additional lateral restraint. Modifications of the sway braces in this instance would be a substantially better heritage conservation outcome that modification of the top chord details.

a) The metal sway braces should be replaced with new strengthened metal sway braces at original locations only. They should be painted black to preserve the original aesthetic

7.5.8 Policy 18 – Cross girders (little significance)

The timber fabric is not original and is subject to deterioration from rot and termite attack. The original design of the primary cross girders cannot be effectively reconstructed due to the excessive shrinkage of timbers available affecting the ability of the truss to carry any loads. Some adaptation is required to allow the bridge to function but also to interpret the original.

a) Secondary cross girders should be reconstructed to their original design dimensions and detailing using NSW Hardwood of suitable strength and durability.

b) Primary cross girders should be replaced with new steel primary cross girders which reflect the form and function of the original. The new steel primary cross girders should be painted white to restore the original aesthetic to the bridge and also to indicate as a form of interpretation that the original primary cross girders were timber.

7.5.9 Policy 19 – Decking (currently intrusive)

The decking does not contribute directly to the significance of the item, and the current decking is intrusive because modifications are so substantial that these elements are now damaging to the item's heritage significance, causing structural deficiencies and undermining interpretation.

a) The decking should be replaced with new decking which should reflect the fabric and function of the original and should restore the original aesthetic of the bridge.

b) The decking including its wearing surface should be maintained in such a way to ensure the safety of those travelling across the bridge and to reduce the risk of damage to the bridge.

7.5.10 Policy 20 – Railing (little significance)

The railing does not contribute directly to the significance of the item, and does not have any ability to prevent a vehicle from falling off the bridge. The railings are therefore a safety hazard.

a) The railing should be replaced with a new visually recessive but complying traffic barrier.

7.5.11 Policy 21 – Abutments (high significance)

Masonry abutments are largely original fabric to the original design and should be preserved.

a) The masonry abutments will be preserved for as long as is practical by ensuring that wombat holes are filled and scour protection is provided to avoid damage by undermining.

b) If cleaning of the abutments is required in order to remove harmful substances and to reveal deterioration then a gentle method such as low pressure water spray will be used.

c) If repair to abutment stone is required then the new stone will match the old as nearly as possible in colour, grain, bedding, durability, porosity and chemical composition.

d) If repair to the abutment mortar is required then the composition of the mortar will match the original lime mortar as nearly as possible to avoid detrimental interaction.

e) Where stones from the abutment require temporary removal to enable access for truss repair works, the stones will be reinstated to their original locations on completion of work.

7.5.12 Policy 22 – Pier (little significance)

The concrete pier is a modern addition constructed as emergency work as a result of the 1986 flood. It is visually intrusive and suffering from graffiti, but the situation could be substantially improved by painting the concrete pier in a dark colour (probably grey) to be visually recessive, and by restoring the original colour scheme of the trusses so that they regain visual dominance.

a) The concrete pier will be painted dark grey with an anti-graffiti coating applied.

8. Implementation of CMP

The conservation policies in Section 7 provide for the ongoing care and management of the bridge so as to ensure the conservation of its cultural heritage values. Critical actions with regard to this bridge for the implementation of this CMP and the Overarching CMP are identified and scheduled in the table below.

Year	Action by Transport for NSW	Priority
Year 1	Submit CMP to the Heritage Council for endorsement.	High
	Formally adopt this CMP and integrate with all other documentation, planning and management processes relating to the bridge.	High
	Train relevant Transport for NSW stakeholders in the use of this CMP.	Medium
	Prepare an Incident Response Plan for the bridge.	Medium
	Continue to actively conserve the bridge by appropriate maintenance, repair and management.	High
	Continue to engage with communities to ensure that the bridge is managed in such a way that meets community needs.	High
	Where modifications are required to the bridge to meet community needs, follow process set out in flowchart provided in Figure 7-1.	High
Years 2-4	Continue to actively conserve the bridge by appropriate maintenance, repair and management.	High
	Continue to engage with communities to ensure that the bridge is managed in such a way that meets community needs.	High
	Where modifications are required to the bridge to meet community needs, follow process set out in flowchart provided in Figure 7-1.	High
Year 5	Continue to actively conserve the bridge by appropriate maintenance, repair and management.	High
	Continue to engage with communities to ensure that the bridge is managed in such a way that meets community needs.	High
	Where modifications are required to the bridge to meet community needs, follow process set out in flowchart provided in Figure 7-1.	High
	Review this CMP.	Medium

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10. Abbreviations and terminology

Term / Acronym	Description
BIS	Roads and Maritime’s Bridge Information System
CMP	Conservation management plan
DMR	NSW Department of Main Roads (now Roads and Maritime)
FRP	Fibre Reinforced Polymer
Heritage Act	*Heritage Act 1977* (NSW)
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the *Environmental Planning and Assessment Act 1979* (NSW)
LVL	Laminated Veneer Lumber (an engineered wood product)
MRB	Main Roads Board (now Roads and Maritime)
NAASRA	National Association of Australian State Road Authorities
OEH	Heritage Division of the Office of Environment and Heritage (now Heritage NSW)
PACHCI	Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation
PAD	Potential Archaeological Deposit
PWD	Department of Public Works (now Roads and Maritime)
REF	Review of Environmental Factors
Roads and Maritime	NSW Roads and Maritime Services
RTA	NSW Roads and Traffic Authority (now Roads and Maritime)
SHR	State Heritage Register
SOHI	Statement of heritage impacts
WHS	Work Health and Safety

Appendix A

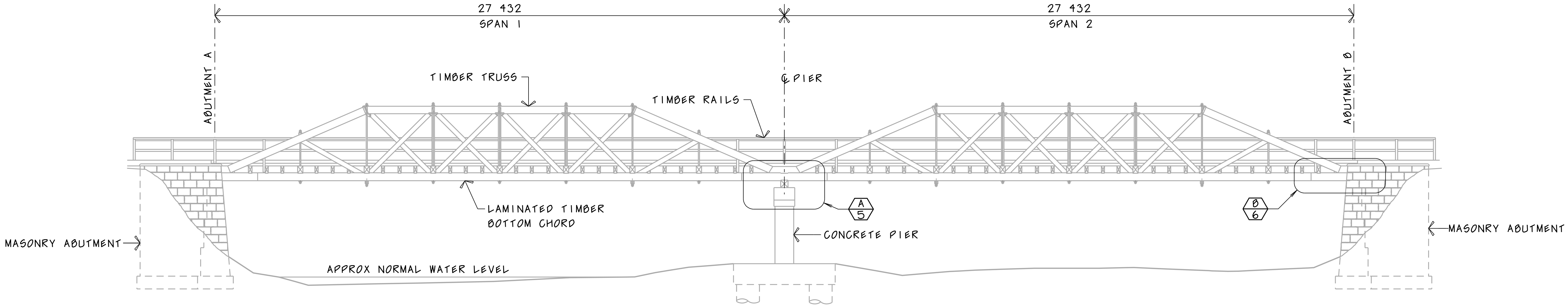
Schedule of Conservation Works

Table A-1: Works exempt under s57 of the Act not requiring notification to the Heritage Council

Element	Works
Site and general	Removal of any rubbish or debris from the site
	Vegetation clearance required to maintain an Asset Protection Zone in accordance with the recommendations of a suitably qualified Bushfire Assessment Consultant accredited by the Fire Protection Association Australia (FPA Australia).
Timber elements generally	Remove any accumulations of dirt or fauna
	Inspect timber and treat active termites
	Check for pain damage, clean and repaint as necessary
	Tighten all bolts
Timber decking	Reseal decking if required
Timber railings	Check for incident damage, repair as necessary to existing detail

Table A-2: Works that may require Heritage Council approval/consent under s57or s60 of the Act

