JJ RYAN CONSULTING PTY LTD

Options Comparison Report

Rehabilitation of Historical Kirwans Bridge

July 2023

Prepared by JJ Ryan Consulting Pty Ltd for Strathbogie Shire Council

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Version History

Version Number	Prepared By	Revision Date	Approved By	Approval Date	Description
A	M.Jafari	24/07/23	M.Omidi	26/07/23	Initial draft report

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Executive Summary

This option report examines rehabilitation and design options for Kirwans bridge.

The scope of the project involves reviewing existing data, available geotechnical investigations, and preparing component replacement, repair, or strengthening designs for the bridge. As a part of this project, this report has developed the potential design options for the bridge.

Three (3) major options have been developed as follows:

- **Option 1: Like-for-like Timber Bridge Replacement**

  Replacing the existing bridge in its current location, with a like-for-like timber bridge with two lanes (according to original bridge built in 1890) and an additional pedestrian and cycling lane.
- **Option 2-1: Rehabilitation by Steel-Timber Composite System**

  Maintaining the existing single lane bridge by undertaking full renovation including adding a new steel girder between the existing girders and replacing the timber decking with new planks. All steel girders in longer spans need to be replaced. In this option, 72 piles will be replaced, and 14 piles will be repaired.
- **Option 2-2: Rehabilitation by Steel-Concrete Composite System**

  Maintaining the existing single lane bridge by undertaking full renovation including keeping the existing girders and replacing the timber decking with new precast concrete decking. In this option, 72 piles will be replaced, and 14 piles will be repaired.
- **Option 3: New Bridge Construction with Steel-Concrete Composite System**

  Demolition of the existing bridge and construction of a new bridge in the same location.

Detailed assessment criteria were developed to comparatively weigh the options which include:

- Bridge safety (road user safety and pedestrian safety);
- Bridge performance (load and durability characteristics);
- Whole of life costs (construction capital costs and maintenance costs);
- Construction (constructability); and
- Heritage (Preservation of Historical Bridge).

The option ranking based on the assessment criteria is shown in Table E–1 with a summary of the overall options in Table E–2.

Table E–1: Overall weighted scores for each option against the set criteria

Assessment Criteria	Criteria Weighting	Sub-Criteria / Inputs	Sub-Criteria Weight (%)	Weighted Criteria Score			
				Option 1	Option 2-1	Option 2-2	Option 3
Bridge Safety	25%	Road User Safety	80%	25	13	15	25
		Pedestrian Safety	20%				
Bridge Performance	25%	Load	50%	21	13	14	25
		Durability Characteristics	50%				
Whole of Life Costs	25%	Capital Costs	80%	7	21	20	3
		Maintenance Costs	20%				
Construction	10%	Constructability	100%	3	5	6	2
Heritage	15%	Preservation of Historical Bridge	100%	8	14	12	2
Overall Score				**64**	**66**	**67**	**57**

Table E–2: Option ranking based on weighted scores

Option	Weighted Score	Rank
Like-for-like Timber Bridge Replacement (Option 1)	64	**3**
Rehabilitation by Steel-Timber Composite System (Option 2-1)	66	**2**
Rehabilitation by Steel-Concrete Composite System (Option 2-2)	67	**1**
New Bridge Construction with Steel-Concrete Composite System (Option 3)	57	**4**

As shown above, option 2-2 was assessed as the recommended option and is discussed further below.

Option 1

Option 1 involves the replacement of the existing bridge in its current location, with a like-for-like timber bridge with two lanes (according to original bridge built in 1890) and an additional pedestrian and cycling lane. This option would complement the heritage of the bridge and provide a lifespan greater than 75 years. The bridge design will be in accordance with AS5100- Bridge Design (SM1600 live loading). For the concept design, refer to Appendix A.

Components

This option includes the following components:

- Nine I-welded steel girders for each span;
- Diaphragms consist of 80x80x8 EA and 50x50x5 EA sections used as inverted V-braced with top and bottom chord at supports (each 5000mm);
- Timber plank decking (150mm);
- 2x300PFC for headstocks; and
- 8 timber piles with 550mm diameter at each pier with variable lengths.

Option Assessment

JJ Ryan believe that this option is cheaper than option 3, but it is more expensive than option 2. This option will provide two traffic lanes, two shoulders, and an additional cycling and pedestrian path. Furthermore, option 1 will also complement the heritage of Kirwans Bridge.

The benefits of this option include:

- This option would complement the heritage of the bridge;
- Cycling and footpath lane;
- Two traffic lanes;
- Two shoulders;
- SM1600 live loading;
- Better bridge alignment; and
- Higher speed limit.

Some disadvantages of this option include:

- Demolition of the existing historical bridge;
- Corrosion of the steel components;

- Lower lifespan (75 years) compared to option 3 (100 years);
- Complex construction; and
- No lighting.

Option 2-1

Description

Option 2-1 involves maintaining the existing single lane bridge by undertaking full renovation including adding a new steel girder between the existing girders and replacing the timber decking with new planks. All steel girders in longer spans need to be replaced. In this option, 72 severely damaged piles and slender piles with less than 300mm diameter will be replaced, and 14 piles with minor to moderate damage will be repaired. The lifespan of this option would be approximately 25 years. This option requires the implementation of a load limit to 30 tonne. For the concept design, refer to Appendix B.

Components

This option includes the following components:

- Two existing and one new I-welded steel girder will be added in the middle for each short span;
- Three new I-welded steel girders for each long span;
- Diaphragms consist of 80x80x8 EA and 50x50x5 EA sections used as inverted V-braced with top and bottom chord at supports (each 5000mm);
- Timber plank decking (150mm);
- 2x300PFC for headstocks; and
- 72 piles will be replaced with timber piles with 500mm diameter, and 14 piles will be repaired with concrete collars.

Option Assessment

JJR believe that this option is the cheapest option and lighter in comparison with other nominated options.

The benefits of this option include:

- This option would preserve most of Kirwans Bridge components;
- Low cost;
- Low weight of the superstructure;
- Fast construction; and
- Low environmental impact compared to other options;

Some disadvantages of this option include:

- 30t load limit;
- 20 km/h speed limit;
- Corrosion of the steel components;
- Existing old timber piles as structural elements;
- Short lifespan;
- No footpath; and
- No lighting.

Option 2-2

Description

Option 2-2 involves maintaining the existing single lane bridge by undertaking full renovation including using existing steel girders and replacing the timber decking with concrete deck slab. In this option, 72 severely damaged piles and slender piles with less than 300mm diameter will be replaced, and 14 piles with minor to moderate damage will be repaired. The lifespan of this option would be approximately 50 years. This option requires the implementation of a load limit to 30 tonne. For the concept design, refer to Appendix C.

Components

This design option comprises the following components:

- Concrete deck slab (380 mm thick);
- Shear studs;
- Existing I-girders;
- Diaphragms consist of 80x80x8 EA and 50x50x5 EA sections used as V-braced with top and bottom chord at supports (each 5000mm);
- 2x300PFC for headstocks; and
- 72 piles will be replaced with timber piles with 500mm diameter, and 14 piles will be repaired with concrete collars.

Option Assessment

JJ Ryan will suggest that this option outweighs other options when considering all design criteria.

The benefits of using composite concrete system with steel girders:

- Longer lifespan compared to option 2-1;
- Increasing the bending capacity of the existing steel girders;
- Protect the steel girders from the rain;
- Lower vibration compared to option 2-1;
- Low cost; and
- Fast construction.

Some disadvantages of this option include:

- 30t load limit;
- 20 km/h speed limit;
- Corrosion of the steel components;
- Existing old timber piles as structural elements;
- No footpath;
- No lighting;
- Heavier than option 2-1; and
- The construction cost is more expensive than option 2-1.

Option 3

Description

Option 3 involves the replacement of the existing bridge, with a concrete bridge with two lanes and an additional pedestrian and cycling lane. This option will provide a lifespan greater than 100 years. The bridge is designed in accordance with AS5100- bridge design (SM1600 live loading). For the concept design, refer to Appendix D.

Components

This design option comprises the following components:

- Concrete deck (313mm thick);
- Shear studs;
- Seven I-welded steel girders for each span;
- Diaphragms consist of 80x80x8 EA and 50x50x5 EA sections used as V-braced with top and bottom chord at supports (each 5000mm);
- Concrete headstocks; and
- 6 concrete piles with 600mm diameter at each pier with variable lengths.

Option Assessment

JJR believe that this option is the most expensive option. However, this option provides the longest lifespan and will be designed to the latest provisions in AS5100- Bridge Design (SM1600 Live Loading).

The benefits of using composite timber and concrete system with perforated steel mesh include:

- Cycling and footpath lane;
- Two traffic lanes;
- Two shoulders;
- Protect the steel girders from the rain;
- SM1600 live loading;
- Better bridge alignment; and
- Higher speed limit.

Some disadvantages of this option include:

- Long construction time;
- Demolition of the existing historical bridge;
- Corrosion of the steel components;
- High construction costs;
- Heavier weight of the structure; and
- The construction cost is more expensive than other options.

JJR intend to undertake further option analysis to identify the most practical solution, as a peer review has identified other potential options.

Contents

Acronyms

AS	Australian Standards
BOQ	Bill of Quantities
DPP	Design Process Plan
JJR	JJ Ryan Consulting Pty Ltd
SSC	Strathbogie Shire Council
PMP	Project Management Plan
SMP	Stormwater management plan
RFI	Request for Information
SiD	Safety in Design

1 Introduction

1.1 Project Background

JJ Ryan Consulting ("JJR") has been engaged by the Strathbogie Shire Council ("Council") to undertake a site inspection, condition assessment report, and feasibility report for investigation, assessment, and detailed design of Kirwans Bridge. As a part of these services, JJR is to develop a feasibility report, which is to consider the following options for the bridge.

- **Option 1: Like-for-like Timber Bridge Replacement**
  Replacing the existing bridge in its current location, with a like-for-like timber bridge with two lanes (according to original bridge built in 1890) and an additional pedestrian and cycling lane.
- **Option 2-1: Rehabilitation by Steel-Timber Composite System**
  Maintaining the existing single lane bridge by undertaking full renovation including adding a new steel girder between the existing girders and replacing the timber decking with new planks. All steel girders in longer spans need to be replaced. In this option, 72 piles will be replaced, and 14 piles will be repaired.
- **Option 2-2: Rehabilitation by Steel-Concrete Composite System**
  Maintaining the existing single lane bridge by undertaking full renovation including keeping the existing girders and replacing the timber decking with new precast concrete decking. In this option, 72 piles will be replaced, and 14 piles will be repaired.
- **Option 3: New Bridge Construction with Steel-Concrete Composite System**
  Demolition of the existing bridge and construction of a new bridge in the same location.

The above options must be assessed and ranked considering all relevant technical, financial, and cultural aspects. This report will allow the Council to review the proposed options and opt for the preferred one.

1.2 Project Scope

The scope of the project includes site inspection, condition assessment report, and feasibility report for investigation, assessment, and detailed design of Kirwans Bridge.

1.3 Exclusions

The following items are outside the scope of the project:

- Detailed feature survey;
- Timber stress-grading;
- Geotechnical investigations/reporting;
- Construction phase services;
- Services locating;
- Stormwater management plan (SMP);
- Erosion and sediment control plan;
- Earthwork design for the abutments;
- Construction supervision;
- Review of environmental factors;
- As-built drawings;
- Design of any required temporary support structures;
- Obtaining any associated utility service approvals or work permits;
- Payment of any authority fees for applications, approvals or permits; and

- Any other item not specifically mentioned in the above scope of works.

It is noted that any of the above exclusions may be refined at the Council's request.

1.4 Project Objectives

The key objectives of this project are as follows:

- Review existing bridge condition;
- Develop design options for Council; and
- Provide detailed design of selected option that meets current standards.

1.5 Scope of this Report

The scope of this report is to list the assumptions and exclusions used to prepare the design options (listed above) to enable Council to opt for a preferred design option based on clear criteria and to progress to the detailed design phase. In this report, different options described in 1.1 section will be assessed and ranked based on the following criteria:

- Bridge Safety
- Bridge Performance
- Whole of Life Costs
- Construction
- Heritage

Finally, JJ Ryan will recommend a preferred option for Council.

1.6 Reference Documents and Design Criteria

This Options Report and subsequent design options have been prepared per the following standards and criteria:

- Relevant Australian Standards include:
  - AS 5100 – 2017: Bridge Design code;
  - AS 3600: Concrete Structures;
  - AS 4100: Steel Structures; and
  - AS 1170: Actions on Structures.

The following information has been referenced and/or utilized in the design development:

- Council provided information including:
  - Previous bridge assessment reports;
  - Geotechnical investigation report;
- Visual inspection as a part of JJR's engagement; and
- Review of aesthetic and environmental factors of Kirwans historical bridge.

2 Project Background

2.1 Site Description

Figure 1 shows the location of the bridge. The coordinates of Kirwans Bridge are as follows:
Lat. -36.745869
Lon. 145.139649

Figure 1: Location of the project

2.2 Site Description

Kirwans Bridge is historically, scientifically, socially, and aesthetically significant at the State level which was constructed in 1890. This Bridge is uniquely angled and has an exceptionally long timber deck with occasional passing bays.
Together with Barwon Heads Bridge, they are equally the longest timber road bridge in Victoria. Kirwans Bridge retains its original 48 spans measuring 5 meters, with its original 7 main river channel spans of 10 meters, giving a deck length of approximately 308 meters. The original timber stringers were replaced in 1957 by steel joists. Its original tall timber trestle piers are largely immersed under Lake Nagambie and its aging timber deck has been narrowed for one-way traffic, with only the passing bays extending the full 6.3 meters width of the original deck. Remnants of its original squared beams and strutted corbels – one of only two remaining examples in Victoria – are still visible beside the bridge.
The superstructure is supported by timber Headstocks which are attached to the driven timber piles. The length of the timber piles is approximately from 3.1m to 13.5m above the natural surface of Goulburn River. The piles are unbraced.
Kirwans Bridge has been taken under construction twice for rehabilitation work. It appears to be at the end of its service life, and a 3t load limit was imposed on the bridge. Structural assessment of the bridge was conducted by JJ Ryan in May 2023, in which it was recommended that as the bridge capacity has been diminished to a serviceable level, motor vehicles cannot be allowed until further investigations have been undertaken.
The plan and elevation views of the bridge along with the typical pier cut section are shown in Figure 2-4.

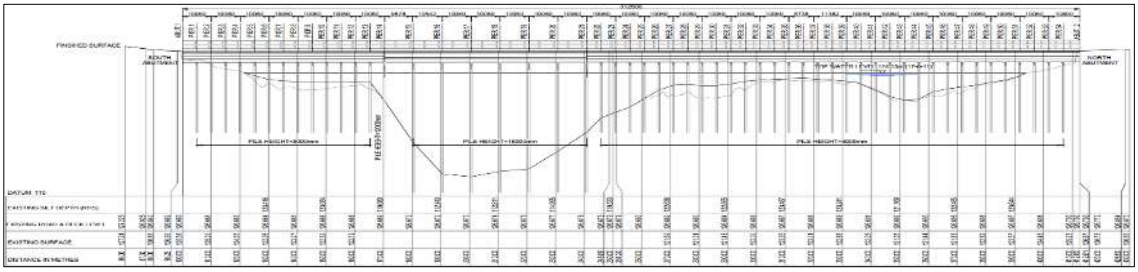


Figure 2: Bridge Longitudinal View

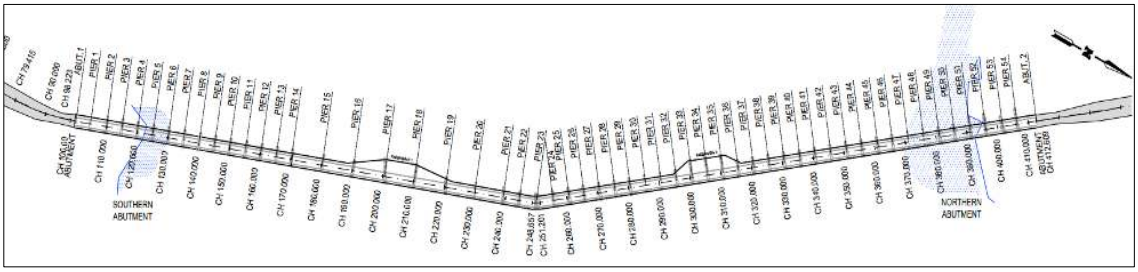


Figure 3: Bridge Plan Enlargement View

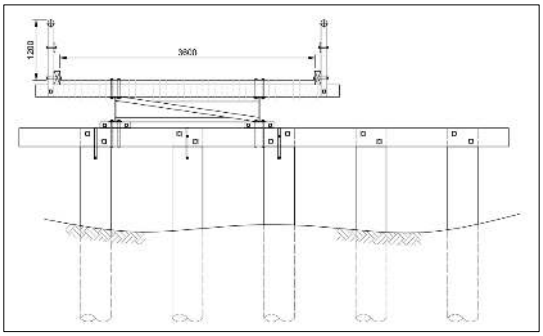


Figure 4: Pier Cut Section

3 Inputs

3.1 Overview of Design

Structures are designed to meet a wide range of requirements, with six main areas highlighted for buildings and adapted further to bridges outlined in Figure 5.

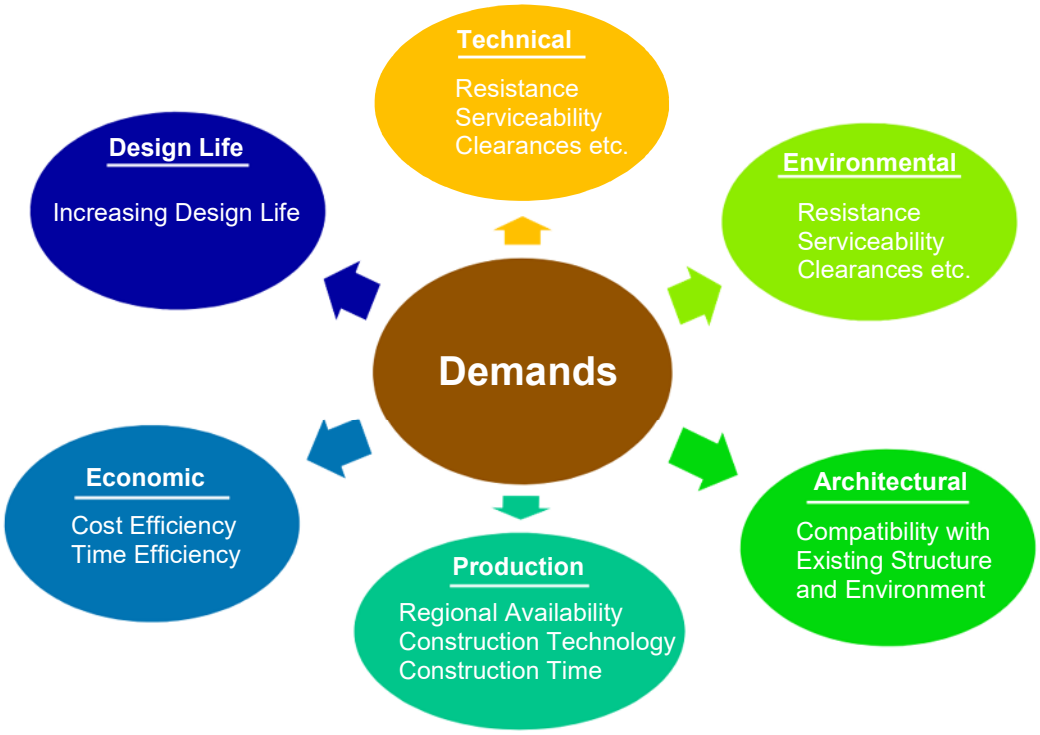


Figure 5: Structure Demands

The architectural demands for the crossing structure have been considered in the development and assessment of design options (Appendix G). The technical, production, economic and design life requirements have all been applied with weightings to provide an accurate representation of each option evaluation.