Elements	Description	Condition / Integrity	Significance (State)	Conservation Works
Top chords	Single timber members as described in Section 3.2.3.	Variable / Good	Exceptional (State)	Routine repair and maintenance as described in Section 6.2 Remove flashing and reconstruct top chords with new timber to original design dimensions and detailing
Bottom chords and butting blocks	Laminated timber members as described in Section 3.2.4.	Good / Poor	Moderate	Routine repair and maintenance as described in Section 6.2 Replace with new laminated timber bottom chords strengthened for today's loads (see Section 6.3 and following plans)
Principals and diagonal props	Various timber members as described in Section 3.2.5.	Variable / Variable	High (State)	Routine repair and maintenance as described in Section 6.2 Reconstruct principals and diagonal props with new timber to original design dimensions and detailing
Diagonals	Various timber members as described in Section 3.2.6.	Variable / Good	Exceptional (State)	Routine repair and maintenance as described in Section 6.2 Reconstruct diagonals with new timber to original design dimensions and detailing
Tension rods	Metal rods with washers and nuts as described in Section 3.2.7.	Fair / Fair	Moderate	Routine repair and maintenance as described in Section 6.2 Reconstruct tension rods with modern steel to original design dimensions and detailing
Cast iron shoes	Iron castings used for connections as described in Section 3.2.8.	Good / Good	High (State)	Routine repair and maintenance as described in Section 6.2 Replace with new ductile cast iron shoes to original design and preserve representative samples of original fabric off site
Sway braces	Elements made of metal T sections as described in Section 3.2.9	Good / Good	High (State)	Routine repair and maintenance as described in Section 6.2 Replace with new strengthened metal T section sway braces at original locations only (see Section 6.3 and following plans)
Cross girders	Large single timber members as described in Section 3.2.10.	Variable / Poor	Little	Routine repair and maintenance as described in Section 6.2 Replace primary cross girders with suitably designed steel cross girders (see Section 6.3 and following plans)
Decking	Heavily modified timber elements as described in Section 3.2.11.	Poor / Poor	Intrusive	Routine repair and maintenance as described in Section 6.2 Replace with suitably designed stress laminated timber (SLT) deck (see Section 6.3 and following plans)
Railing	Heavily modified timber elements as described in Section 3.2.12.	Good / Poor	Little	Routine repair and maintenance as described in Section 6.2 Replace with visually recessive but complying steel traffic barrier (see Section 6.3 and following plans)
Abutments	Masonry wall type abutments as described in Section 3.2.13.	Good / Good	High (State)	Routine maintenance
Pier	Large modern concrete pier as described in Section 3.2.14.	Good / Poor	Little	Routine maintenance and paint with a dark grey paint and anti-graffiti coating
Visual setting and context	Rural road in steep hilly country primarily used for grazing.	Good / Fair	Moderate	Routine maintenance and vegetation control, maintain Engineers Australia plaque, maintain appropriate viewing area, design and install then maintain suitable interpretative information in viewing area



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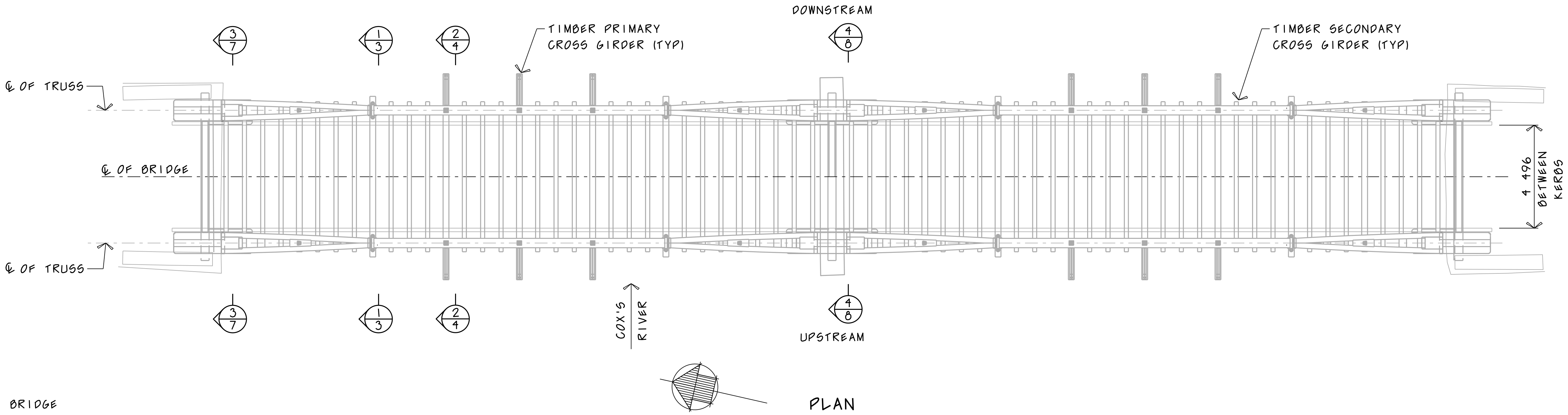

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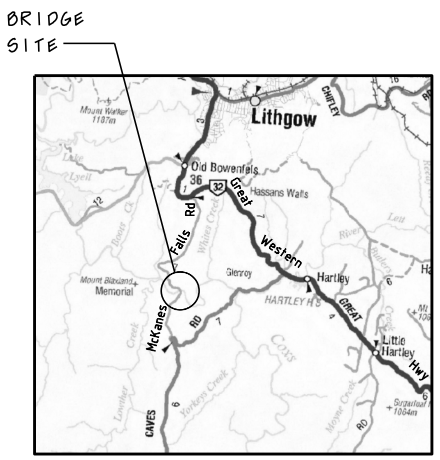
DECK NOT SHOWN FOR CLARITY



LOCALITY PLAN

THE BRIDGE SITE IS APPROXIMATELY 131KM BY ROAD FROM SYDNEY

GENERAL NOTES

SCALE 0 1 2 3 4 5m
1 : 50

DIMENSIONS ARE IN MILLIMETRES.
ALL EXISTING DIMENSIONS ARE BASED ON ORIGINAL DRAWINGS.
NUMBER OF PLAN 000 258 BC 0127.
TYP DENOTES ALL SUCH COMPONENTS IN ALL LOCATIONS.
UC DENOTES UNIVERSAL COLUMN.
SHS DENOTES SQUARE HOLLOW SECTION.
SLT DENOTES STRESS LAMINATED TIMBER.

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LOCAL ROAD — CITY OF LITHGOW

BRIDGE OVER COX'S RIVER
AT 7km SOUTH OF BOWENFELS (McKANES FALLS BRIDGE)
CAPACITY UPGRADE - HERITAGE CONCEPT

GENERAL ARRANGEMENT - SHEET A

NSW GOVERNMENT | Transport Roads & Maritime Services

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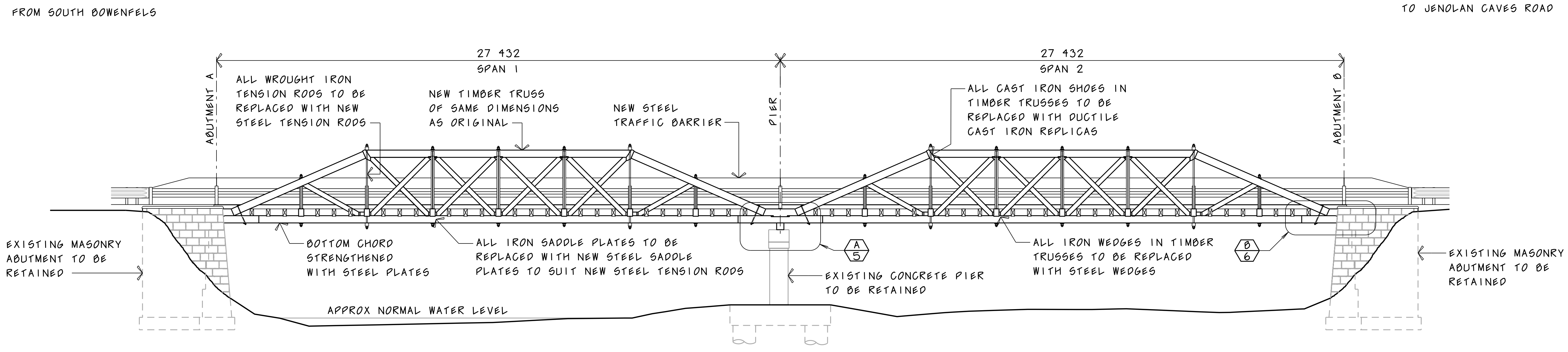