3.2 Design Parameters

The parameters that have been developed and adopted in the generation of this options report are outlined in Table 1.

Table 1: Bridge design criteria

Parameter	Details
Bridge Width	3.6m width with one traffic lane
Bridge Length	310m
Bridge/Road Profile	-
Bridge Loading Requirements	The bridge loading requirement is based on AS 5100 for new design options and 67% of T44 truck loading for rehabilitation options.

3.3 Bridge Loading Requirements

The load assessment for the concept design has adopted the worst case only, however, all design cases listed in AS5100 and AS1170 will be reviewed and provided in the design report.

3.4 Types of Structures / Details

The superstructure including steel girders and deck/planks are considered for the bridge rehabilitation and new bridge design.

3.5 Critical Bridge Components

Critical components for bridges are as follows:

- Superstructure elements including crossbeams, girders, decks/planks, transverse diaphragms etc.;
- Substructure elements including headstocks, piles;
- Elastomeric bearings or corbels; and
- Expansion joints.

3.6 Architectural / Aesthetics

A report including review of Aesthetic and environmental factors has been prepared by JJR due to importance of this issue for the Council (Appendix G).

JJR will design the structure to blend into the existing environment as best as possible and construction works will be designed to be kept to an absolute minimum damage to the environment.

3.7 Alignment

A review of the current bridge/road alignment was outside of the scope of work for this project. However, as the current bridge alignment has a non-standard curve at the middle of its alignment, a straight centerline was proposed for option1 and option 3.

4 Bridge Superstructure Rehabilitation Options

4.1 Overview of Options Considered

Three (3) major options for the bridge strengthening have been prepared. These options are as follows:

- Option 1– Like-for-like Timber Bridge Replacement
- Option 2-1– Rehabilitation by Steel-Timber Composite System
- Option 2-2– Rehabilitation by Steel-Concrete Composite System
- Option 3– New Bridge Construction with Steel-Concrete Composite System

4.2 Assessment Criteria

Each proposed option has been assessed on a qualitative and quantitative basis against specified weighted assessment criteria. The weighting has been developed based on the importance of the assessment criteria and relevant sub-criteria/inputs to the overall design, construction, and implementation.
The qualitative assessment has been based on subjective scores while the quantitative assessment is based on a set formula (for measurable elements), as outlined in Table 2.

Table 2: Adopted options assessment criteria and weightings

Assessment Criteria	Sub-Criteria / Inputs	Assessment Type	Sub-Criteria Weight (%)	Criteria Weight (%)
Bridge Safety	Road User Safety	Qualitative	80%	25%
	Pedestrian Safety	Qualitative	20%	
Bridge Performance	Load	Quantitative	50%	25%
	Durability Characteristics	Qualitative	50%	
Whole of Life Costs	Capital Costs (Construction)	Quantitative	80%	25%
	Maintenance Costs	Quantitative	20%	
Construction	Constructability	Qualitative	100%	10%
Heritage	Preservation of historical bridge	Qualitative	100%	15%

The options assessment has been undertaken by reviewing all relevant factors of the bridge option against the assessment criteria. A description of the assessment against each sub-criteria is provided for every option. The qualitative assessment (or quantitative where there is a formula available) is then used to provide a score as outlined in Table 3.
The overall qualitative and quantitative scoring descriptions are described further in this section for reference.

Table 3: Option assessment score criteria

Score	Description
10	For quantitative scores, this is the most superior option based on the highest-ranked option.
9	The option meets this criterion to a high standard, adds benefit to the crossing structure and provides a significant improvement over the existing
8	
7	
6	The option moderately addresses the criteria, although is not a best or worst case. There are also potential concerns and/or items that require additional investigation.
5	
4	
3	The option either does not address the requirements relevant to this input or does so poorly. The option provides no benefit and, in some cases, is worse than the existing condition.
2	
1	

4.2.1 Bridge Safety

Safety is always a top priority and was subsequently allocated a high percentage weighting in the criteria.

Road User Safety

A number of characteristics of the bridge including the approach roadway geometrics, bridge design, traffic, vibration, the driving environment, pavement markings, and distractions to determine which of these contributed to the assignment of a bridge into either the "more-safe" or "less-safe" bridge class.

Pedestrian Safety

Pedestrian safety was considered which is dependent on the bridge width, and the type of barrier installation provided. Pedestrian safety is affected by the physical separation from vehicles in the clear zone as well as impacts on pedestrian desire lines.

4.2.2 Bridge Performance

Load

The load assessment for the concept design has adopted the worst case only, however, all design cases listed in AS5100 and AS1170 will be listed in the design report.

Durability Characteristics

The design life of the bridge is reduced depending on various factors, most important of which are the materials used in the construction of bridge and design load, considering that timber materials has less durability than concrete and steel.

In the following, important criteria that affect durability of the bridge are as follows:

- Structure type;
- Structural materials and material specifications;
- As-built material qualities and current conditions;
- Truck loads and other live loads;
- Environment—climate, air quality, marine atmosphere;

- Snow and ice removal operations;
- Type, timing, and effectiveness of preventive maintenance;
- Type, timing, and effectiveness of restorative maintenance, minor and major rehabilitation;
- Flooding, hydraulic design, and scour mitigation measures; and
- Soil characteristics—settlement.

4.2.3 Whole of Life Costs

The costs consider the initial capital cost of design and rehabilitation, and maintenance costs of the bridge over a consistent life cycle.

Capital Costs (Construction)

The assessment of different bridge options included an analysis of the project costs associated with each option. The cost of each option has been assessed based on the estimated individual structure.

Maintenance Costs

Maintenance costs include routine maintenance of the bridge/structure to ensure continuous operation (preventative maintenance). Some typical routine maintenance items considered include the following:

- General (graffiti, fire or water damage, vegetation growth);
- Drainage (blocked culverts and approaches, scour of batters);
- Deck joints (blocked or jammed joints, damaged waterproofing seals);
- Bearings (debris and dirt build-up around bearings, rusted steel bearings);
- Barriers (damaged, corroded, and missing posts, end treatments);
- Bituminous surface (uneven surface, settlement of approaches);
- Signs and line marking (missing, damaged, or corroded signposts and connections); and
- Dust and corrosion removal.

4.2.4 Construction

The constructability impacts of each design include consideration of the following elements:

- Road/bridge closure period;
- Traffic management implications;
- Environmental impacts due to the protected waterway; and
- Special experience in construction.

4.2.5 Heritage

Historic bridges are a look into our past. They reveal what life was like during a period in history and help to complete the story of our nation's history and development. Therefore, due to historical aspects of Kirwans Bridge, each option includes consideration of the following elements based on the heritage impacts:

- Minimum damage to the bridge; and
- Maintaining the historical appearance of the bridge.

4.3 Options Assessment

4.3.1 Option 1– Like-for-like Timber Bridge Replacement

This option offers to replace the existing bridge in its current location, with a like-for-like timber bridge with two lanes (according to original bridge built in 1890) and an additional pedestrian and cycling lane.

Description

Option 1 involves the replacement of the existing bridge in its current location, with a like-for-like timber bridge with two lanes (according to original bridge built in 1890) and an additional pedestrian and cycling lane. This option would complement the heritage of the bridge and provide a lifespan greater than 75 years. The bridge design will be in accordance with AS5100- Bridge Design (SM1600 live loading). For the concept design, refer to Appendix A.

Components

This option includes the following components:

- Nine I-welded steel girders for each span;
- Diaphragms consist of 80x80x8 EA and 50x50x5 EA sections used as inverted V-braced with top and bottom chord at supports (each 5000mm);
- Timber plank decking (150mm);
- 2x300PFC for headstocks; and
- 8 timber piles with 550mm diameter at each pier with variable lengths.

Option Assessment

JJ Ryan believe that this option is cheaper than option 3, but it is more expensive than option 2. This option will provide two traffic lanes, two shoulders, and an additional cycling and pedestrian path. Furthermore, option 1 will also complement the heritage of Kirwans Bridge.

The benefits of this option include:

- This option would complement the heritage of the bridge;
- Cycling and footpath lane;
- Two traffic lanes;
- Two shoulders;
- SM1600 live loading;
- Better bridge alignment; and
- Higher speed limit.

Some disadvantages of this option include:

- Demolition of the existing historical bridge;
- Corrosion of the steel components;
- Lower lifespan (75 years) compared to option 3 (100 years);
- Complex construction; and
- No lighting.

4.3.2 Option 2-1– Rehabilitation by Steel-Timber Composite System

This option offers to maintain the existing single lane bridge by undertaking a full renovation including replacing the decking with timber planks and steel girders.

Description

Option 2-1 involves maintaining the existing single lane bridge by undertaking full renovation including adding a new steel girder between the existing girders and replacing the timber decking with new planks. All steel girders in longer spans need to be replaced. In this option, 72 severely damaged piles and slender piles with less than 300mm diameter will be replaced, and 14 piles with minor to moderate damage will be repaired. The lifespan of this option would be approximately 25 years. This option requires the implementation of a load limit to 30 tonne. For the concept design, refer to Appendix B.

Components

This option includes the following components:

- Two existing and one new I-welded steel girder will be added in the middle for each short span;
- Three new I-welded steel girders for each long span;
- Diaphragms consist of 80x80x8 EA and 50x50x5 EA sections used as inverted V-braced with top and bottom chord at supports (each 5000mm);
- Timber plank decking (150mm);
- 2x300PFC for headstocks; and
- 72 piles will be replaced with timber piles with 500mm diameter, and 14 piles will be repaired with concrete collars.

Option Assessment

JJR believe that this option is the cheapest option and lighter in comparison with other nominated options.

The benefits of this option include:

- This option would preserve most of Kirwans Bridge components;
- Low cost;
- Low weight of the superstructure;
- Fast construction; and
- Low environmental impact compared to other options.

Some disadvantages of this option include:

- 30t load limit;
- 20 km/h speed limit;
- Corrosion of the steel components;
- Existing old timber piles as structural elements;
- Short lifespan;
- No footpath; and
- No lighting.

4.3.3 Option 2-2- Rehabilitation by Steel-Concrete Composite System

This option offers to maintain the existing single lane bridge by undertaking a full renovation including replacing the timber decking with concrete deck slab.

Description

Option 2-2 involves maintaining the existing single lane bridge by undertaking full renovation including using existing steel girders and replacing the timber decking with concrete deck slab. In this option, 72 severely damaged piles and slender piles with less than 300mm diameter will be replaced, and 14 piles with minor to moderate damage will be repaired. The lifespan of this option would be approximately 50 years. This option requires the implementation of a load limit to 30 tonne. For the concept design, refer to Appendix C.

Components

This design option comprises the following components:

- Concrete deck slab (380 mm thick);
- Shear studs;
- Existing I-girders;
- Diaphragms consist of 80x80x8 EA and 50x50x5 EA sections used as V-braced with top and bottom chord at supports (each 5000mm);
- 2x300PFC for headstocks; and
- 72 piles will be replaced with timber piles with 500mm diameter, and 14 piles will be repaired with concrete collars.

Option Assessment

JJ Ryan will suggest that this option outweighs other options when considering all design criteria.

The benefits of using composite concrete system with steel girders:

- Moderate lifespan;
- Increasing the bending capacity of the existing steel girders;
- Protect the steel girders from the rain;
- Lower vibration compared to option 2-1;
- Low cost; and
- Fast construction.

Some disadvantages of this option include:

- 30t load limit;
- 20 km/h speed limit;
- Corrosion of the steel components;
- Existing old timber piles as structural elements;
- No footpath;
- No lighting;
- Heavier than option 2-1; and
- The construction cost is more expensive than option 2-1.

4.3.4 Option 3 – New Bridge Construction with Steel-Concrete Composite System

This option offers the demolition of the existing bridge and construction of a new concrete bridge with steel-concrete composite superstructure in the same location with two lanes and an additional pedestrian and cycling lane.

Description

Option 3 involves the replacement of the existing bridge, with a concrete bridge with two lanes and an additional pedestrian and cycling lane. This option will provide a lifespan greater than 100 years. The bridge is designed in accordance with AS5100- bridge design (SM1600 live loading). For the concept design, refer to Appendix D.

Components

This design option comprises the following components:

- Concrete deck (313mm thick);
- Shear studs;
- Seven I-welded steel girders for each span;
- Diaphragms consist of 80x80x8 EA and 50x50x5 EA sections used as V-braced with top and bottom chord at supports (each 5000mm);
- Concrete headstocks; and
- 6 concrete piles with 600mm diameter at each pier with variable lengths.

Option Assessment

JJR believe that this option is the most expensive option. However, this option provides the longest lifespan and will be designed to the latest provisions in AS5100- Bridge Design (SM1600 Live Loading).

The benefits of using composite timber and concrete system with perforated steel mesh include:

- Cycling and footpath lane;
- Two traffic lanes;
- Two shoulders;
- Protect the steel girders from the rain;
- SM1600 live loading;
- Better bridge alignment; and
- Higher speed limit.

Some disadvantages of this option include:

- Long construction time;
- Demolition of the existing historical bridge;
- Corrosion of the steel components;
- High construction costs;
- Heavier weight of the structure; and
- The construction cost is more expensive than other options.

JJR intend to undertake further option analysis to identify the most practical solution, as a peer review has identified other potential options.

4.4 Options Analysis Rankings

An overview of the options assessment for individual options is provided below, and for reference purposes, refer to Appendix E.

An analysis of comparative rankings for each criterion is discussed further in this section.

4.4.1 Bridge Safety

The weighted scores for the system safety ranked from first to last are shown in Table 4.

Table 4: Bridge safety weighted scores

Option	Weighted Score	Rank
Like-for-like Timber Bridge Replacement (Option 1)	25	**1**
Rehabilitation by Steel-Timber Composite System (Option 2-1)	13	**3**
Rehabilitation by Steel-Concrete Composite System (Option 2-2)	15	**2**
New Bridge Construction with Steel-Concrete Composite System (Option 3)	25	**1**

Option 1 and option 3 utilize the same span width and safety barrier and end treatment, resulting in the same safety value for both. However, due to lack of footpath and the problem in the bridge alignment, option 2-1 and option 2-2 fail to achieve more points. Furthermore, option 2-2 will outweigh option 2-1 because of better dynamic response (low vibration).

4.4.2 Bridge Performance

The weighted scores for bridge performance ranked from first to last are shown in Table 5.

Table 5: Bridge performance weighted scores

Option	Weighted Score	Rank
Like-for-like Timber Bridge Replacement (Option 1)	21	**2**
Rehabilitation by Steel-Timber Composite System (Option 2-1)	13	**4**
Rehabilitation by Steel-Concrete Composite System (Option 2-2)	15	**3**
New Bridge Construction with Steel-Concrete Composite System (Option 3)	25	**1**

Option 3 has a higher score in load/durability due to higher bending capacity in the composite section under SM1600 loading. Option 1 will receive a lower score due to using timber which has lower durability compared to concrete. Option 2-1 and option 2-2 fail to provide long lifespan for road users. Therefore, they placed lower. It is obvious that option 2-2 will show better performance because of using concrete rather than timber decking which is the case for option 2-1.

4.4.3 Whole of Life Costs

The cost assessment for each option is ranked from first to last in Table 6.

Table 6: Cost assessment ranking

Option	Weighted Score	Rank
Like-for-like Timber Bridge Replacement (Option 1)	7	**3**
Rehabilitation by Steel-Timber Composite System (Option 2-1)	21	**1**
Rehabilitation by Steel-Concrete Composite System (Option 2-2)	20	**2**
New Bridge Construction with Steel-Concrete Composite System (Option 3)	3	**4**

Option 3 is the most expensive compared to other options. Also, option 2-1 is the most cost-effective option among others due to the fewer changes in the structural members of the bridge.

4.4.4 Construction

The constructability assessment for each option is ranked from first to last in **Error! Reference source not found.**.

Option	Weighted Score	Rank
Like-for-like Timber Bridge Replacement (Option 1)	3	**3**
Rehabilitation by Steel-Timber Composite System (Option 2-1)	5	**2**
Rehabilitation by Steel-Concrete Composite System (Option 2-2)	6	**1**
New Bridge Construction with Steel-Concrete Composite System (Option 3)	2	**4**

The highest-ranked option based on constructability is rehabilitation by steel-concrete composite system because of precast concrete panels.

4.4.5 Heritage

The heritage preservation assessment for each option is ranked from first to last in Table 7.

Table 7: Heritage impacts assessment ranking

Option	Weighted Score	Rank
Like-for-like Timber Bridge Replacement (Option 1)	8	**3**
Rehabilitation by Steel-Timber Composite System (Option 2-1)	14	**1**
Rehabilitation by Steel-Concrete Composite System (Option 2-2)	12	**2**
New Bridge Construction with Steel-Concrete Composite System (Option 3)	2	**4**

Option 2-1 and option 2-2 will preserve most of Kirwans Bridge compared to other options. Therefore, they are the highest-ranked options based on historical aspects.

5 Preferred Option

A summary of the overall option rankings is provided in Table 8.

Table 8: Overall options rankings

Assessment Criteria	Criteria Weighting	Sub-Criteria / Inputs	Sub-Criteria Weight (%)	Weighted Criteria Score			
				Option 1	Option 2-1	Option 2-2	Option 3
Bridge Safety	25%	Road User Safety	80%	25	13	15	25
		Pedestrian Safety	20%				
Bridge Performance	25%	Load	50%	21	13	14	25
		Durability Characteristics	50%				
Whole of Life Costs	25%	Capital Costs	80%	7	21	20	3
		Maintenance Costs	20%				
Construction	10%	Constructability	100%	3	5	6	2
Heritage	15%	Preservation of Historical Bridge	100%	8	14	12	2
Overall Score				**64**	**66**	**67**	**57**

The overall highest-ranked alternative is Option 2-2– Rehabilitation by Steel-Concrete Composite System. This has been detailed in the following section of this report.

5.1 Option Summary

After considering the available options, it is evident that Option 2-2 is the optimal choice. This particular option stands out from the rest as it offers a cost-effective solution. Additionally, it has significant advantages such as having less impact on the historical aspects of Kirwans Bridge.

6 Conclusion and Recommendation

JJR have undertaken a concept options assessment for rehabilitation or replacement of Kirwans Bridge. Three (3) major options were developed as follows:

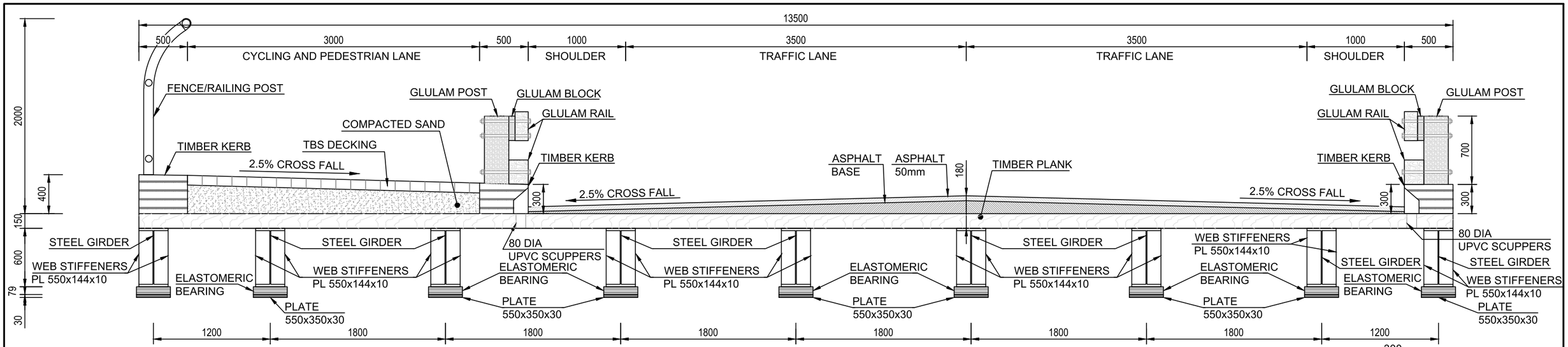
- Option 1 – Like-for-like Timber Bridge Replacement
- Option 2-1 – Rehabilitation by Steel-Timber Composite System
- Option 2-2 – Rehabilitation by Steel-Concrete Composite System
- Option 3 – New Bridge Construction with Steel-Concrete Composite System

Detailed assessment criteria were developed to comparatively weigh the options which include:

- Bridge safety (road user safety and pedestrian safety);
- Bridge performance (load and durability characteristics);
- Whole of life costs (construction capital costs and maintenance costs);
- Construction (constructability); and
- Heritage (Preservation of Historical Bridge).

As discussed in Section 4 of this report, the recommended option is Option 2-2, which involves adding steel girders and using precast/cast in-situ concrete decking instead of timber planks for the superstructure. This option also involves replacement of 72 and rehabilitation of 14 existing timber piles. Furthermore, all corbels need to be replaced with new ones. The timber headstocks need to be replaced with 2x300PFC as well. The proposed lifespan of the bridge using this option is 50 years.

Appendix A – Option 1



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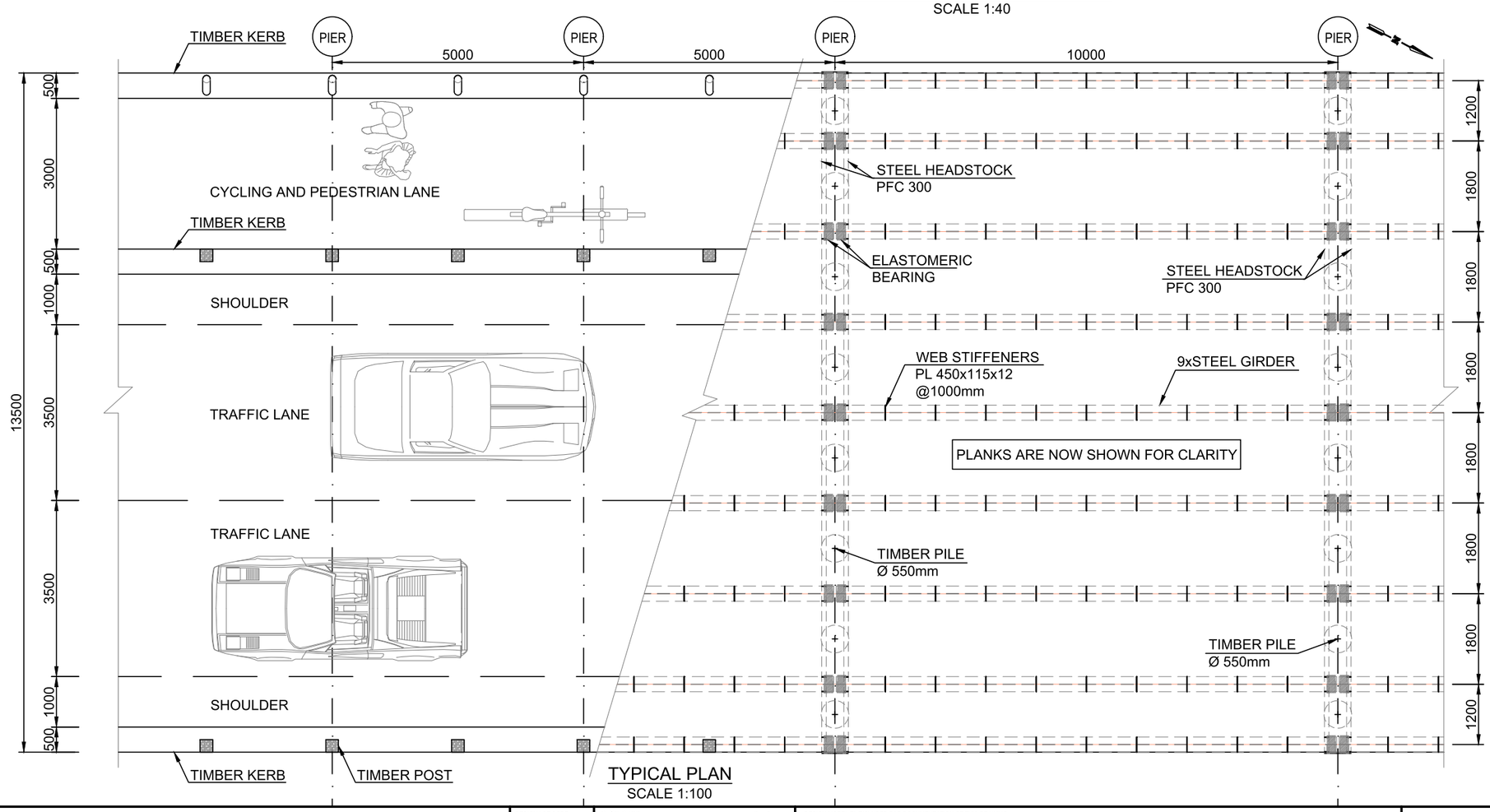

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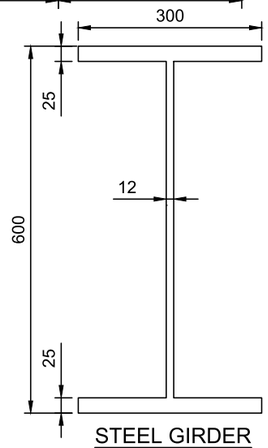

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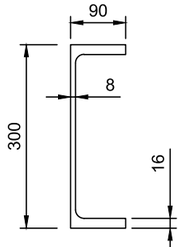

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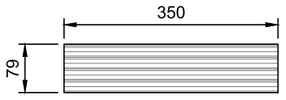

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KIRWANS BRIDGE REHABILITATION

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CONCEPT DESIGN

TYPICAL DECK CROSS SECTION AND SECTIONS (OPTION 1)

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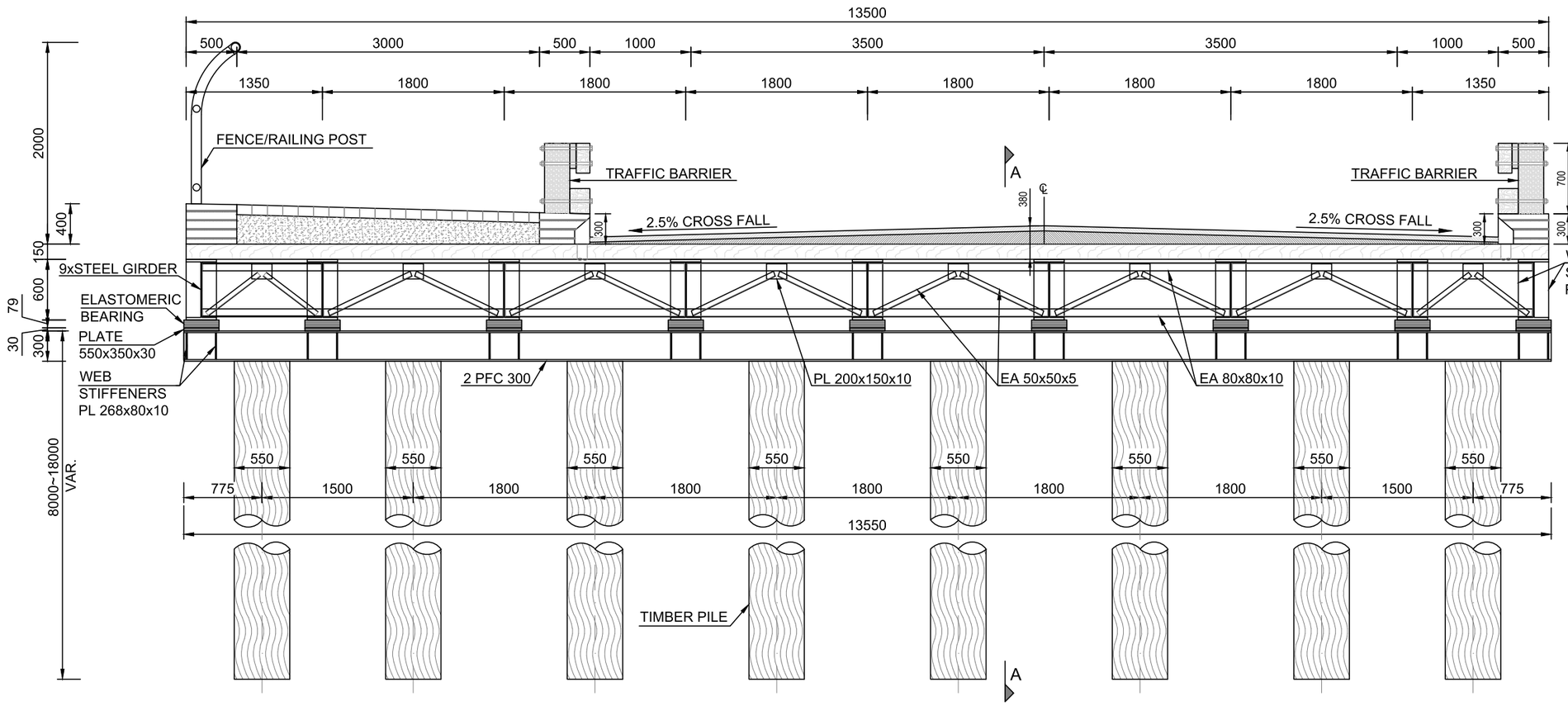

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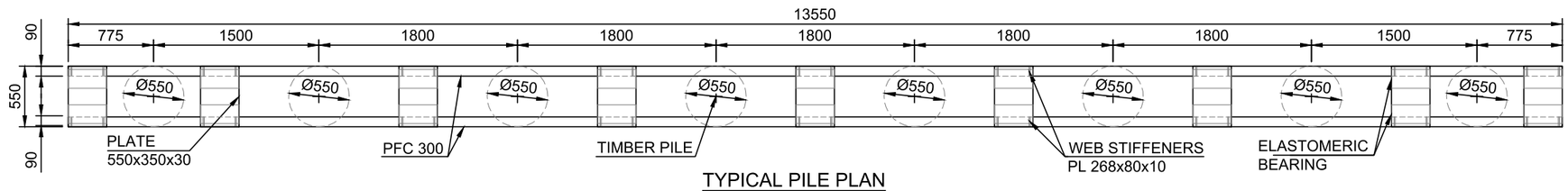

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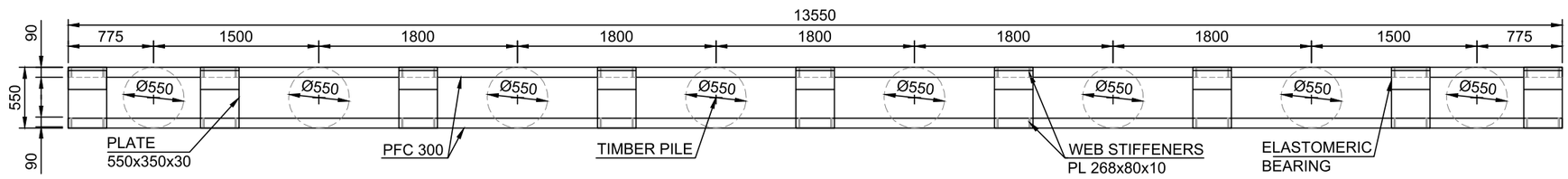

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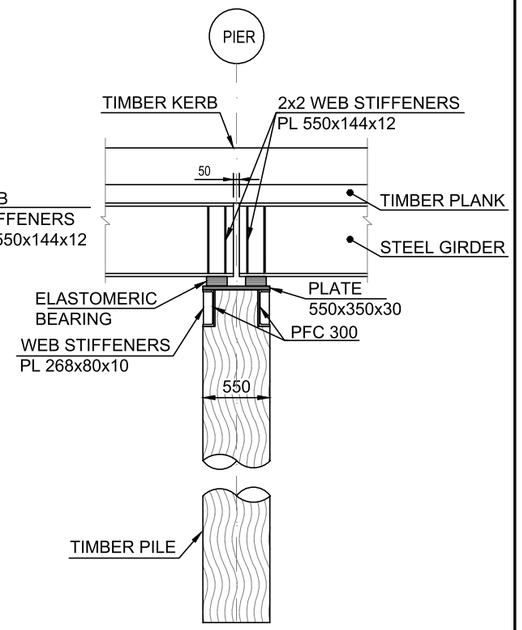

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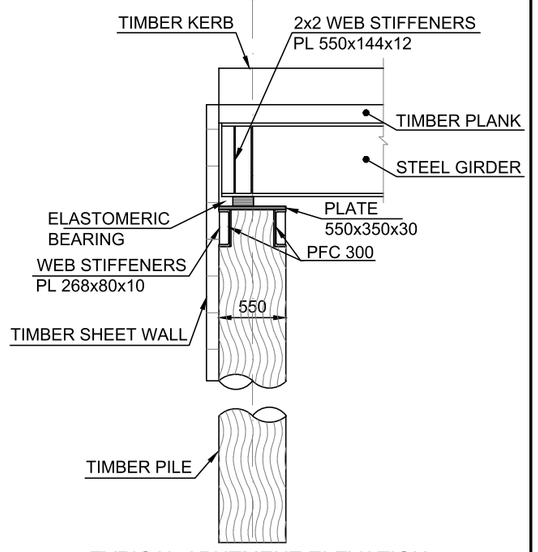

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TYPICAL PIER AND ABUTMENT FRONT VIEW AND ELEVATION (OPTION 1)

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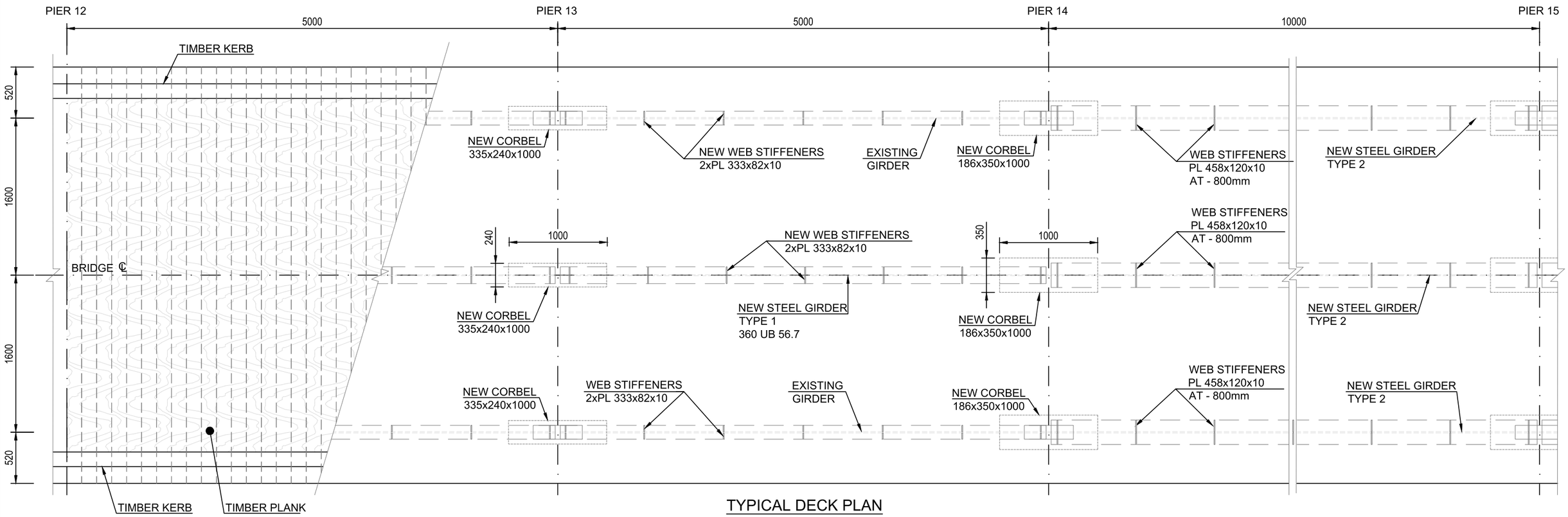
Appendix B – Option 2-1



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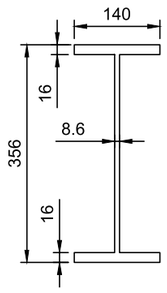

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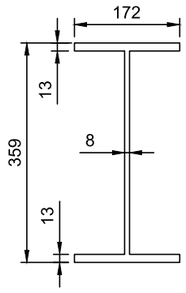

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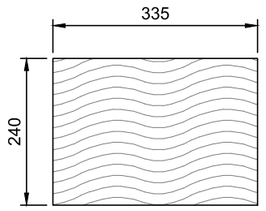

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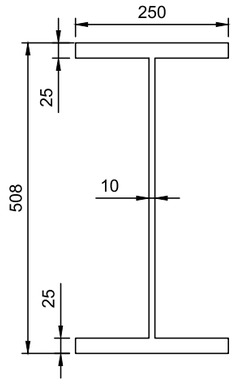

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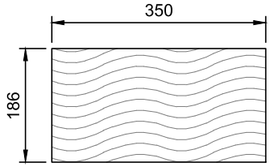

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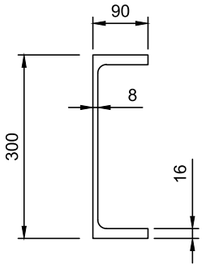

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TYPICAL DECK PLAN AND SECTIONS (OPTION 2-1)