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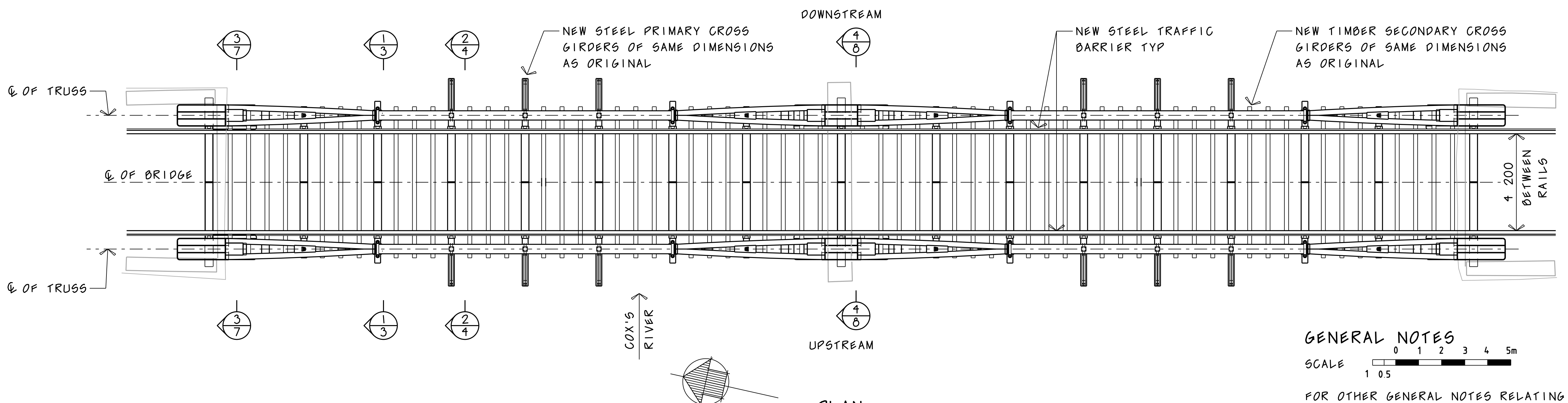

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DECK NOT SHOWN FOR CLARITY

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BRIDGE OVER COX'S RIVER
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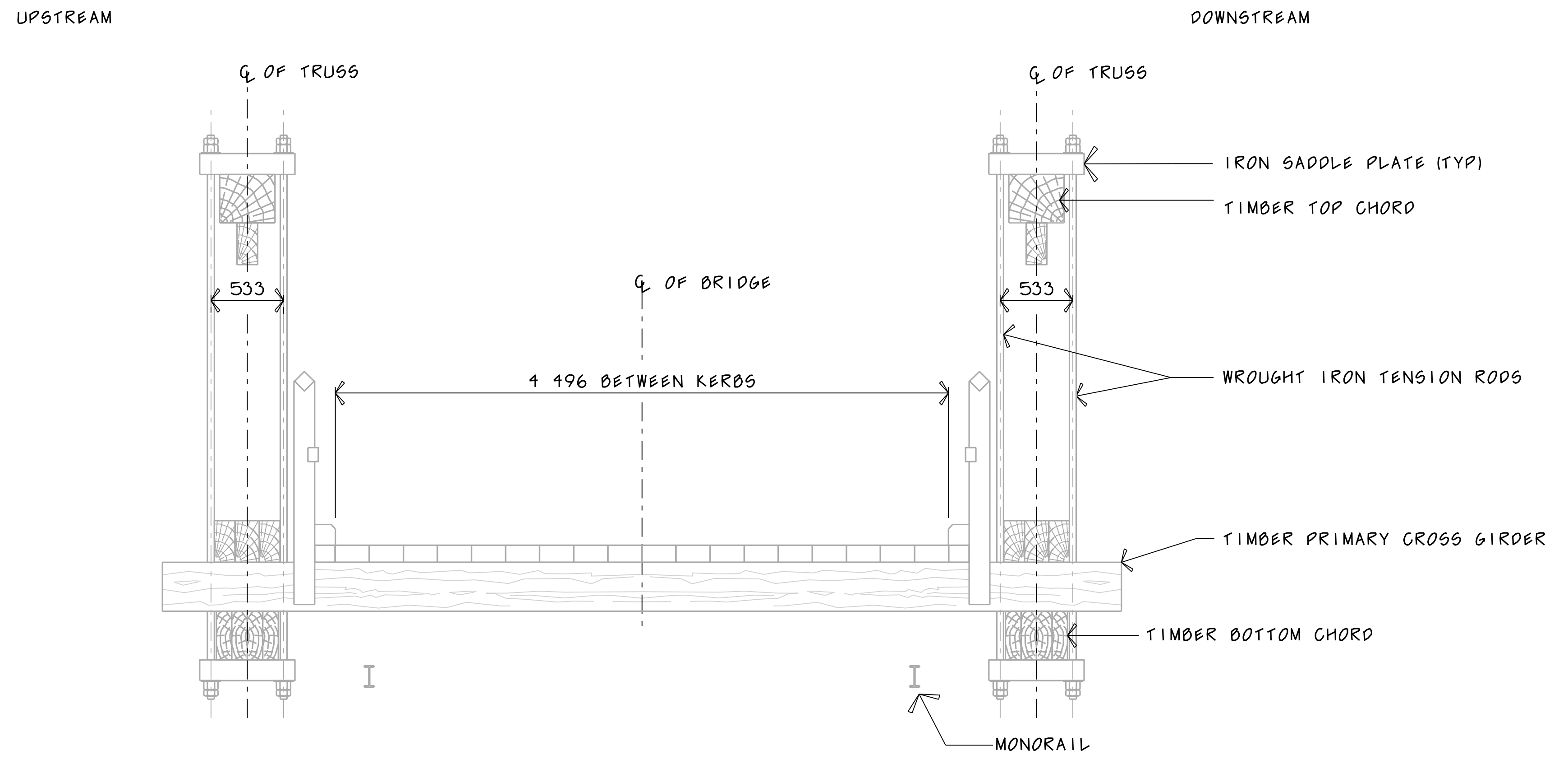

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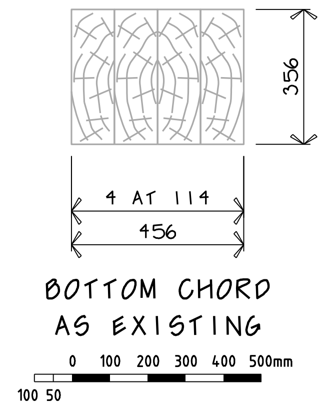

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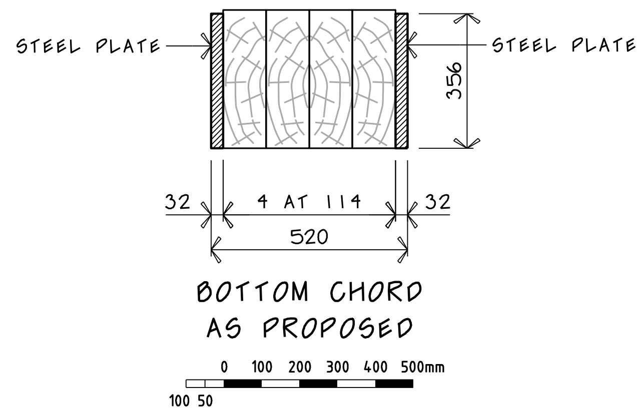

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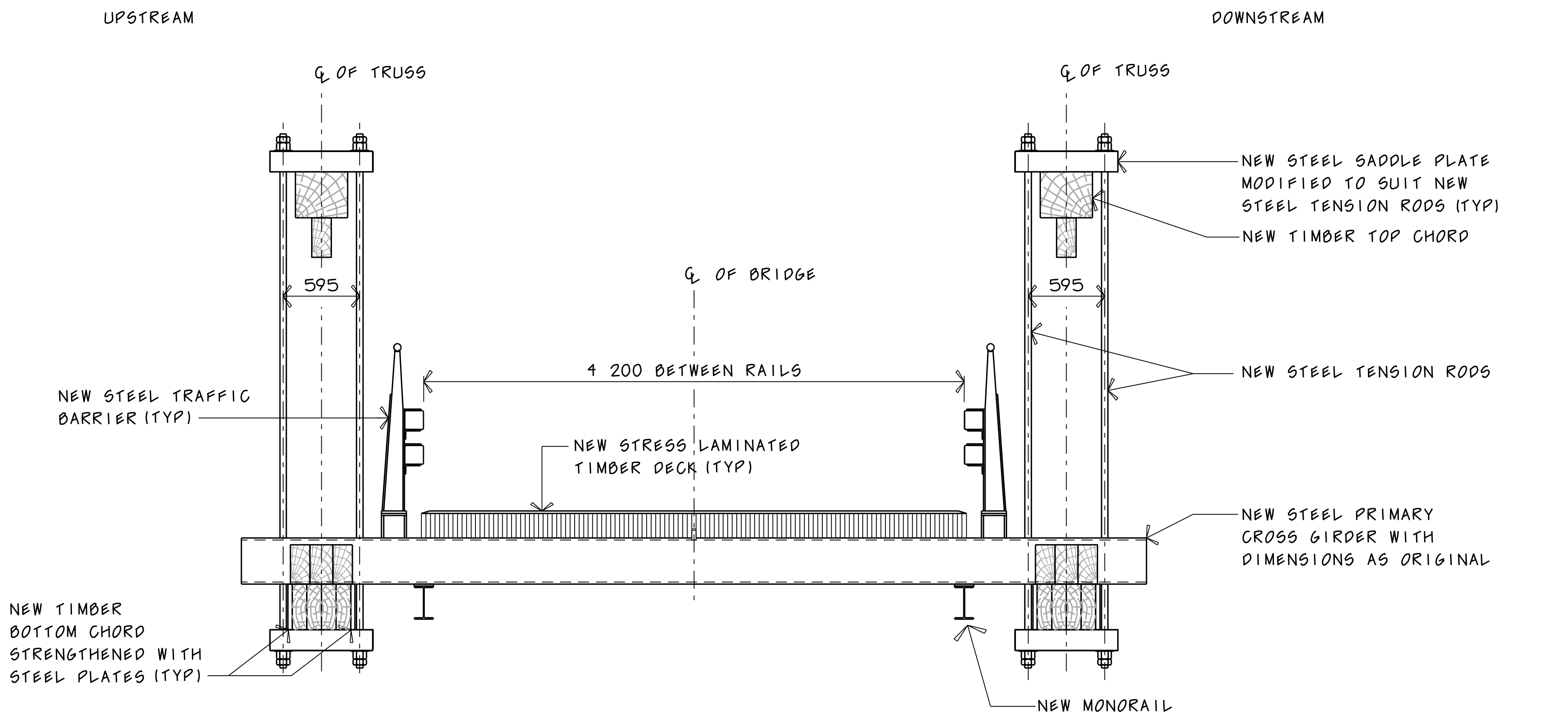