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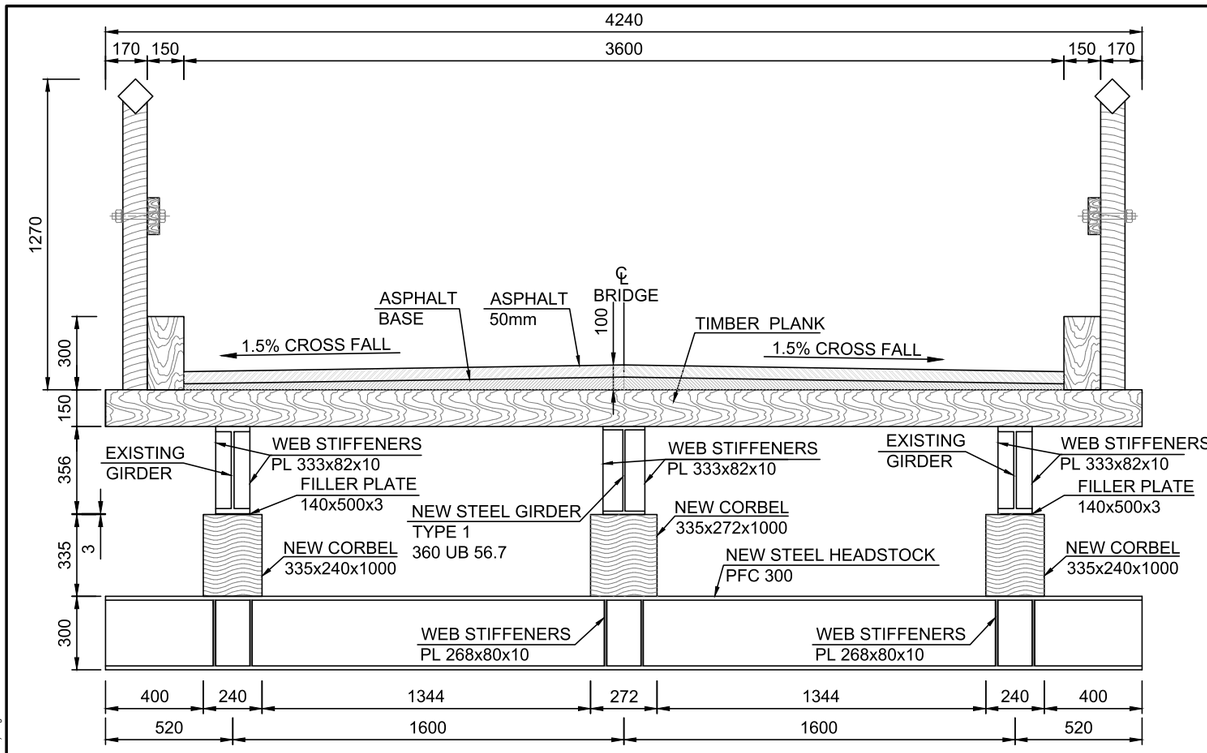

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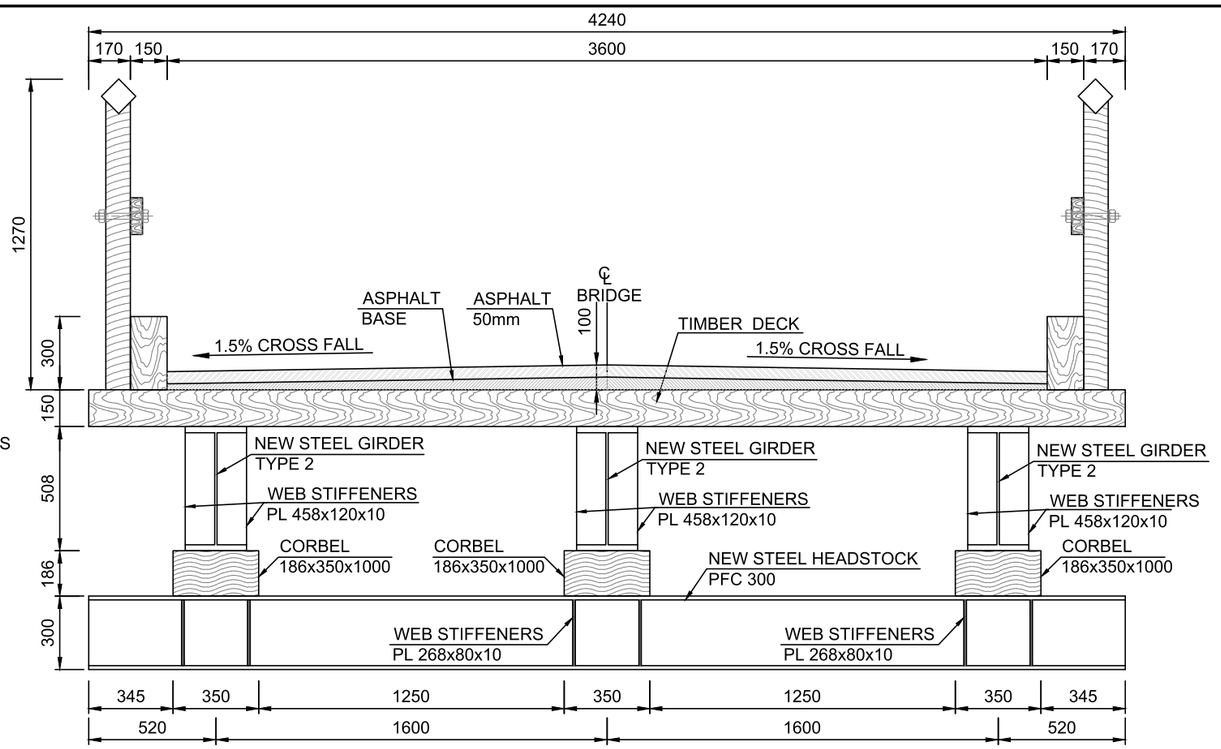

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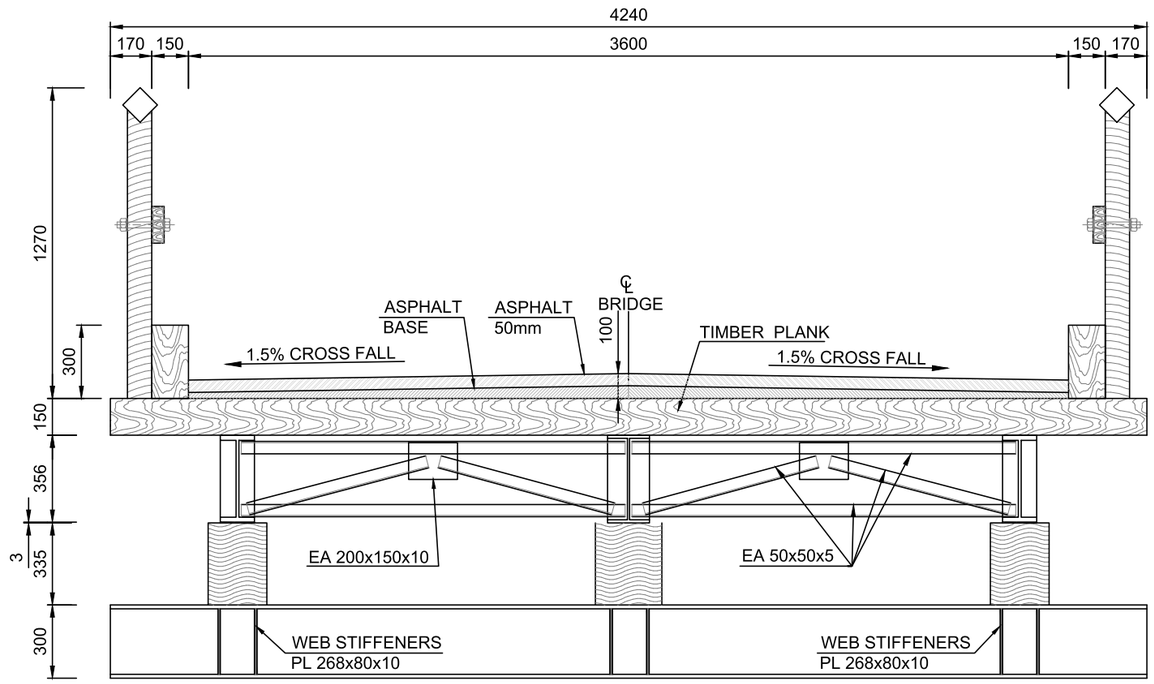

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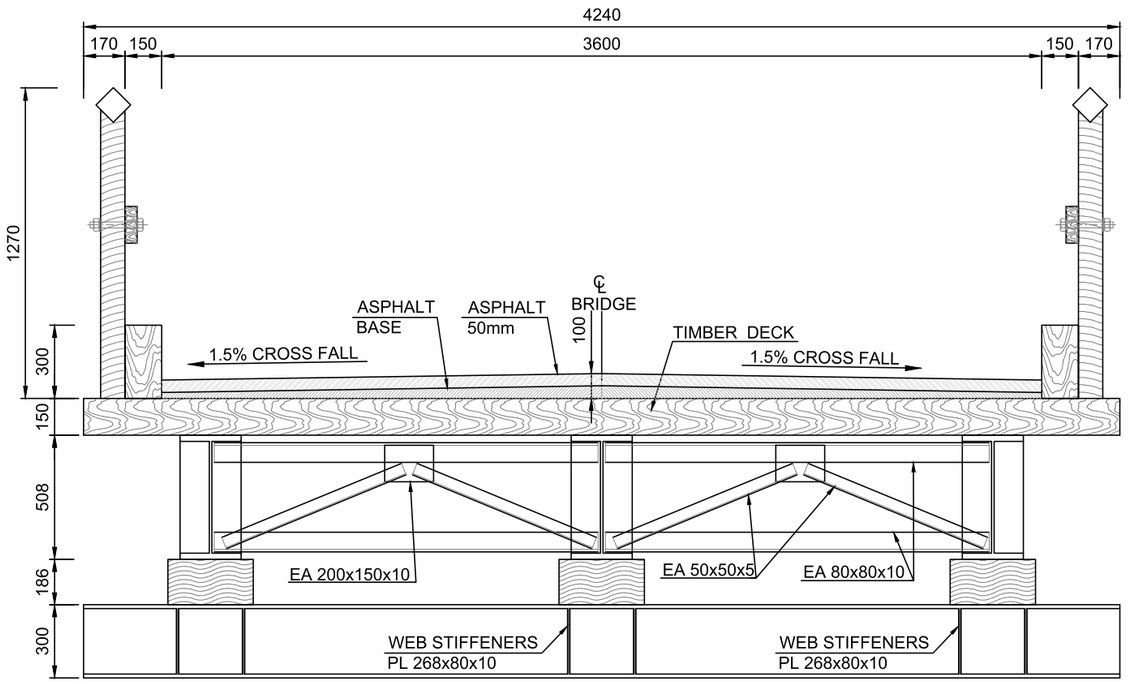

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KIRWANS BRIDGE- LONGWOOD ROAD, NAGAMBIE

CONCEPT DESIGN

TYPICAL DECK AND DIAPHRAGM CROSS SECTION (OPTION 2-1)

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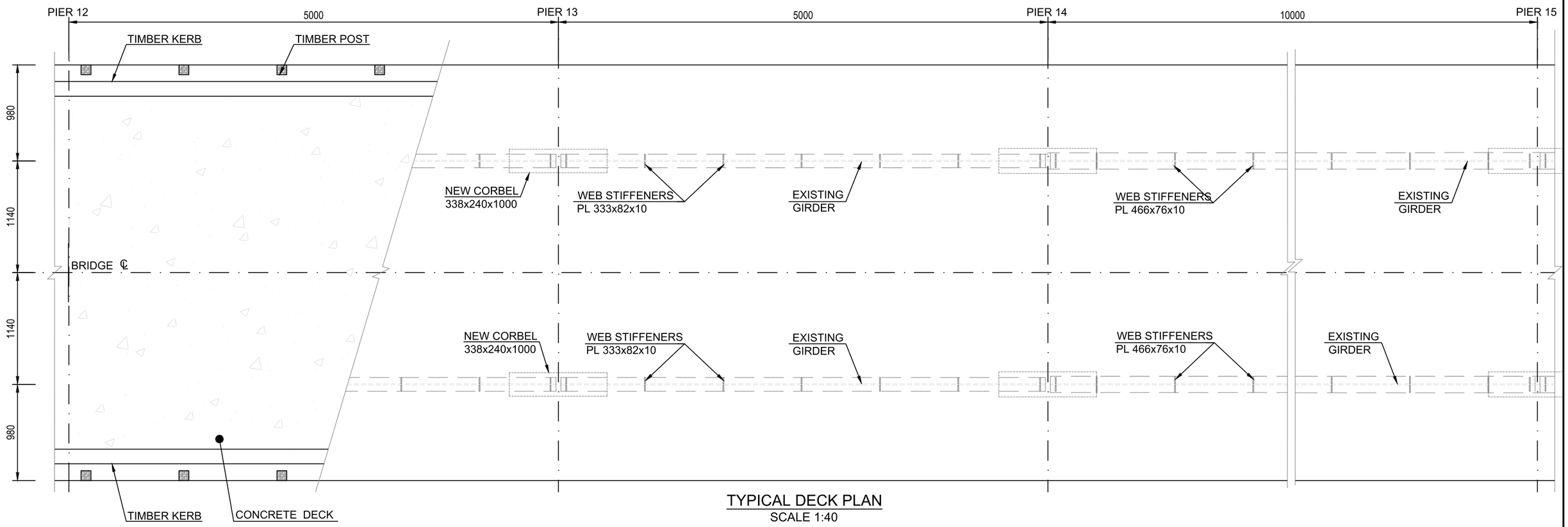
Appendix C – Option 2-2



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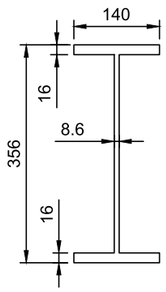

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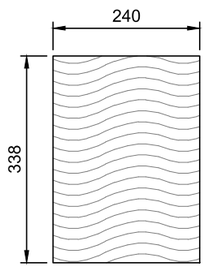

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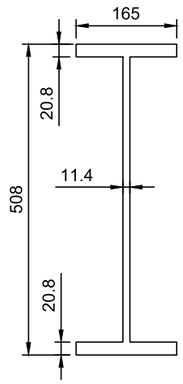

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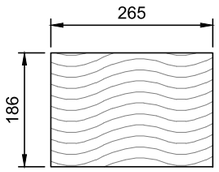

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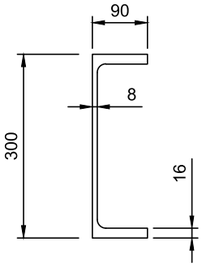

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EXTERNAL REFERENCE FILES (UP TO 35 XREFS)	REV	DATE	AMENDMENT / REVISION DESCRIPTION
	A	25.07.2023	ISSUE FOR REVIEW

DESIGN LOT CODE — DVF No: - — APPROVAL: -

PLOT DATE TIME

TITLE	NAME
DRAFTER	R.ABBASI
DRAFTING CHECK	C.JURY
DESIGNER	M.JAFARI
DESIGN CHECK	C.JURY
DESIGN MANAGER	M.OMIDI
PROJECT MANAGER	A.SABOURI

DESIGN MODEL FILE(S) USED FOR DOCUMENTATION OF THIS DRAWING

PRINCIPAL: Strathbogie Shire

DESIGNER: JJ RYAN CONSULTING PTY LTD

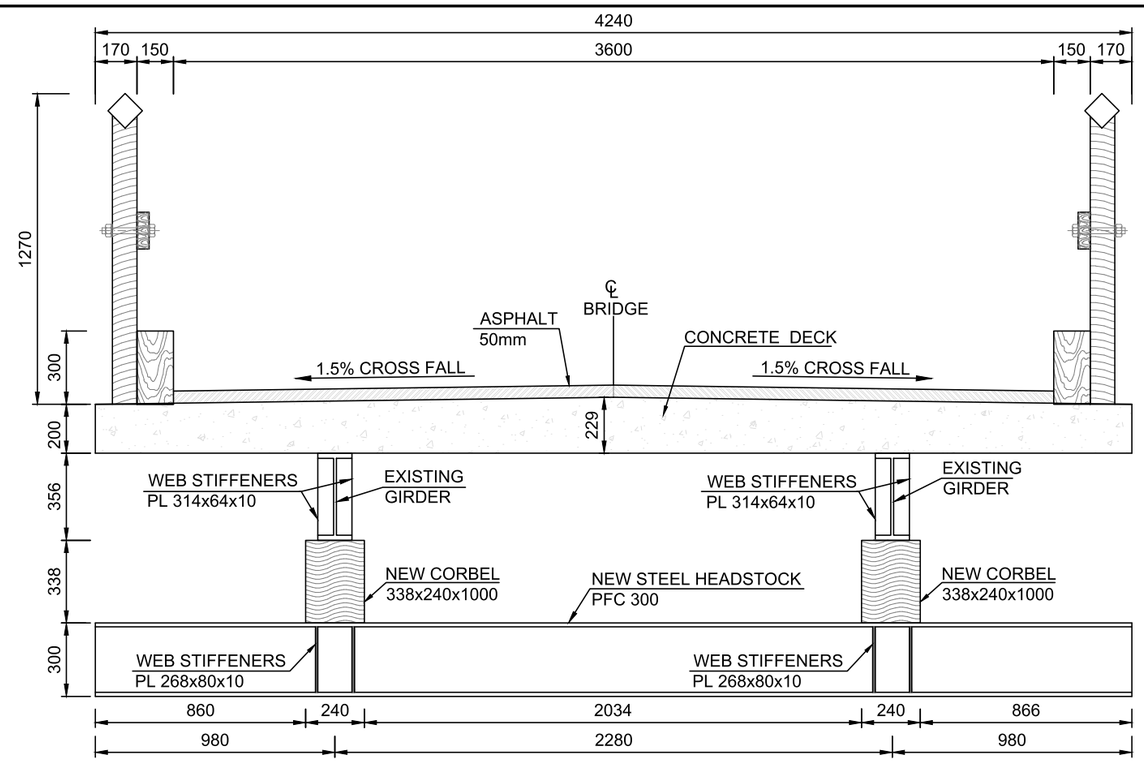
SCALES AT A3 SIZE DRAWING: AS SHOWN

CO-ORDINATE SYSTEM: MGA ZONE 55 — HEIGHT DATUM: A.H.D.