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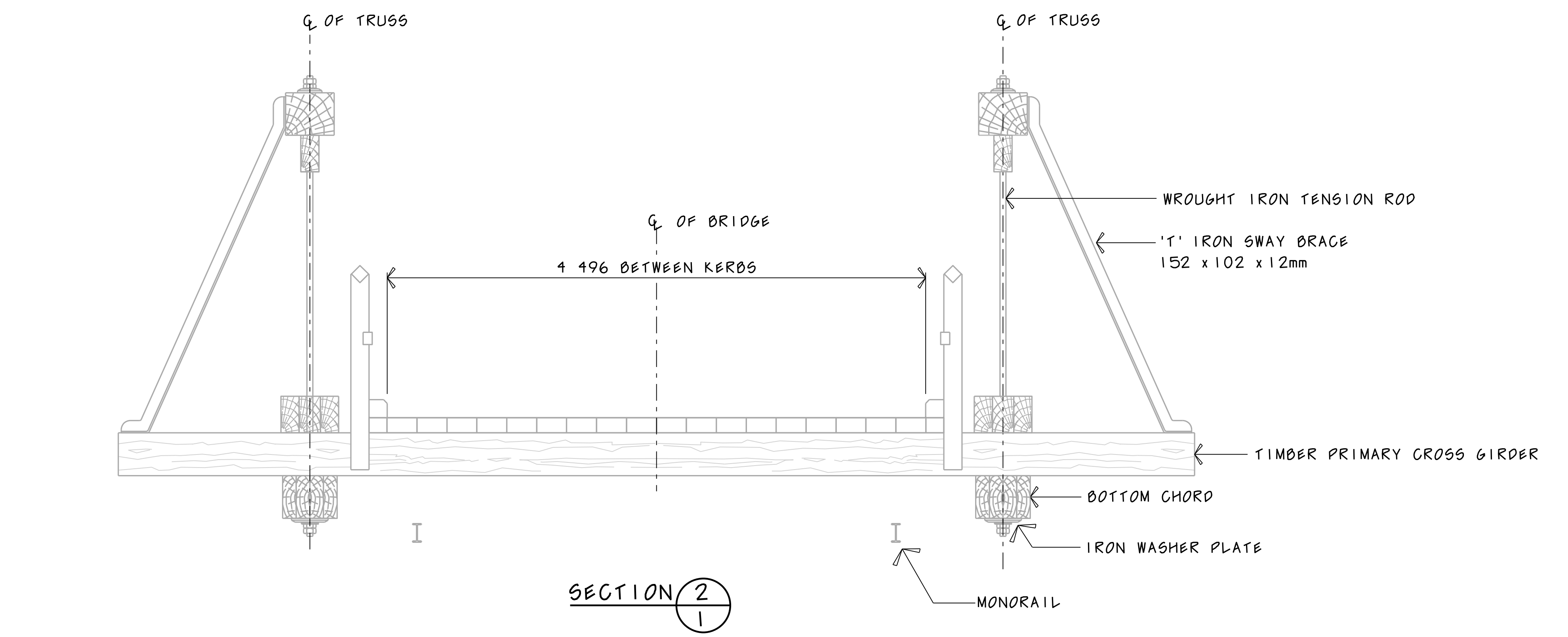

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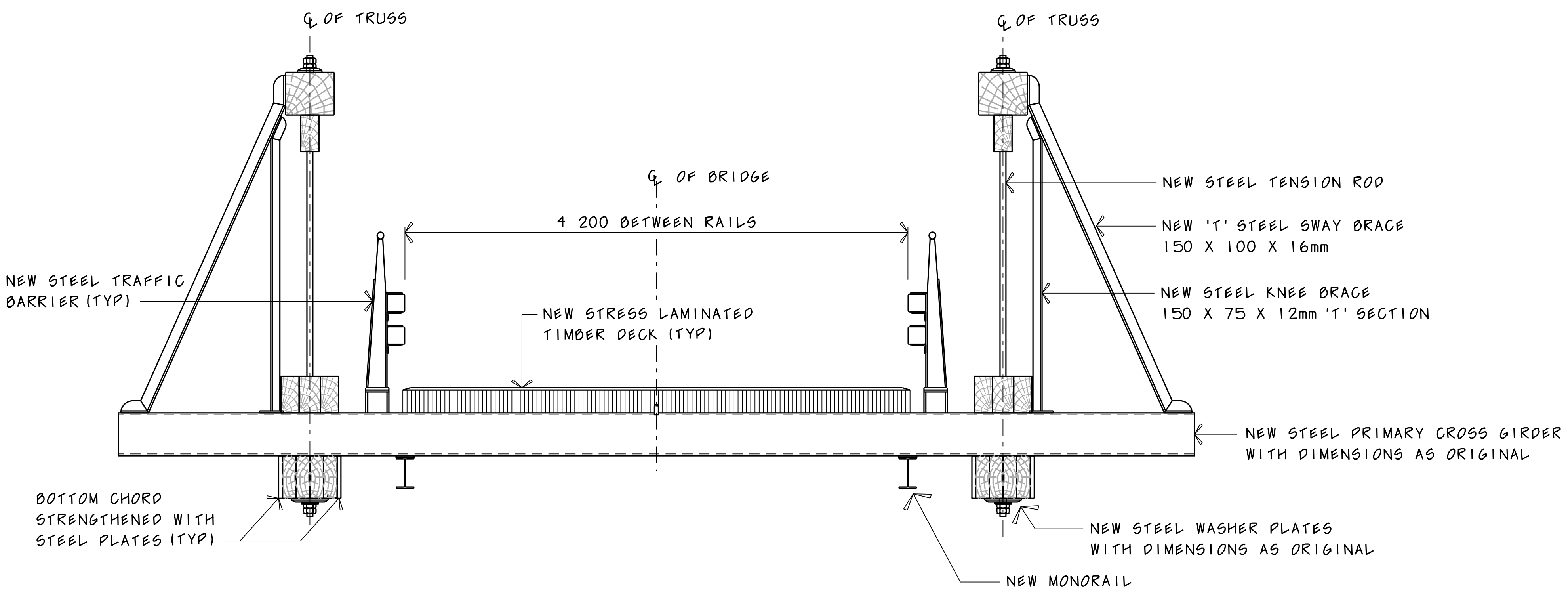

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CAPACITY UPGRADE - HERITAGE CONCEPT