STRATHBOGIE SHIRE COUNCIL

KIRWANS BRIDGE REHABILITATION
KIRWANS BRIDGE- LONGWOOD ROAD, NAGAMBIE
CONCEPT DESIGN
TYPICAL DECK PLAN AND SECTIONS (OPTION 2-2)

CLIENT PROJECT / DRAWING No	ISSUE STATUS	JJR PROJECT / DRAWING No	ISSUE
	FOR REVIEW	JJR-4220916B-ST008	A



TYPICAL DECK CROSS SECTION (CONCRETE DECK)

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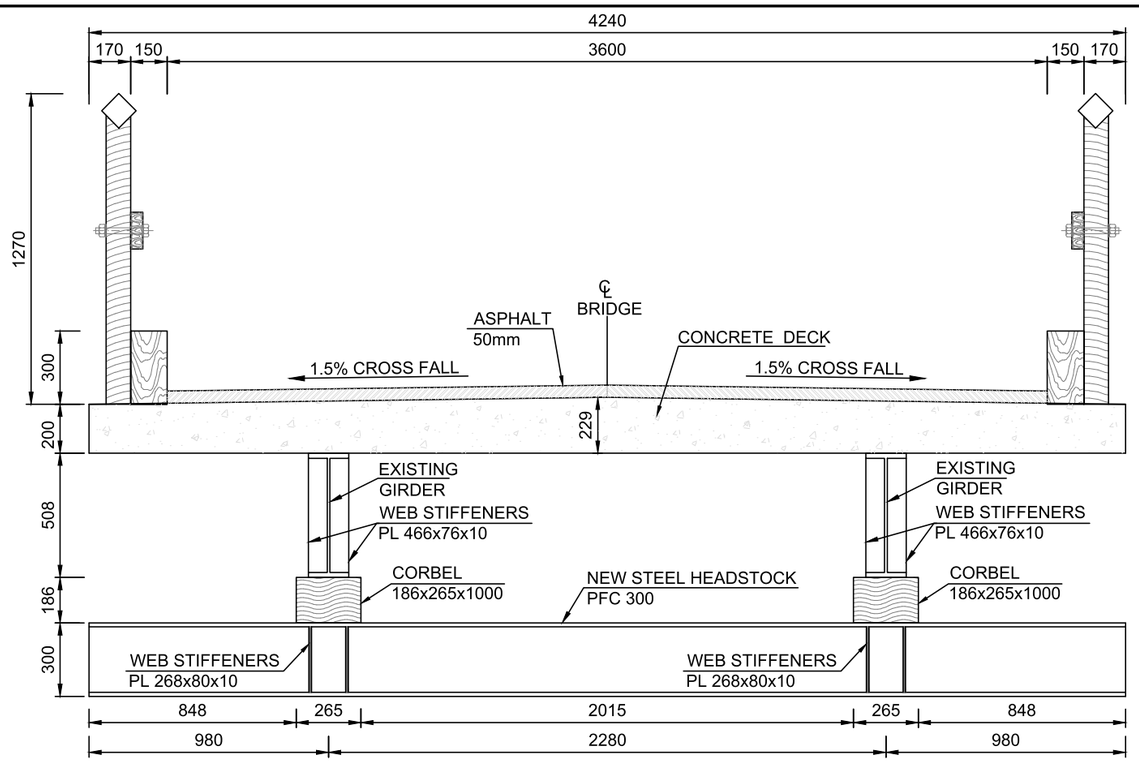

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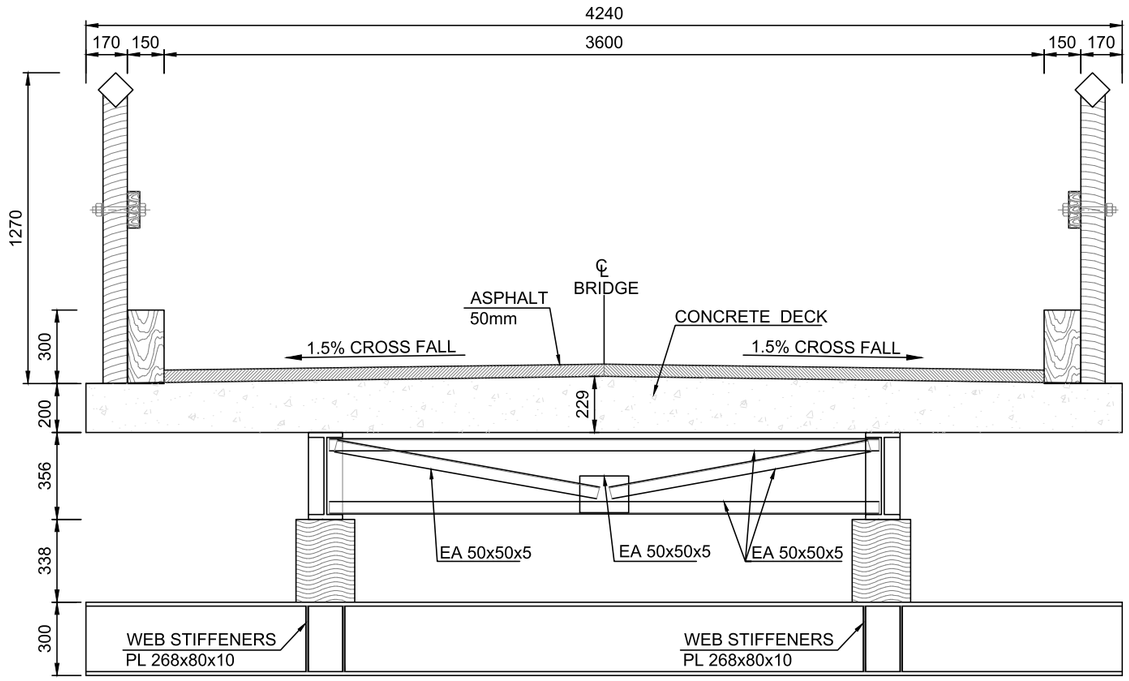

TYPICAL DIAPHRAGM CROSS SECTION (CONCRETE DECK)

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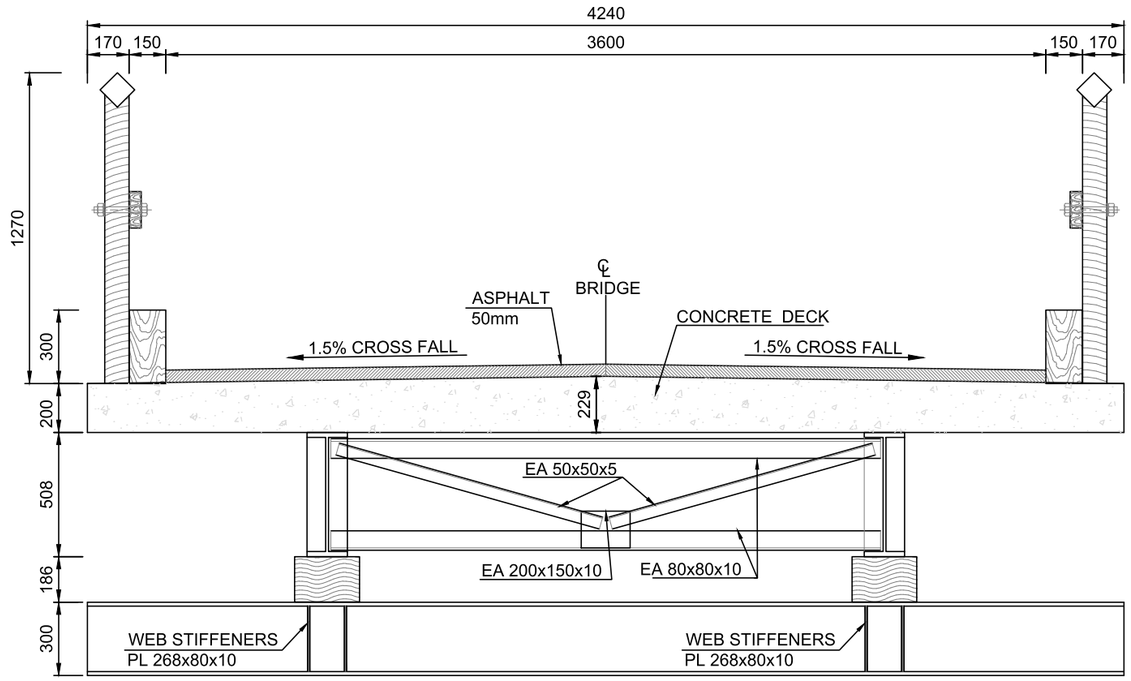

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PRINCIPAL: Strathbogie shire

DESIGNER: JJ RYAN CONSULTING PTY LTD

SCALES AT A3 SIZE DRAWING: AS SHOWN

CO-ORDINATE SYSTEM: MGA ZONE 55 | HEIGHT DATUM: A.H.D.

KIRWANS BRIDGE REHABILITATION

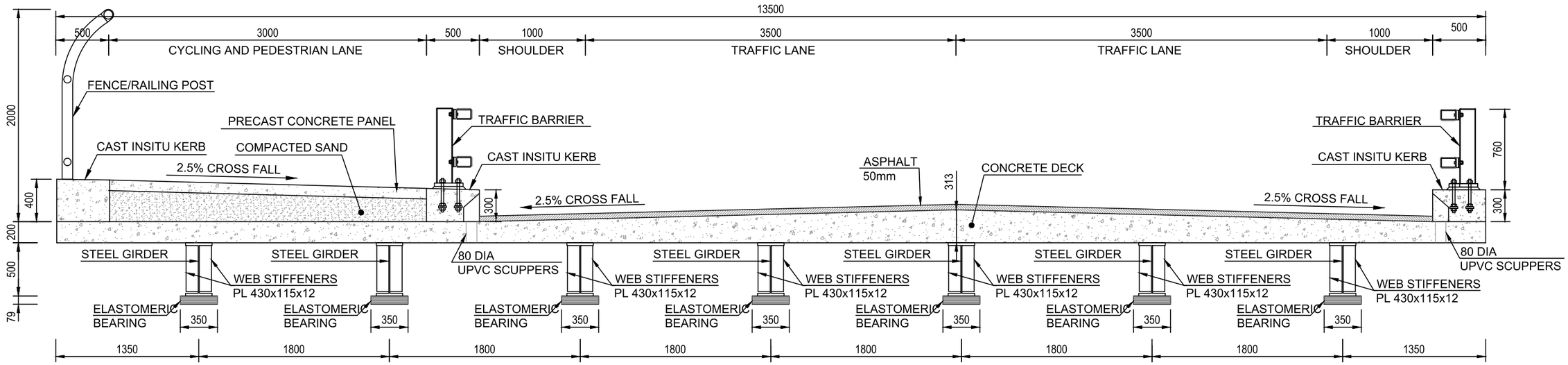
KIRWANS BRIDGE- LONGWOOD ROAD, NAGAMBIE

CONCEPT DESIGN

TYPICAL DECK CROSS SECTION (OPTION 2-2)

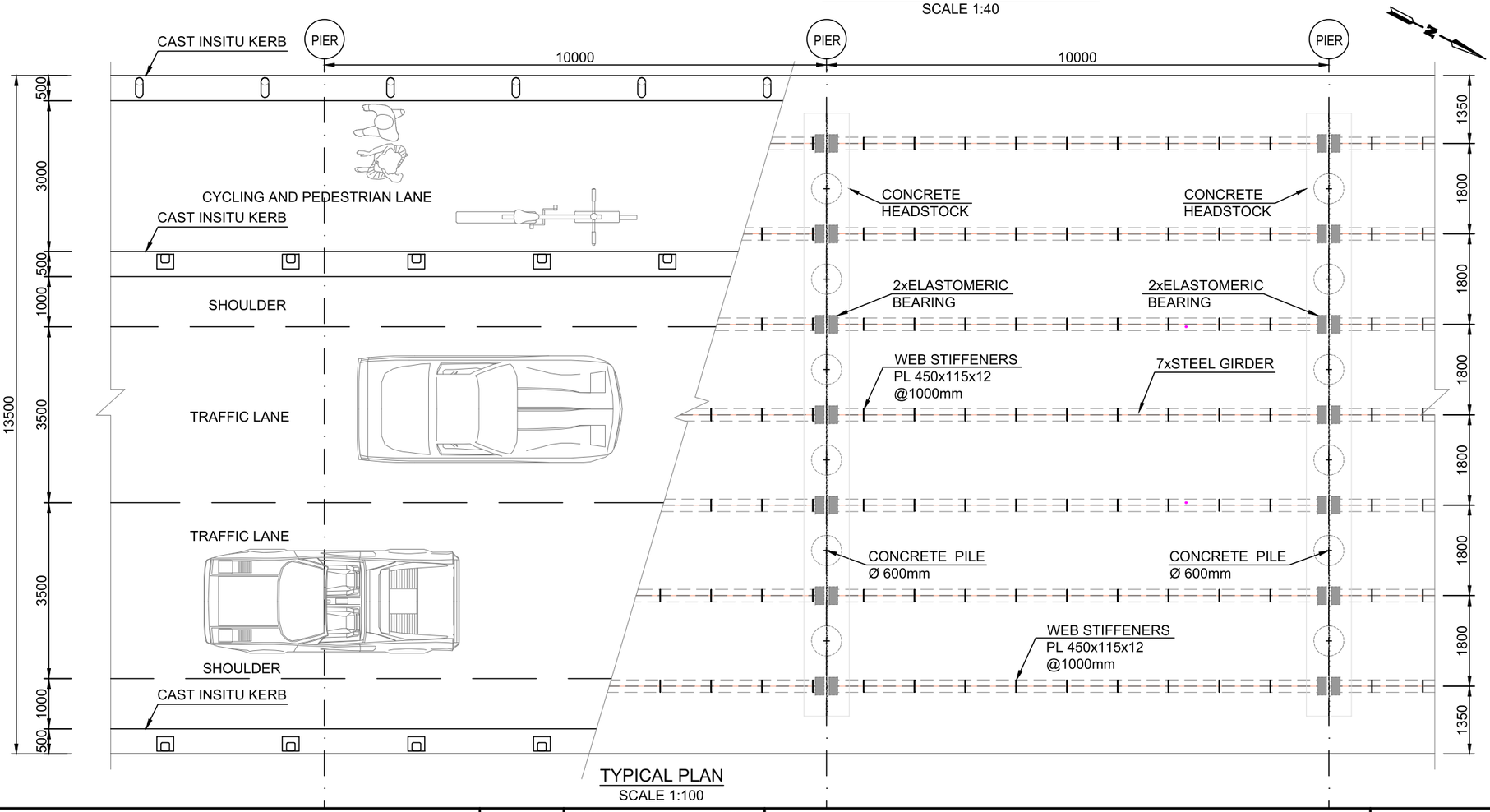
CLIENT PROJECT / DRAWING No	ISSUE STATUS	JJR PROJECT / DRAWING No	ISSUE
	FOR REVIEW	JJR-4220916B-ST009	A

Appendix D – Option 3



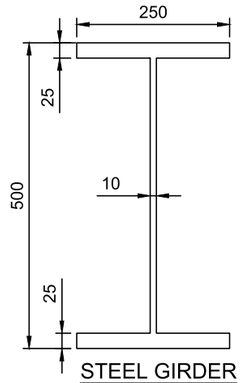
TYPICAL DECK CROSS SECTION

SCALE 1:40



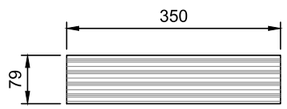
TYPICAL PLAN

SCALE 1:100



STEEL GIRDER

SCALE 1:10



ELASTOMERIC BEARING 350x170x79

SCALE 1:10

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SCALES AT A3 SIZE DRAWING: AS SHOWN

CO-ORDINATE SYSTEM: MGA ZONE 55

HEIGHT DATUM: A.H.D.

STRATHBOGIE SHIRE COUNCIL

KIRWANS BRIDGE REHABILITATION

KIRWANS BRIDGE- LONGWOOD ROAD, NAGAMBIE

CONCEPT DESIGN

TYPICAL DECK PLAN AND SECTIONS (OPTION 3)

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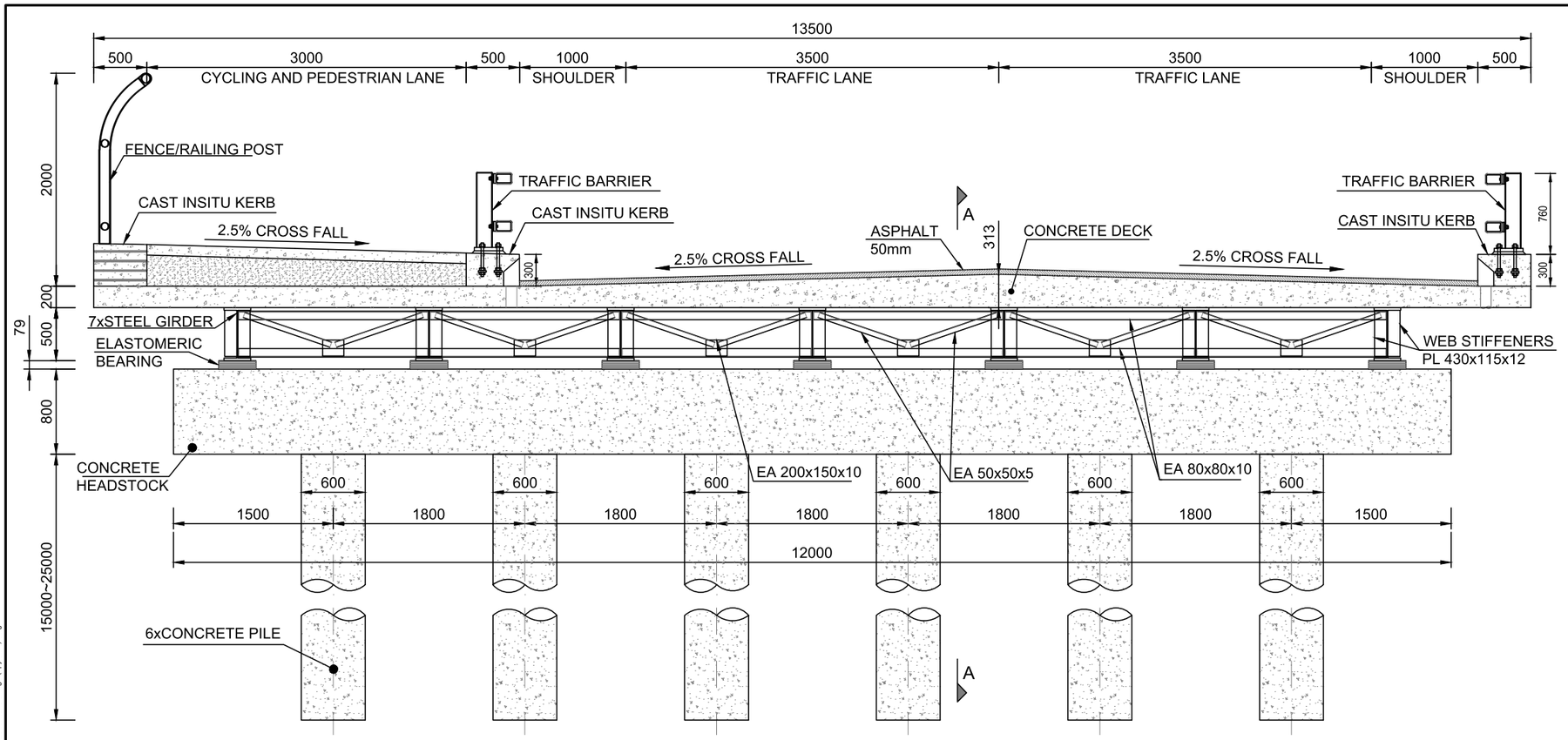
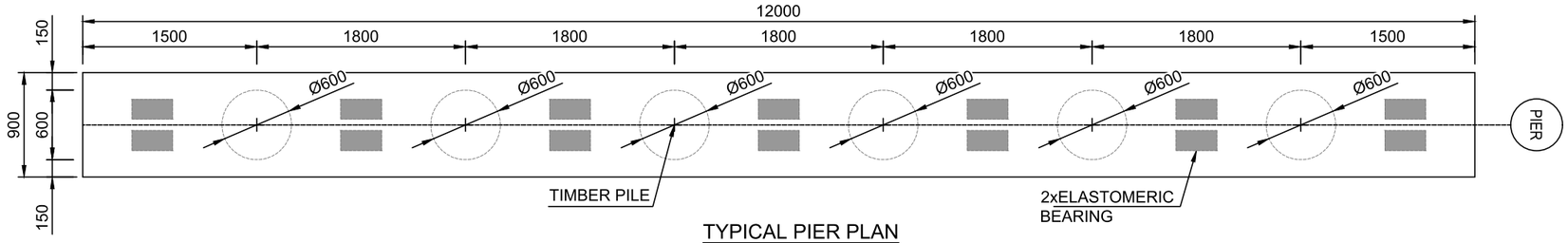
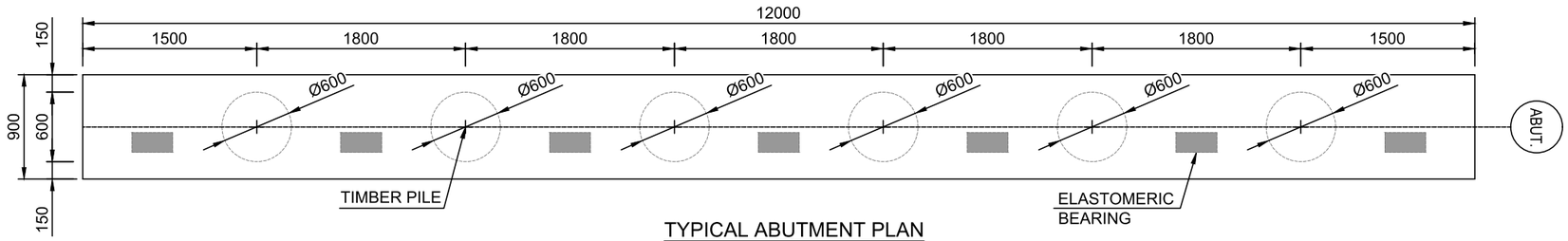
	FOR REVIEW	JJR-4220916B-ST028	A



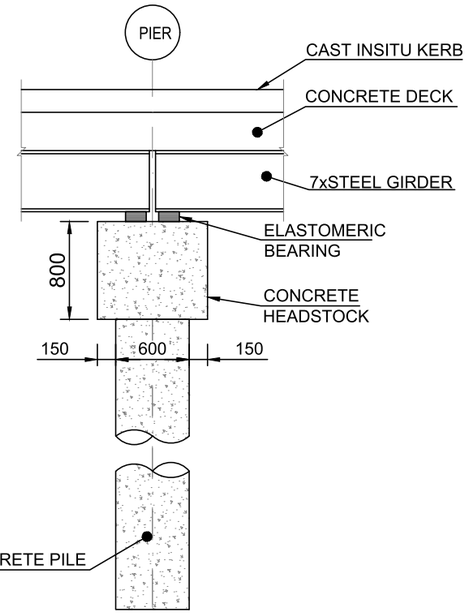
TYPICAL PIER FRONT VIEW
SCALE 1:50



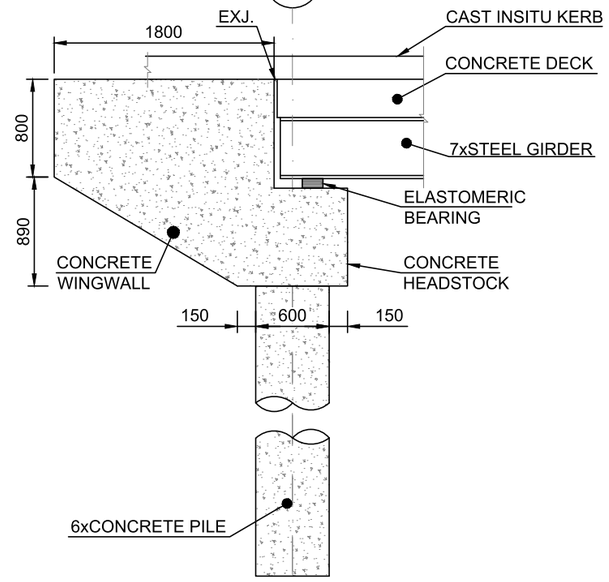
TYPICAL PIER PLAN
SCALE 1:50



TYPICAL ABUTMENT PLAN
SCALE 1:50



TYPICAL PIER ELEVATION
SECTION A-A
SCALE 1:50



TYPICAL ABUTMENT ELEVATION
SECTION A-A
SCALE 1:50

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PRINCIPAL: Strathbogie shire

DESIGNER: JJ RYAN CONSULTING PTY LTD

SCALES AT A3 SIZE DRAWING: AS SHOWN

CO-ORDINATE SYSTEM: MGA ZONE 55 | HEIGHT DATUM: A.H.D.

STRATHBOGIE SHIRE COUNCIL

KIRWANS BRIDGE REHABILITATION

KIRWANS BRIDGE- LONGWOOD ROAD, NAGAMBIE

CONCEPT DESIGN

TYPICAL PIER AND ABUTMENT FRONT VIEW AND ELEVATION (OPTION 3)

CLIENT PROJECT / DRAWING No	ISSUE STATUS	JJR PROJECT / DRAWING No	ISSUE
	FOR REVIEW	JJR-4220916B-ST029	A

Appendix E – Weighted scoring assessments for each option

Assessment Criteria	Criteria Weighting	Sub-Criteria / Inputs	Sub-Criteria Weight (%)	Input Score				Weighted Input Score				Weighted Criteria Score				Options Overall Score			
				Option 1	Option 2-1	Option 2-2	Option 3	Option 1	Option 2-1	Option 2-2	Option 3	Option 1	Option 2-1	Option 2-2	Option 3	Option 1	Option 2-1	Option 2-2	Option 3
				1	3	1	3	3	2	1	4	3	2	1	4	3	2	1	4
Bridge Safety	25%	Road User Safety	80%	10	6	7	10	8	4.8	5.6	8	25	13	15	25	64	66	67	57
		Pedestrian Safety	20%	10	1	1	10	2	0.2	0.2	2								
Bridge Performance	25%	Load	50%	10	6	6	10	5	3	3	5	21	13	14	25				
		Durability Characteristics	50%	7	4	5	10	3.5	2	2.5	5								
Whole of Life Costs	20%	Capital Costs (Construction)	80%	3	9	8	1	2.4	7.2	6.4	0.8	7	21	20	4				
		Maintenance Costs	20%	1	7	8	3	0.2	1.4	1.6	0.6								
Construction	10%	Constructability	100%	3	5	6	2	3	5	6	2	3	5	6	2				
Heritage	15%	Preservation of Historical Bridge	100%	5	9	8	1	5	9	8	1	8	14	12	2				

Appendix F – Cost Estimation

STRATHBOGIE SHIRE COUNCIL

Bill of Quantities
Summary

JOB No :	JJR-4220916B-SSC	**PREPARED BY :**	M. Jafari
JOB NAME :	KIRWANS BRIDGE	**CHECKED BY :**	M. Omidi
ISSUE FOR :	CONCEPT DESIGN COST ESTIMATE Rev.1	**ISSUE DATE :**	24-Jul-23

WBS	Description	Total Cost ($ exc GST)			
		OPTION 1	OPTION 2-1	OPTION 2-2	OPTION 3
1	Site Establishment	$481,600.00	$373,600.00	$373,600.00	$517,600.00
2	Demolition	$347,200.00	$86,800.00	$86,800.00	$347,200.00
3	Earthworks	$423,000.00	$98,000.00	$98,000.00	$423,000.00
4	Bridge Substructure	$6,663,411.12	$1,174,466.80	$1,222,472.80	$11,535,770.33
5	Bridge Superstruture	$7,167,398.00	$2,287,040.00	$2,894,587.92	$9,056,833.50
6	Others	$32,000.00	$122,000.00	$212,000.00	$32,000.00
	SUB-TOTAL =	$15,114,609.12	$4,141,906.80	$4,887,460.72	$21,912,403.83
	Contingency (20%) =	$3,022,922.00	$828,382.00	$977,493.00	$4,382,481.00
	Project Budget =	**$18,137,531.12**	**$4,970,288.80**	**$5,864,953.72**	**$26,294,884.83**
	Contractors Margin (10%) =	$1,813,760.00	$497,030.00	$586,500.00	$2,629,490.00
	Contractors Sell Price =	**$19,951,291.12**	**$5,467,318.80**	**$6,451,453.72**	**$28,924,374.83**

Appendix G – Review of Aesthetic and Environmental Factors of Kirwans Bridge

JJ RYAN CONSULTING PTY LTD

ABN 69 145 797 726
Ground Floor, 105 Highbury Rd,
Burwood VIC 3125
+61 3 9850 8979
www.jjryan.com.au

Our ref JJR-4220916B
Your ref CN 22/23-21

MEMORANDUM

Review of Aesthetic and Environmental Factors of Kirwans Historical Bridge	
Project Title:	Investigation, Assessment and Detailed Design of Kirwans Bridge
Project Code:	JJR-4220916B
Client:	Strathbogie Shire Council
Prepared by:	Atefeh Bakhshandeh, Mahsa Agharezaei
Date:	19-Jun-23
Approved by:	Dr. Leanne Sparrow
Date:	23 June 2023

1 Background

The historic Kirwans Bridge appears to be at the end of its service life and currently has a 3t load limit. Strathbogie Shire Council (Council) engaged JJ Ryan Consulting (JJR) to undertake an options investigation for the rehabilitation, replacement or other hybrid of the historical Kirwans Bridge (Bridge), located at Nagambie.

The Bridge was opened in 1890, is 310 metres long, of timber construction and is still used by vehicles to cross over Goulburn River. The original Bridge was constructed of timber in 1890, and then in 1957 the timber rectangular beams were replaced with steel RSJ beams.

To evaluate the most feasible option, a comparison report of options will be prepared, which will assess options against factors including, structural, performance, construction costs, safety, whole life operations, aesthetic and environmental factors as well as environmental issues.

2 Purpose

The purpose of this memo is to identify the aesthetic and environmental factors for consideration in the comparison of options for the Kirwans Bridge.

A desktop assessment was conducted to consider aesthetic and environmental factors in accordance with s171 of the Environmental Planning and Assessment Regulations 2021. The desktop assessment included consideration of the heritage significance and requirements for the historic Bridge, as well as an assessment of potential occurrence of significant flora and fauna that may be impacted by proposed works on the Bridge (subject site).

3 Location

The historical Kirwans Bridge was built over Goulburn River, which is located near the Nagambie township in central Victoria, approximately 110km north of Melbourne. The Bridge is in the Strathbogie Local Government Area (LGA), approximately 140 km northeast of Melbourne (Figure 1).

Figure 1 The location of Kirwans Historic Bridge within the Kirwans Bridge Locality
(Sourced: Google maps; accessed 19 June 2023)

4 Land Zones

The Bridge crosses Goulbourn River, which is located within the Public Use Zone (PUZ7) under Victorian planning scheme, with the Public Park and Recreation zone (PPRZ) adjoining on the western side of the Bridge (Figure 2). The land adjoining the bridge to the north and south are within a Farming Zone (FZ).

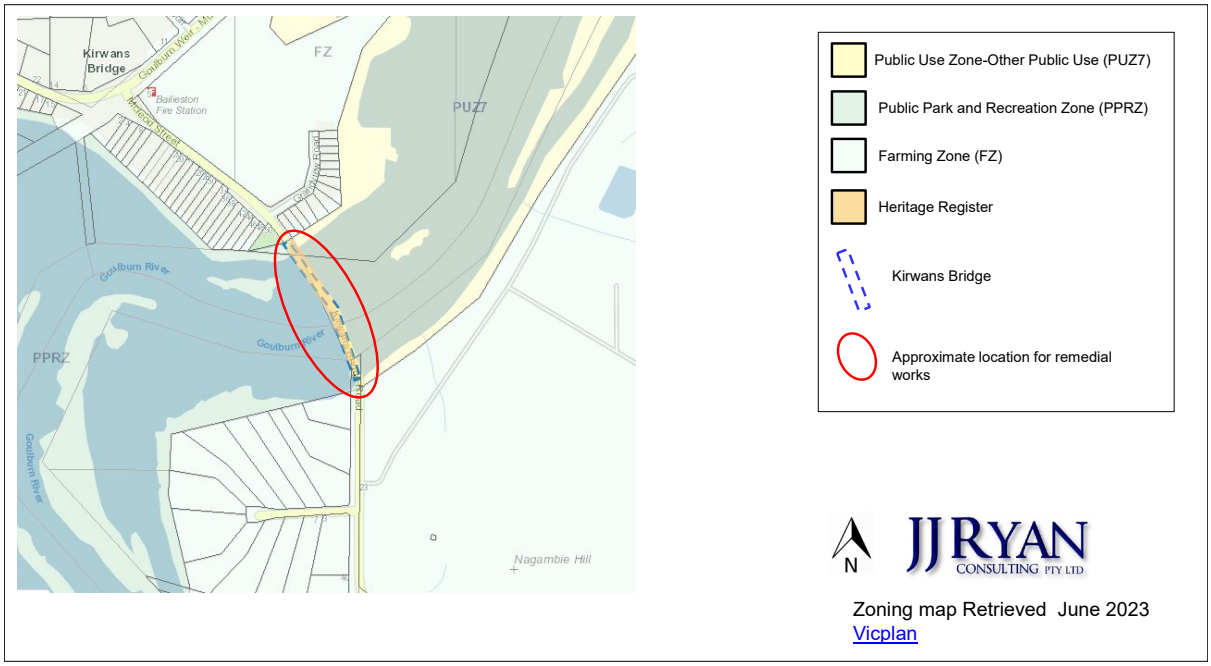


Figure 2 Land Zone around the Kirwans Historic Bridge
(Sourced: VicPlan; accessed 12 June 2023)

To provide the farming lands with Irrigation water sourced from Goulburn Weir Backwater services the surrounding farming lands. The east side of the bridge is located in PUZ7 zoning, which allows recreational activities, including fishing and boating activities.

5 Overlays

The Victorian planning scheme identified two overlays that affect the subject site, being a Heritage Overlay (HO) for the Bridge and a Floodway Overlay (FO) relating to Goulburn River (Figure 3).

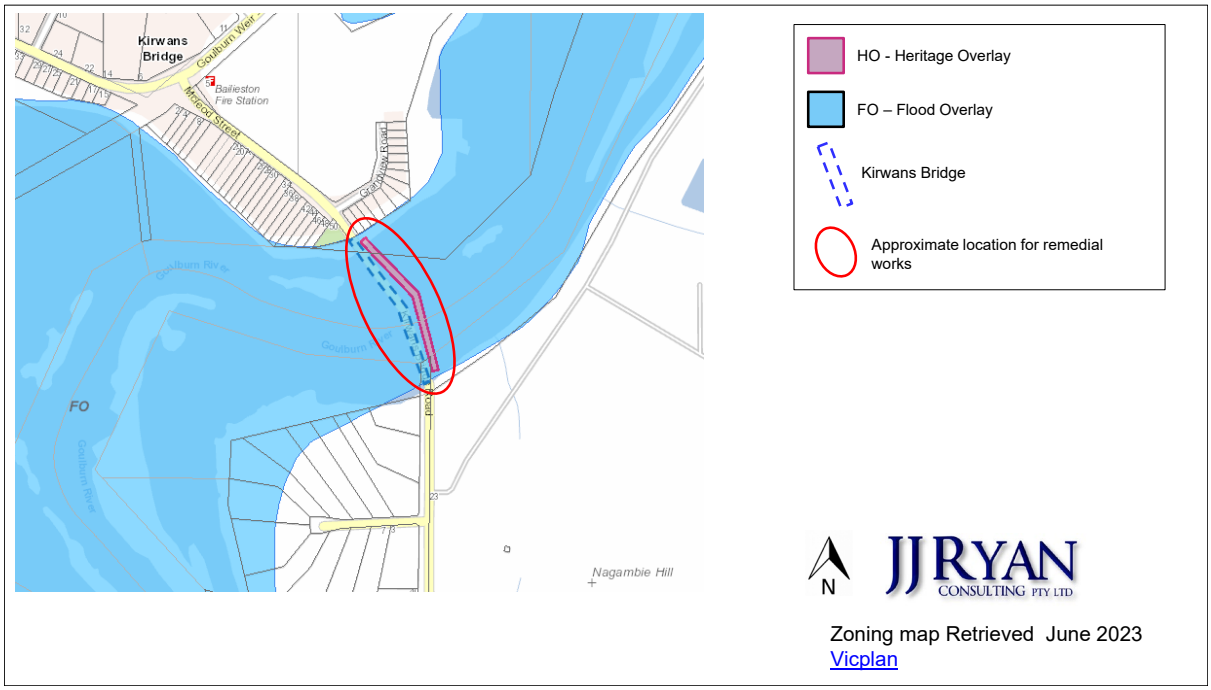


Figure 3 Land Overlays around the Kirwans Historic Bridge
(Sourced: VicPlan; accessed 14 June 2023)

The bridge is identified as HO26 under the Schedule to the Heritage Overlay in the Strathbogie Planning Scheme, which notes that the Bridge is listed as item Ref No H1886 on the Victorian Heritage Register, which is managed by Heritage Victoria under the *Heritage Act 2017*.

As the Bridge is locatd within FO, Melbourne Water consent will be required prior to submission of a planning development and buidling development applications.

6 Historical Importance of Kirwans Bridge

The Bridge is listed in the Victorian Heritage Register, as it is of State significance due to historic, scientific (technical), and aesthetic importance. A detailed heritage report generated by the Victorian Heritage Database is at Attachment 1.

The historic significance relates to the Bridge being built in association with the construction of the Goulburn Weir, which was the base of Alfred Deakin's "National" irrigation system. The large size of the Bridge, with its timber structure and continued operation since 1890 contributes to its historic importance.

The Bridge is of scientific (technical) importance, being one of two remaining timber bridges in Victoria that has retained a component of its colonial, strutted-corbel type of bridge design, which presents a unique opportunity to view an example of historic European bridge construction. To date, the Bridge is shown to also be an engineering example of successfully adapting the structure to changing vehicle needs that has supported the community needs for more than a century.

The aesthetic significance of the Bridge relates to timber being the primary construction material, the length and shape of the structure associated with its position above Lake Nagambie presenting a unique aesthetic level that has unique value in Victoria.

6.1 Heritage Permit Requirement

The Bridge is a State listed heritage structure and is managed by Heritage Victoria under the *Heritage Act 2017*. A Heritage Permit is required for any proposed works that may harm the heritage significance of the structure or propose construction of a new bridge, unless the works are covered by either general or specific exemptions.