TRUSS DETAILS - SHEET B

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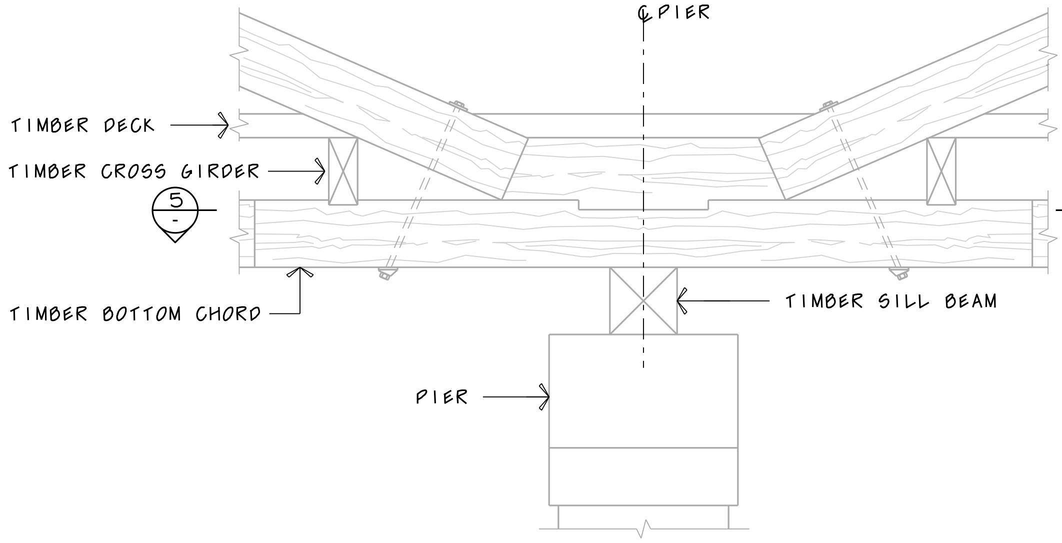

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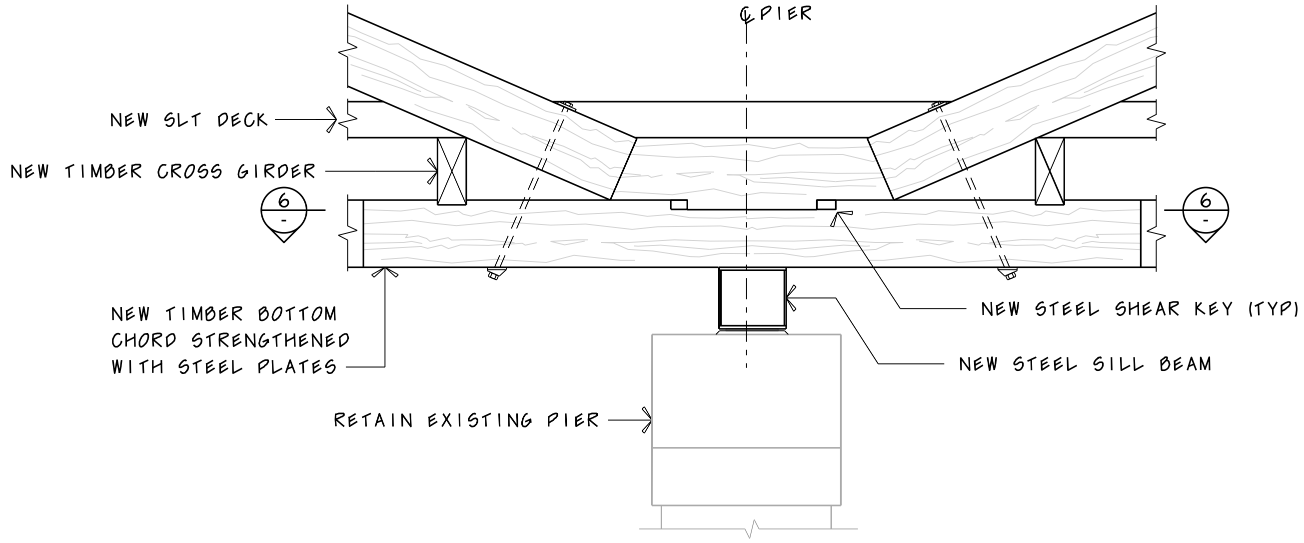

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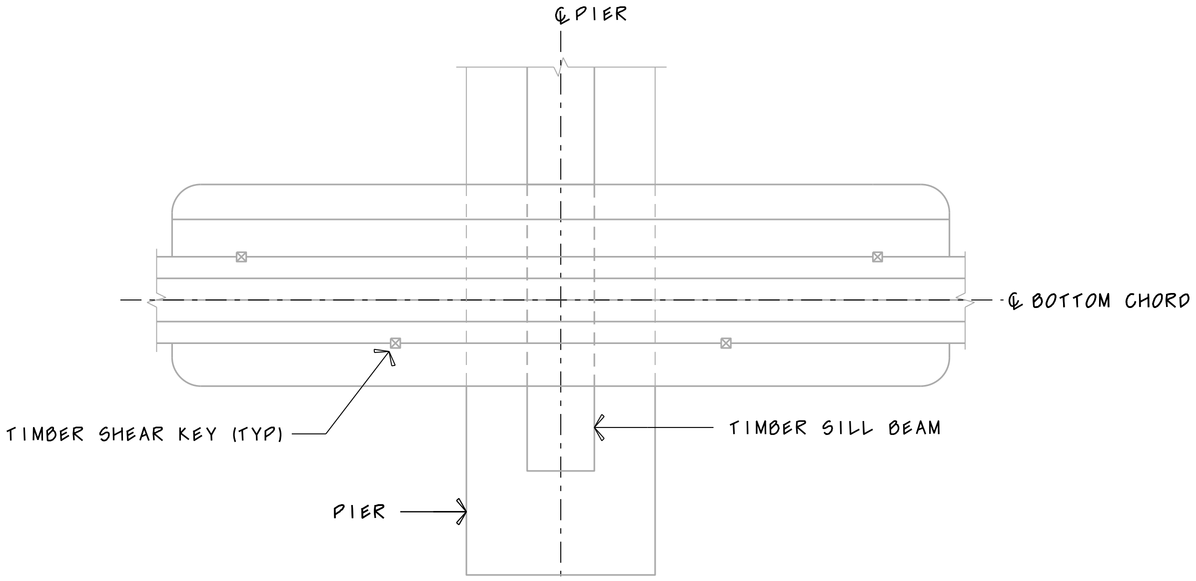

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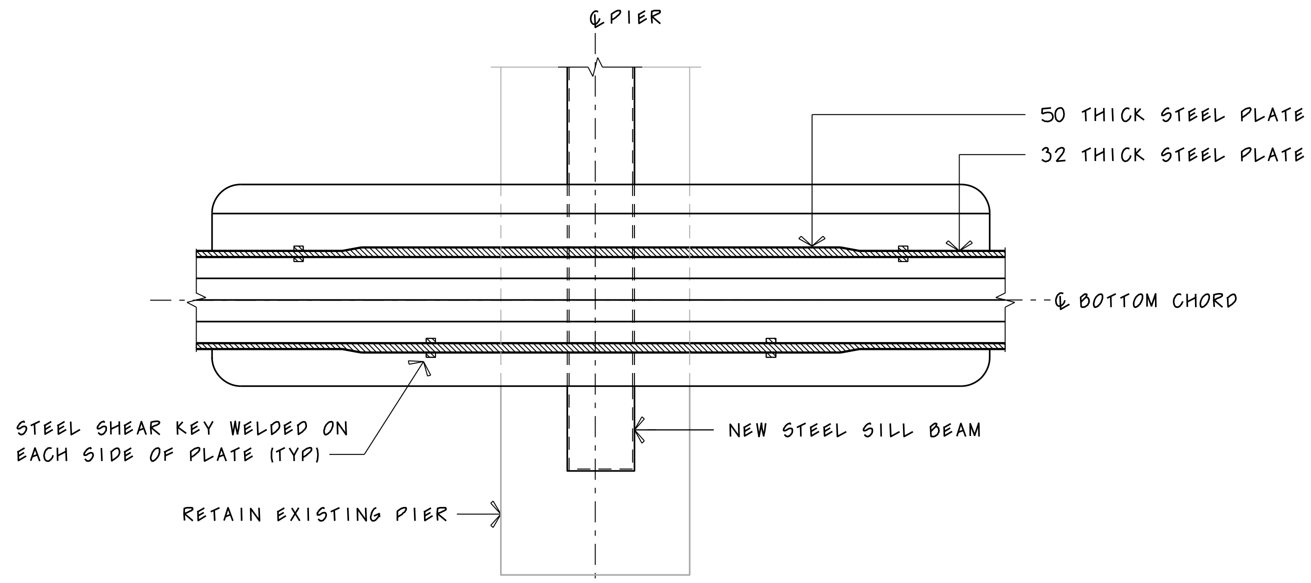

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BRIDGE OVER COX'S RIVER
AT 7km SOUTH OF BOWENFELS (McKANES FALLS BRIDGE)
CAPACITY UPGRADE - HERITAGE CONCEPT

TRUSS DETAILS - SHEET C

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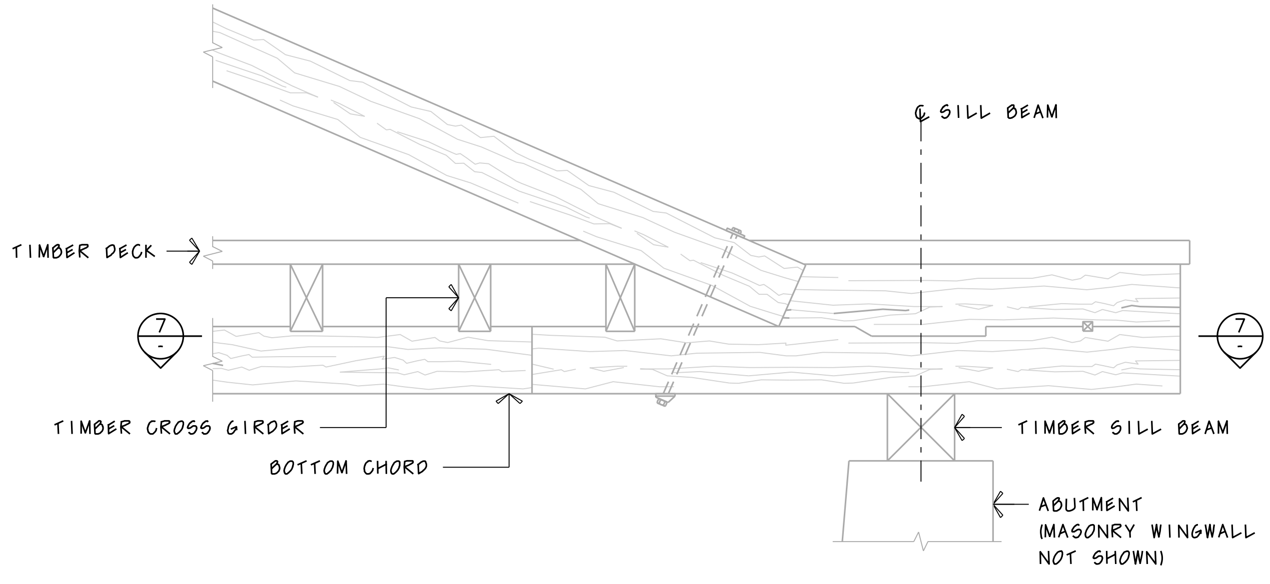
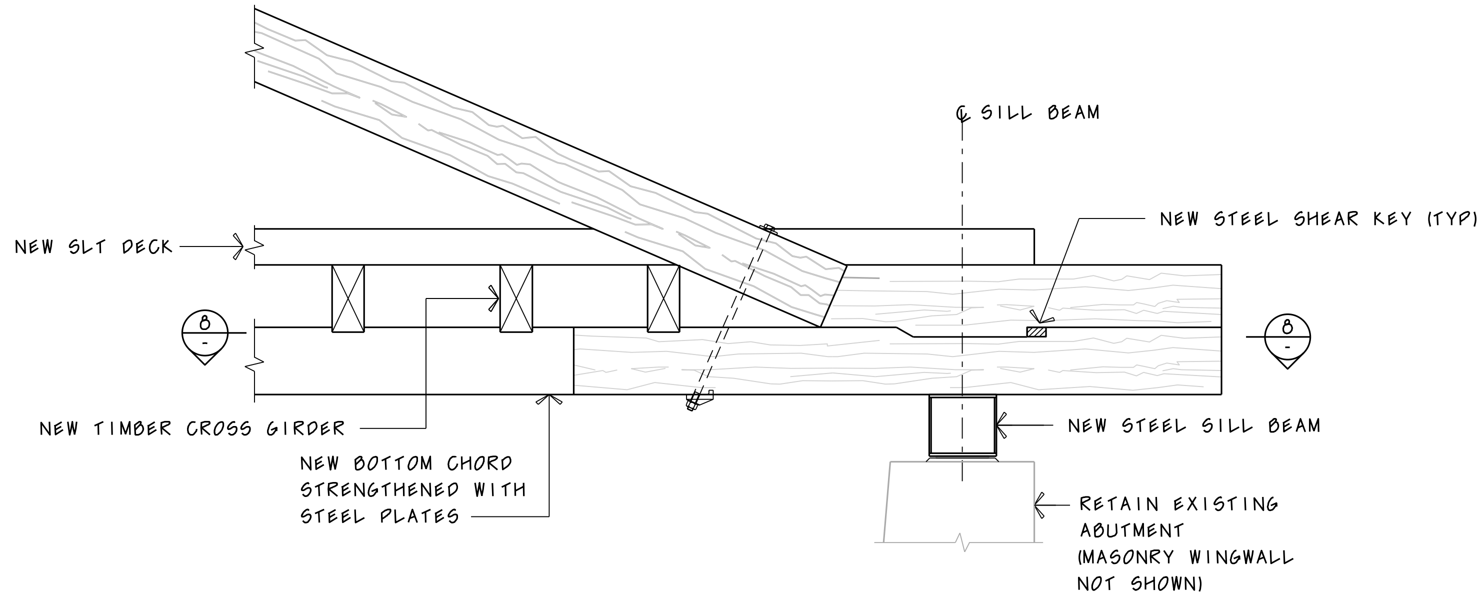