The general exemption applied to the Bridge is to allow minor repairs and maintenance which replace like with like.

There are five (5) specific exemptions that apply to the bridge detialed in Attachment 1. It is noted that specific exemptions include:

- Reconstruction of the bridge to plans and specifications approved by the Executive Director of Heritage Victoria; or
- Works undertaken in accordance with a conservation policy and plan approved by the Executive Director.

New construction or reconstruction works will require a permit obtained from Heritage Victoria unless specific exemption is satisfied by obtaining approved plans and specifications or conservation policy by the Executive Director.

7 Threatened Environmental Species

JJR conducted an environmental desktop assessment using EPBC Protected Matters Search Tool (PMST) with a 1km buffer to the subject site. The PMST report was generated to investigate the likely occurrence of national significant biodiversity values at the subject site.

The full PMST report is at Attachment 2 and details whether species or species habitat presence is known to occur, may occur, or is likely to occur within the feature area (subject site) or buffer.

In summary a total of 29 national threatened or significant fauna species are likely to occur within 1 km of the subject site (feature area in the PMST), being 17 bird species; 3 fish species; 2 amphibian species; and 1 species of mammal, reptile and insect.

A total of four national vulnerable flora species were identified to likely occur within 1km of the subject site, being *Amphibromus fluitans* (River swamp wallaby-grass); *Glycine latrobeana* (Clover glycine); *Senecio macroarpus* (Large-frult fireweed); and *Brachyscome muelleroides* (Mueller daisy). A national recovery plan is approved for all vulnerable species, except the River swamp wallaby-grass, which has a regional priority recovery and threat abatement action plan.

The disturbance to land adjoining the Bridge for farming purposes is likely to result in unsuitable environments for the likely occurrence of the abovementioned vulnerable flora species. However, the subject site is located within the Victorian Riverina bioregion, which is likely to be intact along the Goulburn River embankments, with potential suitable habitat for the abovementioned vulnerable flora species may occur, including in vicinity of the Bridge.

8 Aesthetic Factors

The aesthetic importance of the Bridge has historic significance to the State and is a tourist attraction to the region. The unique position and construction materials compliments the surrounding environment and is a positive attribute to the local amenity.

It is anticipated that community and stakeholder consultations will be required prior to any major construction works or construction of a new bridge in its place. Consultations may be suitable to

undertake as part of a submission for approval from the Executive Director of Heritage Victoria (refer to section 6.1).

9 Conclusion and Recommendation

Investigation of options for the rehabilitation, replacement or other hybrid of the Bridge will need to consider the aesthetic and environment factors listed above, including the heritage importance of the Bridge. The permits, approvals and surveys that may be needed, depending on the preferred feasible option are:

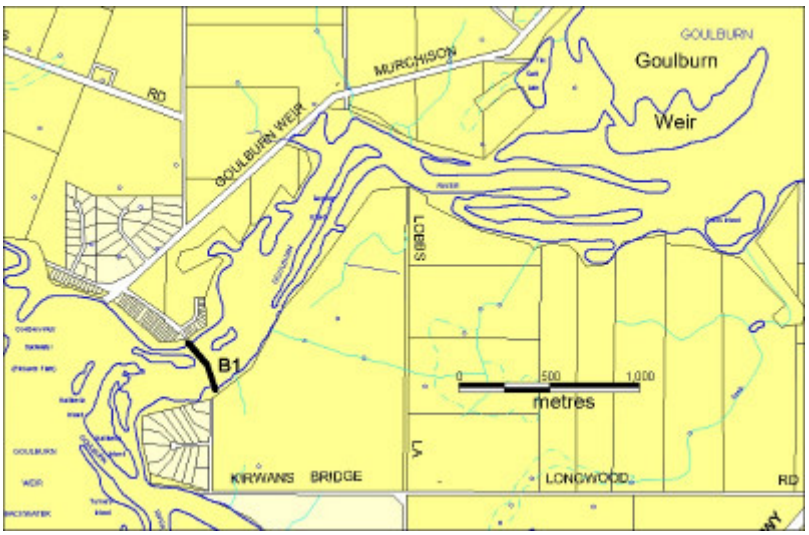
- Heritage Victoria permit or as an approval by the Executive Director under specific exemptions (refer section 6.1);
- Melbourne Water permit (refer section 5)
- Planning and building approval from Strathbogie Shire Council;
- Flora and fauna assessment, including field inspection to evaluate presence of threatened species and remnant native vegetation.

ATTACHMENT 1 – VICTORIAN HERITAGE DATABASE REPORT FOR KIRWANS BRIDGE

KIRWANS BRIDGE

KIRWANS BRIDGE SOHE 2008

1 kirwans bridge bailieston



Plan

Location

OVER GOULBURN RIVER, KIRWANS BRIDGE-LONGWOOD ROAD KIRWANS BRIDGE, STRATHBOGIE SHIRE

Municipality

STRATHBOGIE SHIRE

Level of significance

Registered

Victorian Heritage Register (VHR) Number

H1886

Heritage Overlay Numbers

HO26

VHR Registration

July 20, 2000

Heritage Listing

Victorian Heritage Register

Statement of Significance

Last updated on - April 27, 2000

What is significant?

The 310 metres long Kirwans Bridge is situated over the Goulburn River at Bailieston near Nagambie. It was opened in 1890, and is still in use for (one-way) motor traffic. The only comparable timber bridge in Victoria in terms of length is the 1927 Barwon Heads Bridge which is 308 metres long. In 1955 the bridge was modified by the construction of a new superstructure, in which its timber beams were replaced by RSJs, and its deck narrowed to single lane, with passing bays maintaining the full 21 feet (6.3 metres) original width. The bridge retains its original forty-eight spans of sixteen and a half feet (5 metres), and its original seven main river-channel spans of thirty-three feet (10 metres). Its tall timber trestles are largely immersed under Lake Nagambie. Remnants of its original squared beams and strutted corbels - one of only two remaining examples in Victoria - are clearly visible beside the bridge.

The bridge features a dramatic mid-stream bend, and is also unique in its incorporation of two vehicle passing-bays. It is set at the northern arm of Lake Nagambie, a very popular boating and fishing venue close to Melbourne. The distinctive and imposing nature of the bridge has seen it feature in State-wide commercial and social promotions.

How is it significant?

Kirwans Bridge is of historical, scientific (technical) and aesthetic significance to Victoria.

Why is it significant?

It is of historical significance as a work directly associated with Alfred Deakin's dream of a great 'National' irrigation system based upon the construction of the Goulburn Weir. Consequently, with nearby Chinamans Bridge, it was built entirely with Victorian government funds, a factor in its large size. When opened in 1890, it provided access to Nagambie and the railway for the mining areas of Bailieston and Whroo. So significant was the access to Nagambie it provided for those living on the west of the Goulburn River that a threat to the bridge's continuing future in the mid-1950s led to a municipal secession movement that enlarged the Shire of Goulburn at the expense of Kirwans' original builders, the Shire of Waranga. The current narrowed timber deck with passing bays, supported by rolled steel joists placed over the ancient piers, remains a memorial to that municipal protest. It is one of Victoria's very oldest timber road bridges still in operation; very few are earlier. Kirwans Bridge is also one of a unique group of four large timber road bridges from the 1890s, of contrasting types, located on the Goulburn River between Seymour and Murchison; this is the last remaining group of large old timber river bridges in Victoria.

It is of scientific (technical) significance as one of only two extant Victorian timber bridges retaining vestiges of a colonial 'strutted-corbel' type of river-bridge design. Only at Kirwans Bridge and the Jeparit Bridge is it now possible to study examples of this historic European form of timber-bridge craftmanship. Although its visual effect is not greatly different from that of the equally rare and historic 'strut-and-straining-piece' design of nearby Chinamans Bridge, the detail and mechanics of the stringer-support system are structurally different. Kirwans Bridge also provides a remarkably successful example of engineering adaptation to changing vehicle needs over more than a century. It has an exceptionally long timber deck; no road bridge in Victoria is longer.

It is of aesthetic significance as a predominantly-timber structure whose exceptional length is accented by full timber side-rails, and which features a pronounced mid-stream bend and unique vehicle passing-bays. This aesthetic quality, unique in Victoria, is accentuated by the bridge's setting just above the broad waters of Lake Nagambie.

Permit Exemptions

General Exemptions:
General exemptions apply to all places and objects included in the Victorian Heritage Register (VHR). General exemptions have been designed to allow everyday activities, maintenance and changes to your property, which don’t harm its cultural heritage significance, to proceed without the need to obtain approvals under the Heritage

Act 2017.
Specific exemptions may also apply to your registered place or object. If applicable, these are listed below. Specific exemptions are tailored to the conservation and management needs of an individual registered place or object and set out works and activities that are exempt from the requirements of a permit. Specific exemptions prevail if they conflict with general exemptions.
Find out more about heritage permit exemptions here.
Specific Exemptions:
General Conditions:
1. All alterations are to be planned and carried out in a manner which prevents damage to the fabric of the registered place or object.
2. Should it become apparent during further inspection or the carrying out of alterations that original or previously hidden or inaccessible details of the place or object are revealed which relate to the significance of the place or object, then the exemption covering such alteration shall cease and the Executive Director shall be notified as soon as possible.
3. If there is a conservation policy and plan approved by the Executive Director, all works shall be in accordance with it.
4. Nothing in this declaration prevents the Executive Director from amending or rescinding all or any of the permit exemptions.
5. Nothing in this declaration exempts owners or their agents from the responsibility to seek relevant planning or building permits from the responsible authority where applicable.

Exemptions:
* Minor repairs and maintenance which replace like with like.
* reconstruction of the bridge to plans and specifications approved by the Executive Director
* Emergency and safety related works.

Construction dates	1890,
Heritage Act Categories	Registered place,
Hermes Number	6067
Property Number	

History

INFORMATION SUPPLIED IN SUPPORT OF NOMINATION BY NATIONAL TRUST
During the 1880s Alfred Deakin enthused Victorians with a dream of the potential agricultural bonanza that could be created by using irrigation to transform the fertile but arid Murray-Goulburn plains into dairies and orchards. Central to Deakin's vision were weirs across the impetuous Goulburn River, to dam its melting snows and transform this ancient waterway which periodically and destructively inundated large areas of low-lying farmland, into an economically fruitful irrigation channel. Deakin's irrigation visions involved a big weir below Nagambie, which could be used to create vaste artificial lakes beloved of campers and fishermen today. (On Deakin and irrigation, see Australian Dictionary of Biography, vol. 8, 'Alfred Deakin'; for Deakin's comments on the Goulburn River situation, see P. B. F. Alsop, 'Bridges Over The Goulburn River at Nagambie, Victoria', (unpublished paper) Geelong, Victoria, February 1991.)

Kirwans Bridge, and nearby Kerris (Chinamans) Bridge built by the Goulburn Shire at the same time, were unusual in being built by rural municipalities entirely from State funding, as compensation for flooding of local traffic facilities by the new Goulburn Weir. These big bridges had to be built quickly, because of the near-completion of the impressive weir that would submerge previous roads and bridges connecting the south-east of the Waranga Shire hinterland with Nagambie.

By mid-1889 a sense of strident urgency coloured correspondence between Victoria?s State Water Supply Department and the adjacent shires of Goulburn and Waranga, which had long been at war over problems in bridging their shared municipal boundary: the formidable Goulburn River. The shires were warned that with the weir expected to be completed by year?s end, many ratepayers would be isolated when their earlier 'lifeline' (Kettles Bridge near Nagambie) was inundated. Such a 'National Work' could not wait on municipal bickering, and the Water Supply Department threatened to take the bridging of the swollen Goulburn River into its own

hands. (Rushworth Chronicle, 24 May 1889)

Faced with the unpleasant prospect of losing control of large sums of State compensation for road and bridge building in areas soon to be flooded, the shires stopped their traditional warring over bridges and agreed on a need for two large bridges to replace Kettle's Bridge. They also agreed that they needed very large sums of State money. Wrangling between the shires temporarily ceased, while arguments between municipalities and State Water authorities over estimated costs increased, and the weir wall crept ever-closer to completion.

That the need for two large and expensive bridges was quietly conceded by State authorities, indicates that they were keen to reach an agreement which absolved them from any future bridging liabilities. Waranga Shire based on Rushworth was intent on getting as much State funding into the municipal coffers as possible. Their big bridge over the Goulburn to replace Kettles was seen as benefiting long-term Nagambie rivals, but it was also a convenient tool to lever money from State authorities: money which they hoped to use more widely. Waranga Shire insisted that in bridge construction 'too many cooks spoil the broth', so it was agreed that Waranga take responsibility for constructing Kirwans while Goulburn handled the construction of Kerris (Chinamans) Bridge a few miles upstream. (Goulburn Advertiser, 6 Sept. 1889) By mid-1889 the race was on for first picking at the shared pool of State funding.

A joint municipal delegation had fraternized with uncharacteristic amiability as its members bumped over submerged logs and sandbars along the Goulburn River on the Nagambie-based paddle steamer, Agnes, inspecting possible bridge sites and sharing riverside victuals and local wine. There were three possible sites for the more northerly of the two new bridges, and the State Water Supply Department's engineer favoured the middle site which was one and a half miles north of Kirwans. However, a majority of local residents appeared keen to spend their government booty at Kirwans, probably unaware of just how wide the flooded weir would be at that point, and of the extent of road cuttings needed to link this bridge with the earlier road from 'Kettles' to Nagambie. (Rushworth Chronicle, 24 May 1889) With Rushworth's municipal authorities intent on building a case for extorting as much government funding as possible, such 'difficulties' passed unnoticed. Meanwhile, State authorities used the columns of Melbourne's Argus newspaper to publicize their view that '... the local bodies wish for a greater expenditure than the official engineer deems necessary.' (Goulburn Advertiser, 5 July 1889, citing Argus 1 July 1889)

The municipalities eventually agreed to depart from their costing of 40,000 pounds, as against the State's costing of 10,000 pounds, and by late 1889 all had agreed on a joint compensation sum of 17,000 pounds (Goulburn Advertiser, 6 Sept. 1889). Ten thousand pounds was allocated for the two bridges and their road approaches (Goulburn Advertiser, 25 Oct. 1889) (although Rushworth-based councillors soon decided that costly road-cuttings over the river were not 'bridge approaches', to Nagambie's dismay). Privately, Waranga's councillors rubbed their hands in glee in the belief that any 'surplus' from the State booty was theirs: as yet unaware that bridge contractors faced with frightening risks from an ever-rising weir wall and unpredictable winter and spring rainfall, along with a nasty and close 'deadline' when the weir eventually filled, would tender high.

Although compelled to publish all tenders for projects funded by ratepayers, Waranga councillors were extremely secretive about State-funded projects. Not even the Shire Minutes could be trusted with tendering details for Kirwans Bridge. However, in September 1889, councillors noted that their original bridge claim had been drastically cut by State authorities, while the State Water authorities simultaneously approved the Shire's original expensive bridge plans (Goulburn Advertiser, 6 Sept. 1889). Plans for the new bridge would be available to potential contractors at Rushworth's Shire Hall from 1st October 1889, and a preliminary notice that tenders would be called in two months was to be published in the local press and Melbourne's Argus and Age. A joint meeting of neighbouring shire representatives late in October had lost any signs of the amiability expressed while sailing the Goulburn on Nagambie's paddle steamer, and drinking Nagambie wine.

Waranga's delegates were jealous of Goulburn's big sum for bridge building, since they considered Kerris (Chinamans) an 'optional extra' funnelling even more Waranga ratepayers into Nagambie. As problems piled up, the tendering process was delayed, and in November Waranga councillors threatened to hand the problem back to State water authorities (Goulburn Advertiser, 25 Oct., 8 Nov., 1889). Meanwhile, the Nagambie Steam Navigation and Sawmill Company, proprietors of the good ship Agnes, sent a solicitor's letter to the Waranga Shire indicating that their bridge plans allowed inadequate waterway for river steamers, and that unless greater waterway were provided they would intervene at law to prevent bridge construction (Goulburn Advertiser, 6 Dec. 1889). Rushworth had no objection to expensive 'drawbridges' for river boats, provided that Nagambie paid.

Meanwhile, councillors at Nagambie pondered Rushworth's plans for Kirwans, and decided (since there were expensive road-cuttings on their side of the river) that the actual bridge structure was unnecessarily expensive.

Goulburn's Shire Engineer was accordingly instructed to modify Waranga Shire's plan, and send it back to them (Goulburn Advertiser, 6 Dec. 1889). Waranga councillors never complained about cheaper plans, and early in January the State Water authorities acknowledged receipt of altered specifications and drawings for Kirwans, noting that 'the alteration on land spans from 33 feet to 16 feet 6 inches should materially reduce the cost of the bridges'. Thus did Kirwans depart from its original vision as a large timber bridge of totally 'strutted-corbel' construction, to one where strutted-corbel construction would be reserved for the main river channel of the new weir situation. The fact that Kerris (Chinamans) plans escaped retaliation from Rushworth's councillors can largely be explained by the fact that Goulburn councillors did not show Waranga councillors their plans until after tenders were accepted! Thus Chinamans remains today a fully-strutted structure (Public Record Office, Laverton, VPRS 3908, UNIT 4, P. 506).

'Cheaper' plans notwithstanding, Waranga councillors were shocked by the costings of tenderers for the Kirwans job. Tenderers' fears of risks and complications from ever-rising waters as the weir wall progressed were not unfounded, and the first contractor for Kerris (Chinamans) gave up and forfeited his plant when his piles disappeared under winter waters in 1890. The original tenders for Kirwans being considered outrageous, new tenders were called returnable at Rushworth on 20th January, and a special (and highly-secretive) meeting of selected Waranga councillors considered tenders that day. Although no tender details were confided to the Minutes, the record suggests that only one (compromise?) tender was received at this meeting, and its acceptance was delayed while councillors sought to get reassurance from State water authorities that extra costs would be picked up in Melbourne. State authorities were now desperate to get bridges up before the weir was completed, and a telegram from the water authority's Chief Engineer early in February reassured councillors that he had advised the Minister to provide the extra funding needed for Kirwans (P.R.O. Laverton, VPRS 3908, unit 4, p. 519; Goulburn Advertiser, 24 Jan., 7 Feb. 1890).

Thus reassured, Waranga councillors gave contractors Dainton and Hesford the job, and the race for government funds was on in earnest as Kerris (Chinamans) also proceeded under Nagambie supervision. Contractor Dainton asked to be allowed to use (local) hewn timber instead of sawn timber for stringers, corbels and gravel beams, 'to expedite the work'. Councillors considered hewn timber as good as (if not better) than sawn, and this meant work for shire residents rather than importing sawn timber into the shire (Goulburn Advertiser, 7 Feb. 1890). No indications are given as to timber used, but decaying stringers visible beside Kirwans today look like red gum. With cost-cutting and speed of construction the orders of the day, this should not surprise, red gum being ready to hand near the river and iron bark from Whroo forest (for such a large structure) being considerably more expensive in terms of government royalties and wages for working.