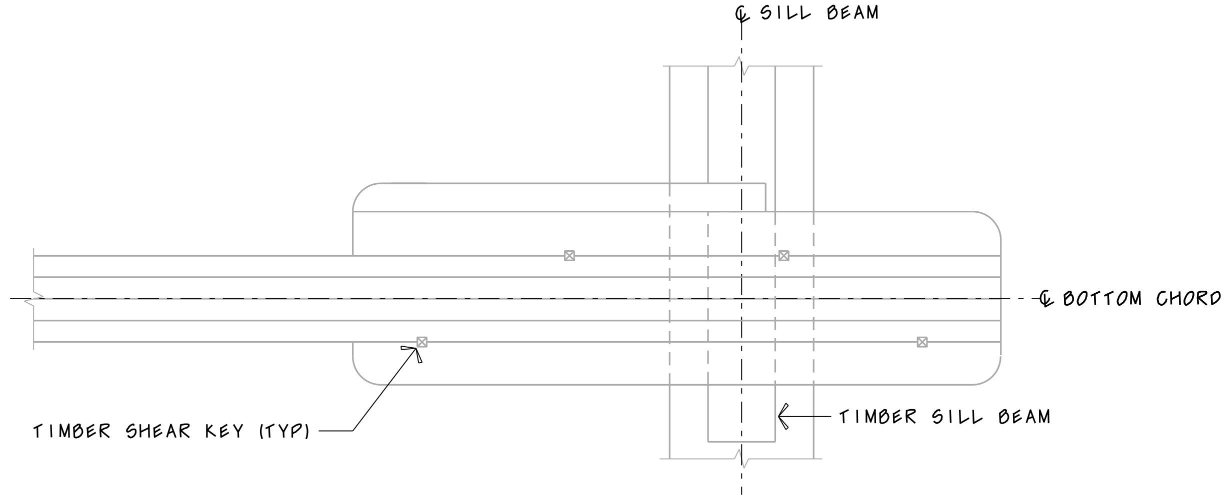
DETAIL B/1

EXISTING CONNECTION OF PRINCIPAL TO BOTTOM CHORD AT ABUTMENTS



DETAIL B/2

PROPOSED CONNECTION OF PRINCIPAL TO BOTTOM CHORD AT ABUTMENTS



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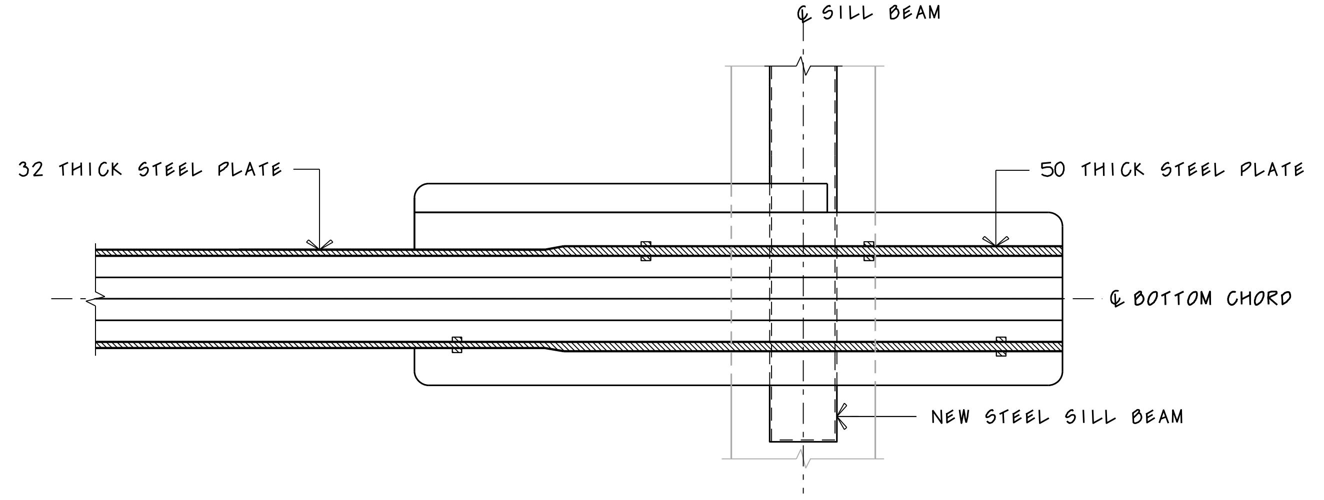

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BRIDGE OVER COX'S RIVER
AT 7km SOUTH OF BOWENFELS (McKANES FALLS BRIDGE)
CAPACITY UPGRADE - HERITAGE CONCEPT

TRUSS DETAILS - SHEET D

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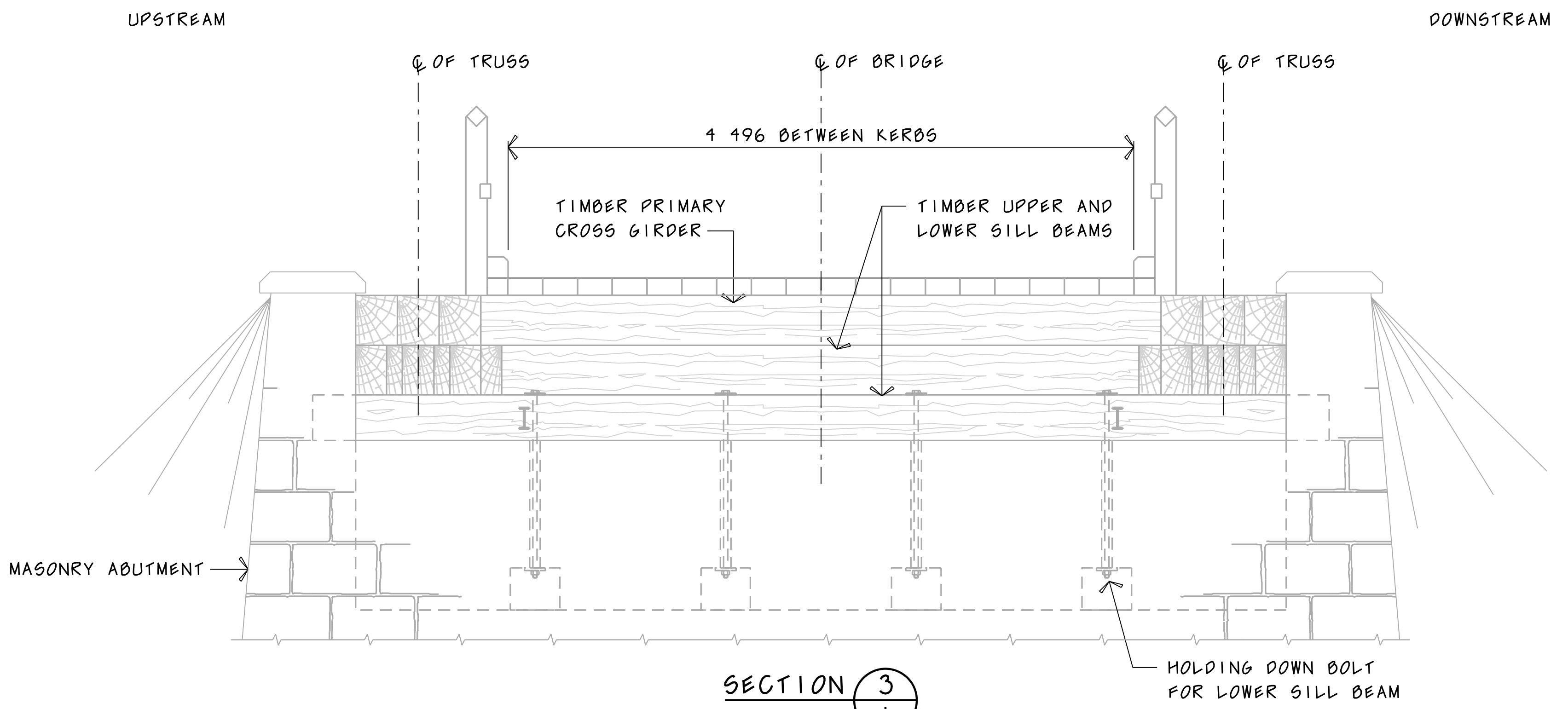
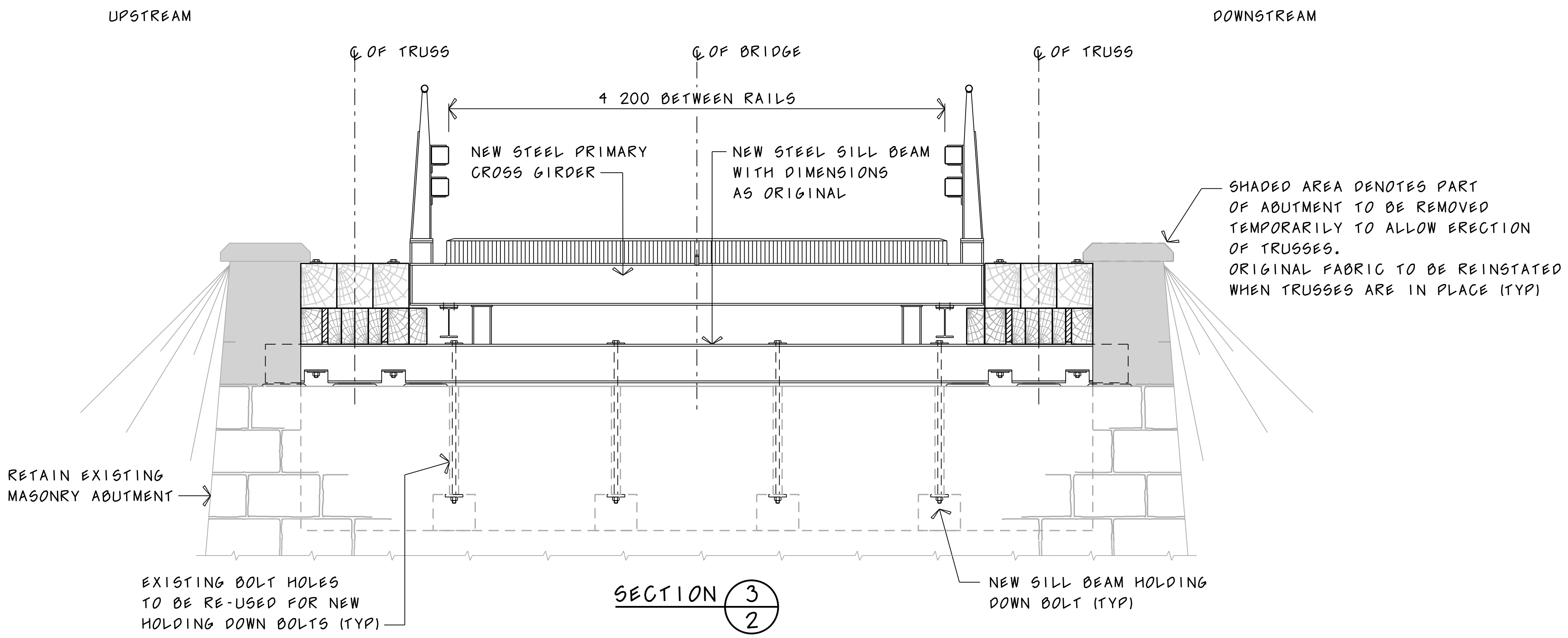


SECTION 3/1

ABUTMENT A
AS EXISTING

ABUTMENT B SIMILAR



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ABUTMENT B SIMILAR

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LOCAL ROAD — CITY OF LITHGOW

BRIDGE OVER COX'S RIVER
AT 7km SOUTH OF BOWENFELS (McKANES FALLS BRIDGE)
CAPACITY UPGRADE - HERITAGE CONCEPT

ABUTMENTS

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DRAWING	JK	A NICHOLAS

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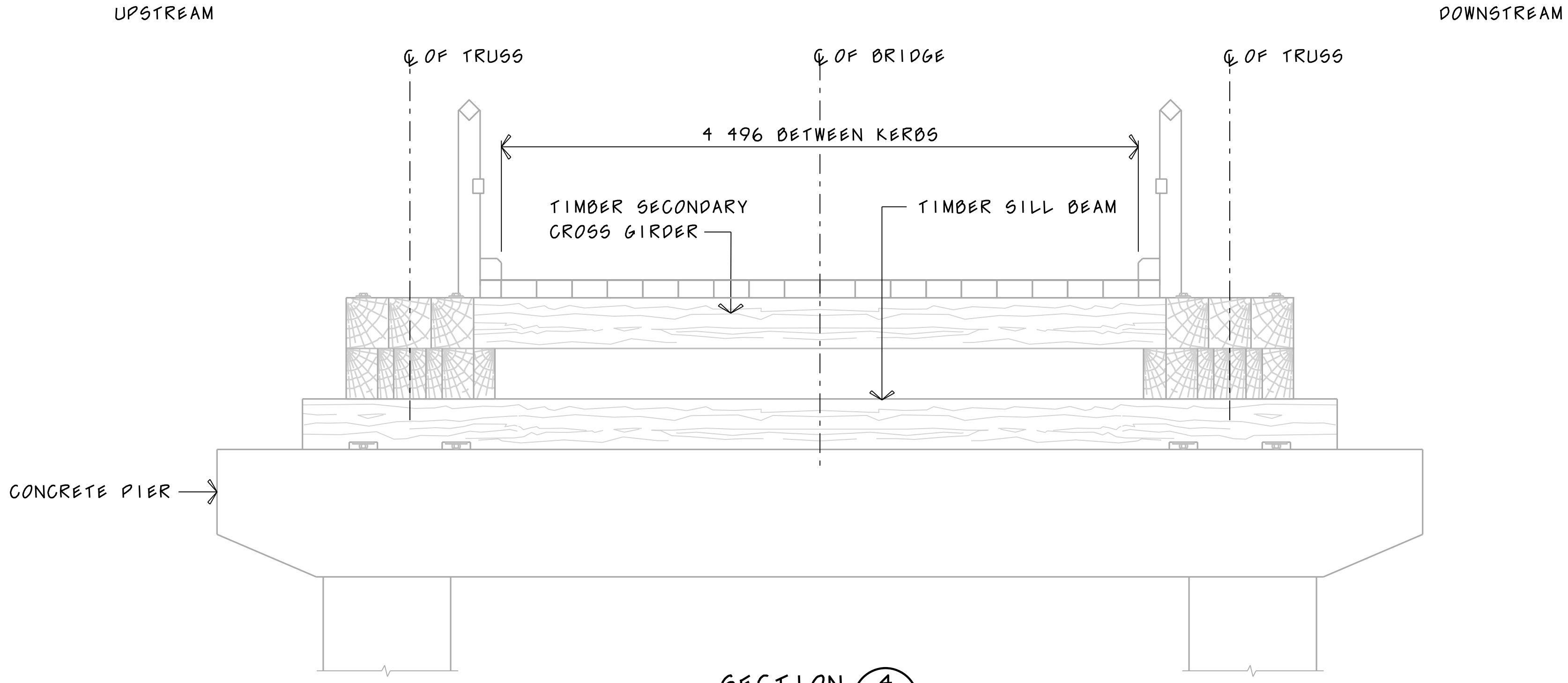
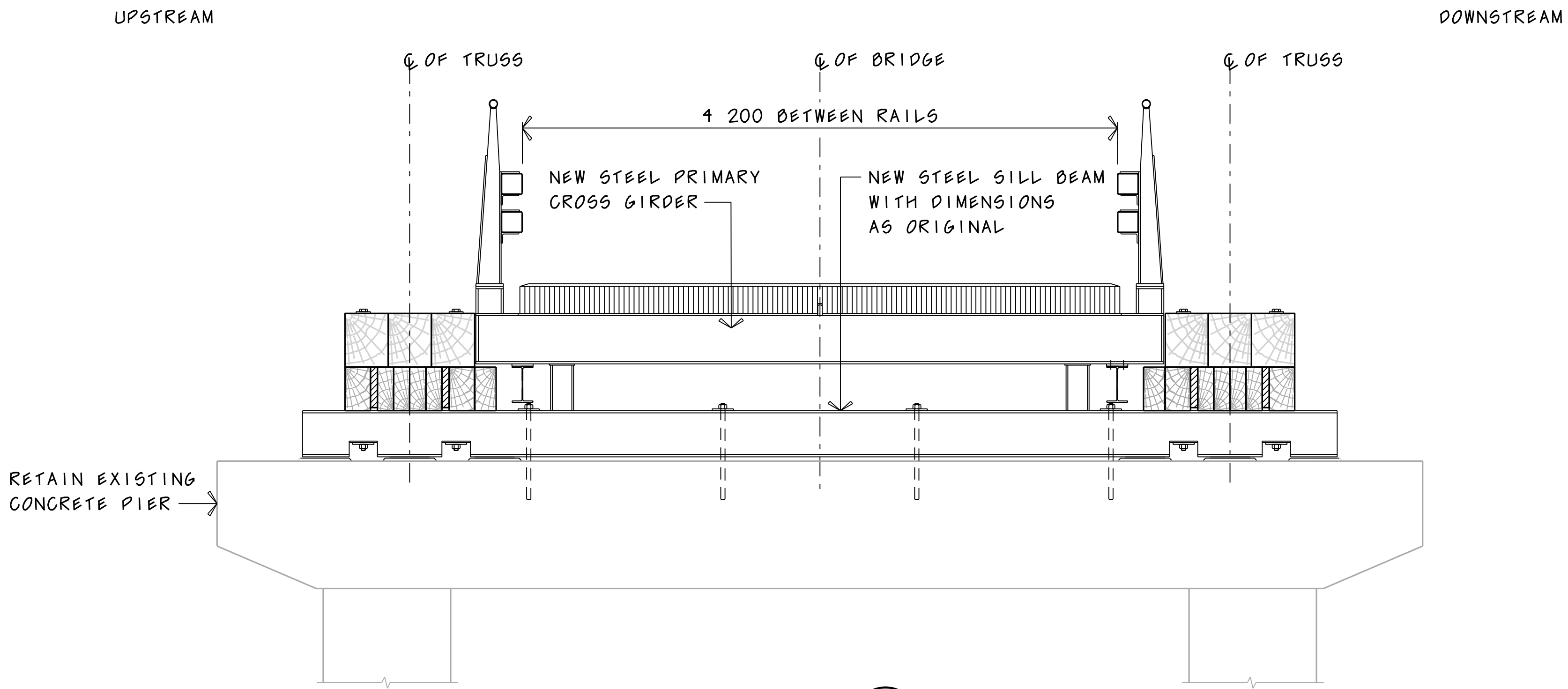


SECTION 4/1

PIER
AS EXISTING



SECTION 4/2

PIER
AS PROPOSED

GENERAL NOTES

SCALE 500 250 0 500 1 000 1 500mm

FOR OTHER GENERAL NOTES RELATING TO THIS SHEET, SEE SHEET NO 1.

ISSUE	DATE	REVISION	PREP	CHECK	AUTH
B	30.11.2016	TRAFFIC BARRIERS REVISED	JP		

LOCAL ROAD — CITY OF LITHGOW

BRIDGE OVER COX'S RIVER
AT 7km SOUTH OF BOWENFELS (McKANES FALLS BRIDGE)
CAPACITY UPGRADE - HERITAGE CONCEPT

PIER

NSW GOVERNMENT — Transport Roads & Maritime Services

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	PREPARED	CHECKED
DESIGN	A NICHOLAS	S SUN
DRAWING	JK	A NICHOLAS

S DESHPANDE
BRIDGE ENGINEER (REHABILITATION DESIGN)

SKETCH No KA872HCS
BRIDGE NUMBER B1302
ISSUE STATUS: HERITAGE REVIEW
SHEET No 8 OF 8 ISSUE B

CAD No KA872PIE_8_B.dgn

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