Although some locals questioned the quality of bridge piles being used at Kirwans, talking of 'plugged' piles and knot holes, this bridge contract went ahead by leaps and bounds while the contractor up-river at Kerris tore his hair because of his inability either to get sufficient high-quality bridge-timber on credit, or to get adequate 'advances' from Goulburn Shire to buy timber. Goulburn councillors showed signs of panic as the 'vouchers' for payments to Waranga's contractor (totalling several thousands of pounds) steadily rolled in for signature, while their own bridge piles were under the Goulburn River's apparently ever-rising waters and work on Kerris (Chinamans) at a standstill.

Whereas Kerris bridge appears today to have an obvious function in connecting major centres like Nagambie and Heathcote and old mining centres like Costerfield and Graytown en route, the purpose of the big and expensive bridge at Kirwans in 1890 is now less obvious. In 1890 Kirwans was described as being at Bailieston, then a mining and postal township with two booming hotels. Although within Waranga Shire, the township was associated with Nagambie rather than Rushworth, travellers thence being advised to take a train to Nagambie and catch the coach for a final nine-mile stage over Kettle's (later, Kirwans) Bridge. Bailieston's little populace largely depended on antinomy and quartz mining. Further along the road and more associated with Rushworth was the gold-mining township of Whroo, with its post office, savings bank, three hotels, one church (for the sober of all denominations), mechanics' institute and free lending library. Whroo still claimed to indulge in alluvial as well as quartz mining for gold, and was proud of its rich Balaclava Hill claim. Travellers to Whroo were advised to entrain to Rushworth, and board the coach thence (Victorian Municipal Directory, 1891, pp. 510-11).

The coming of the railway to link Rushworth with Nagambie had already taken away much direct traffic that had earlier traversed rough bush tracks between Nagambie and Rushworth. Obviously, miners and farmers across the river to the north-west of Nagambie, depending on Nagambie for supplies and market links, considered the bridge to be vital. With the railway link no longer available, the road through Bailieston by Reedy Lake and the Whroo ironbark forest and mining relics to Rushworth, now provides an interesting tourist route for people not in a hurry. In 1890 that connection with the timber riches of Whroo forest remained important for Nagambie district, especially when bridges needed to be constructed.

Waranga councillors visited the Kirwans site in May 1890, and expressed surprise at the 'splendid progress'.

Nearly all piles were driven, and in the main river-channel section the whole substructure was complete with tie-beams firmly bolted 'so that no ordinary flood can now interfere with the completion.' Doubtless, the contractors were relieved (Goulburn Advertiser, 23 May 1890). Among rare relevant surviving documents that I have located in Water Supply Department archives, is a telegram from Rushworth saying that money due for works at Bailieston has not arrived, terminating with a big 'Why?'. Nagambie-based councillors hinted at illicit 'influence'behind the scenes, with Rushworth apparently in line for big cash input from Melbourne while their own bridge works were hopelessly inundated. Kirwans would be completed by 8th of November, 1890.

Despite modifications to suit a trimmed budget, the completed Kirwans Bridge was an impressive sight. It was reported to be 1225 feet long, with 48 openings of sixteen feet six inches over what had previously been dry land, and seven 'strutted-corbel' spans of 33 feet covering the old river channel. These span dimensions do not 'add up' to the stated deck length and the correct figure was presumably 1025 feet, or approximately 308 metres, which equates with current reality. Thirty-six piles, each of sixty-feet length, were used in the main river channel section. The neatly squared stringers measured sixteen inches by fourteen inches by 36 feet length in the main channel section. Long squared corbels were of sixteen-inch by twenty-two inch timber, and the iron fastenings, bolts and spikes used in the structure weighed twenty tons. The bridge was twenty-one feet wide and its transverse decking of nine-inch by six-inch planking was designed for heavy wagons and steam traction engines (Nagambie Times, 7 Nov. 1890). By modern engineering standards, Kirwans Bridge was certainly not 'underbuilt' for its expected loadings. The completion was just in time, because by December 1890 weir waters were rising to normal irrigation levels and covering the ancient river flats at Kirwans.

Waranga Shire councillors at Rushworth were not happy when the Water Supply Department informed them in November 1890 that they would get eleven thousand pounds, and that the remaining six thousand pounds of the joint fund was being reserved for Goulburn Shire to complete its big road-cutting down to Kirwans Bridge, and to pay the second contractor at Kerris (Chinamans) Bridge in a more difficult and expensive bridge-construction project at that soon-to-be-flooded site. Cr Brisbane contended that the Water authority had 'gone back on its word', while Cr Healy continued to complain that Goulburn Shire was 'getting more than it ought'. Cr Mason was more philosophical, commenting that 'the increased cost of the bridges had put the calculations out a little' (Nagambie Times, 21 Nov. 1890). The long-anticipated 'surplus' of government funds had evaporated at Rushworth, while rivals across the river at Nagambie who had always known there would be no 'surplus' were now concerned to minimize their losses on their own disastrous bridge project.

When the biggest flood on the Goulburn since the legendary 'monster' of 1870 hit, in September 1916, distant Reedy Lake would be joined to the Goulburn River by a surging inland sea, and Waranga Shire's approaches to both bridges would be decimated. 'Chinamans' stood defiant, apart from minor damage to timber wing walls and badly scoured approaches, but Kirwans was a sorry sight with its proud strutted-corbel river spans sagging towards the water where the sixty-feet piles had been undermined by scouring. It was a nasty sight for residents of Bailieston and district, and for Waranga councillors.

Old residents hotly debated whether the new flood exceeded the 'whopper' of 1870 that had decimated bridges throughout the area. But Goulburn Weir had not been there in 1870, and the impeded flood waters on the morning of Tuesday 26 September 1916 were piled high above the weir wall, only the tops of its electric-light standards being visible. Only when the surging waters had dropped again was it possible to see the havoc wreaked upon Kirwans' timber structure, and all traffic was diverted over Kerris (Chinamans) Bridge which had quick repair works performed on its battered approaches (Nagambie Times, 29 Sept., 6 Oct. 1916). Because the extent of damage by erosion of pier foundations was invisible below the waters, initial estimates of repair costs (in the vicinity of three hundred pounds) were unrealistically low.

Local councillors had initially assumed that Kirwans (like Kerris nearby) was by then the responsibility of the recently-formed Country Roads Board, with its access to State funding. However, with railways linking Nagambie to Rushworth, the Board did not consider the old miners' route to Bailieston and beyond a 'Main Road' deserving of State funding. Councillor Gordon of Goulburn Shire had political influence, and he suggested in October 1916 'that this was a case in which they might well approach the Government for assistance'. It was moved that Councillor Gordon and Goulburn Shire's President wait upon the Minister for Public Works in this matter, and that Waranga Shire be asked to send representatives (Nagambie Times, 13 Oct. 1916).

Kirwans Bridge had a gravelled surface over its heavy timber decking, because in 1916 'fully half of the gravelled track' was swept off. The real damage, however, had occurred at the big bend in the 'v' shaped deck of Kirwans, sixty to seventy feet of the timber superstructure having collapsed due to scouring of the old river channel below. Waranga Shire seemed initially much less concerned about the bridge that they had built, than did Goulburn Shire neighbours. As late as 12th November, Councillor Gordon of the Goulburn Shire stated that the proposed visitation upon the Minister in search of State funds had been postponed, because Waranga

Shire's Engineer had not yet inspected the damage and estimated repair costs. Waranga Shire's President had been contacted to impress upon him the urgency of repairs (Nagambie Times, 17 Nov. 1916). Waranga ratepayers having to make the long detour around by Kerris (Chinamans) to Nagambie were doubtless impatient with Rushworth's leisurely approach.

In 1916, however, Kirwans Bridge was still situated on the river boundary line between the two shires, and Waranga Shire could not avoid responsibility. Eventually, at a meeting of Waranga Shire on 14th November, 1916, a motion was passed that the President be appointed to join the Goulburn Shire's representatives in waiting upon the Minister for Public Works, to ask for a State bridge-repair grant. With heavy rains continuing to fall, the sagging structure at Bailieston was deteriorating, but only at this meeting was Waranga's Engineer formally instructed to confer with Goulburn's Engineer at Kirwans. By December councillors at Rushworth were beginning to take notice, fearing they would lose much of the bridge's structural timber that was now swinging perilously close to water. However, Waranga's Engineer had still not inspected the damage. With the bridge urgently needed to handle the coming harvest, it was suggested that cables be strung below the superstructure, to allow vehicle passage. But the damage was more serious than then realized (Murchison Advertiser, 17 Nov., 8 Dec. 1916.)

On 13th December, a joint deputation that included Waranga Shire's Engineer and John Gordon M.L.A. waited upon the Minister for Public Works, who appeared sympathetic and promised to send an engineer from his department to assess the damage, and on receipt of this official report to favourably consider the request for State aid. The engineer from Melbourne arrived on 3rd of January 1917. A Waranga Shire meeting on 2nd of January had decided that, should agreement be reached with the State authorities, tenders for the bridge's reconstruction could be called at its next meeting pending the Government's decision on the extent of financial assistance. State authorities obviously realized the urgency of repairs, to avert more expensive works later, and by early February had offered one hundred and eighty seven pounds conditional upon the shires contributing like amounts (Nagambie Times, 15 Dec. 1916; Murchison Advertiser, 5 Jan., 9 Feb. 1917).

The extent of replacement timbers required is indicated by the size of the initial tenders for 'supply and delivery of piles and sawn or hewn timber for Kirwans bridge, near Nagambie', that of local timber-cutter J. T. Hipgrave for two hundred and twenty seven pounds and fifteen shillings being the lowest received. Hipgrave's separate quotation for 'timber work and repairs to Kirwans bridge' was also easily the lowest received, at two hundred and fifty three pounds and ten shillings, and he was given the job (Murchison Advertiser, 9 Feb. 1917). By April the real nature of the disaster at Kirwans became more obvious, as pile-driving got under way. Despite increasing the length of piles over those first ordered, thus increasing costs, 'there appears to be no hard bottom at all, even at 25 feet driven depth.' With the alluvial banks of the old river channel saturated in irrigation water for decades, any 'bottom' that the 'dry-land' contractor of 1890 might have claimed to find had apparently disappeared.

The vibrations of a four-ton donkey engine seated upon the 'firm' structure for pile-driving purposes, caused two apparently sound timber piers to 'settle' alarmingly. To allay this damage would cost a further one hundred and fifty pounds, but councillors were warned that unless they did it while machinery was on site, it would cost much more. They must have rued the day that they accepted State funds for this bridge's construction, to allow their farmers and miners easy access to Nagambie. Their engineer advised finding even longer piles to strengthen the main-channel piers. Goulburn Shire's representatives meeting at Nagambie remained keen to maintain access from the Waranga hinterland to their town centre, and readily agreed to additional contributions (Murchison Advertiser, 6 Apr. 1917, Nagambie Times, 20 Apr. 1917).

It seems likely that at least the longest piles used in reconstruction were red gum, since they were imported from Murray River forests near Cobram. Shorter and medium-length piles were obtained locally, and we have no indication of the timber used (apart from the fact that Waranga Shire's engineer favoured local iron bark over red gum, generally). The need to await timber 'imports' held up repairs, but by 3rd of July 1917 (more than nine months after the damage occurred) Waranga Shire's engineer could report that repairs were completed and that Kirwans Bridge was again open to traffic. The coach to Bailieston could henceforth avoid its long enforced detour around via Kerris (Chinamans) Bridge (Murchison Advertiser, 8 June, 6 July 1917).

Despite fears that Kirwans was a sitting-duck for the next big wash along the Goulburn, the reconstructed bridge gave long and satisfactory service through the troubled eras of Great Depression and World War 2, and was still coping with its traffic loads in the early 1950s when rural Australia's economy was revolutionized by American stock-piling of Australian wool for Korean War purposes. Virtually overnight, large American sedan cars appeared in farming areas to replace the battered old Chevrolet, Dodge or Ford touring cars of the 1920s. Farmers could now afford large new trucks and tractors and farm machinery, and ageing pre-war roads and bridges that had lacked proper maintenance through the long war years felt the impact. Any surviving original timber stringers in Kirwans Bridge would have been sixty-three years old in 1953: a great age for timber bridge

components in a moist weir environment. The big hewn red gum stringers in the similarly-aged bridge across the Goulburn River at Seymour had been replaced by rolled steel joists in 1933.

At a meeting of Waranga councillors at Rushworth in January 1953, 'Cr. Keily asked what was the position in regard to Kirwans bridge and the proposed deputation to the Minister of Public Works.' Councillors decided to arrange a deputation to the Minister (P.R.O., Laverton, VPRS 3908, unit 20, 8 Jan. 1953, p. 265). Waranga councillors sitting at Rushworth had always felt that Kirwans Bridge benefited Nagambie rivals, and the intervening years had not been kind to mining interests of settlements like Bailieston and Whroo. By 1953 Whroo was just another Victorian 'ghost town', and Bailieston was more interested in sheep and wool than antinomy and gold.

If Waranga councillors meeting at Rushworth had not shown any sense of urgency when flood waters devastated Kirwans Bridge in 1916, they appeared positively bored when local ratepayers indicated that Kirwans needed serious repairs in 1953. Nagambie had long been maintaining the trafficability of Kirwans. A Waranga Shire meeting in February 1953 moved that, before approaching the Minister of Public Works, council representatives should confer with Goulburn councillors. Goulburn representatives were asked to attend the next monthly Waranga Shire meeting at Rushworth, but it seems that they may have been taking initiatives of their own. They thanked Waranga Shire for the invitation to parley, 'but in view of the inspection by members of the Country Roads Board of Kirwans Bridge on 11th of February 1953, consider visit should be postponed' (P.R.O. Laverton, VPRS 3908, unit 20, 3 Feb. 1953, p. 272; 3 March 1953, p. 279).

Representatives of both interested shires were present when C.R.B. officers inspected Kirwans Bridge, and the C.R.B. requested the two shire engineers to make a thorough inspection and submit reports on estimated repair costs. C.R.B. officials were sufficiently concerned to suggest an immediate load limit, so signs limiting loads to thirty hundredweight were set up. On giving the bridge a closer inspection, the two local engineers seem to have been positively alarmed, so Goulburn Shire decided to close the bridge. Waranga Shire was consulted, and after hearing its engineer's comments decided that 'both ends [were] to be substantially fenced' to keep traffic off. It appeared to residents of Bailieston and district that Rushworth was simply wiping its hands of local bridging problems. Tradition has it that locals helped themselves to timber from the ageing structure, convinced that its death warrant had been signed. By mid-July, 1953, the bridge had been fenced off and warning notices erected (P.R.O. Laverton, VPRS 3908, unit 20, 3 March p. 279, 4 Aug. 1953, p. 323).

In October a letter from a Nagambie resident to Waranga Shire pointed to the sad state of the roads in the Goulburn Weir area under Rushworth control: 'He thought it would be to the advantage of the Council if some announcement was made regarding proposed repairs to Kirwans Bridge as press reports so far indicated that the Goulburn Shire was doing all the work in this regard' (P.R.O. Laverton, VPRS 3908, unit 20, 6 Oct. 1953, p. 340). Sporadic grading by Rushworth authorities did little to quieten growing local feeling against the Shire of Waranga.

By January 1954, Waranga Shire was receiving correspondence from a body calling itself the Waranga and McIvor Severance Committee. McIvor Shire authorities shared with Goulburn Shire the responsibility to maintain the other ageing Goulburn River bridge upstream at Mitchellstown, and they were affected by a growing desire throughout the Goulburn Weir area to strengthen links with Nagambie. The Severance Committee wanted Waranga councillors to pursue the earlier idea of meeting with Public Works authorities to discuss the bridge problem, and Rushworth was agreeable provided that C.R.B. authorities were advised of the date of the suggested conference (P.R.O. Laverton, VPRS 3908, unit 20, 7 Jan. 1954, p.364).

In February 1954 Waranga Council received legal correspondence from the new Severance Committee, asking whether it was in favour of annexation of its south-east section to Goulburn Shire. Rushworth councillors denied knowledge of any severance movement. By that time their ratepayers in the vicinity of the Goulburn Weir had lost all patience with Waranga's apparent indifference to the bridge's future. In a last desperate effort, Waranga Shire had approached the Country Roads Board about getting the old road linking Nagambie with Rushworth via Bailieston and Whroo declared a 'Forest Road'. Such a classification would have made both road and bridge a State financial responsibility, but the Country Roads Board regretted it was not in a position to declare more Forest Roads (P.R.O. Laverton, VPRS 3908, unit 20, 7 Jan. 1954,2 Feb. 1954, pp. 372-3).

By March 1954 it was apparent that the bridge issue was going to blow Waranga Shire apart. A delegation of Bailieston ratepayers, with their Nagambie solicitor, attended at Rushworth to argue their severance case. The Severance Committee had already petitioned the Governor in Council for annexation to Goulburn Shire, and Waranga councillors said that the normal local-government process could take its course. Related correspondence from the Minister of Public Works was referred to the Shire's solicitor. A poll of ratepayers in the disaffected area was duly held, and in October 1954 the Public Works Department advised Waranga Shire of the

unwelcome result (P.R.O. Laverton, VPRS 3908, unit 20, 7 Jan. 1954,3 March 1954, p. 383, 4 May 1954, p. 400, 7 Oct. 1954, p. 440).

The Kirwans Bridge issue had significantly changed local government boundaries, and Goulburn councillors were committed to renovating the old timber structure that would henceforth connect numerous ratepayers to their municipal centre at Nagambie. In August 1955 Goulburn Council told Waranga councillors that 'they considered both shires should bear their share of cost of any repairs up to date of severance'. This correspondence suggests that Goulburn Shire was then repairing Kirwans Bridge. The letter stated that 'it had always been the policy of the shire to inform Waranga when it intended to carry out any work on this bridge'. The nameless bridge could have been no other than Kirwans (P.R.O. Laverton, VPRS 3908, unit 20, 7 Jan. 1954,2 Aug. 1955, p. 527).

During the second half of 1955, Kirwans Bridge apparently underwent major reconstruction. Its broad timber deck was drastically narrowed, with occasional 'passing bays' utilizing the full original width of substructure. More significantly, the huge squared stringers and corbels of an earlier era of bridge construction were replaced in the renovated section of the bridge by rolled steel joists. Kirwans Bridge is still largely of timber construction, the only non-timber element being its steel joists hidden below deck. Though narrowed down, it retains its impressive length of timber deck and side-rails, and the curious angled construction that impresses all who see it. It retains vestiges of the original 'strutted corbel' design, and examples of the huge squared beams that long carried traffic over Lake Nagambie.

Its very long and very distinctive deck structure, in conjunction with an unusual setting over the broad waters of Lake Nagambie, combine to provide a rare and increasingly valued aesthetic experience. For example, it has featured in marketing of new motor vehicles in the journal Royal Auto. In March 2000 it was the setting for one of the Melbourne Food and Wine Festival's 'long lunches', a single dining table set the length of its deck. It is situated in a summer paradise for holiday-makers and fishermen.

Assessment Against Criteria

Criterion A
The historical importance, association with or relationship to Victoria's history of the place or object.
It is of historical significance as a work directly associated with Alfred Deakin's dream of a great 'National' irrigation system based upon the construction of the Goulburn Weir.

Consequently, with nearby Chinamans bridge, it was built entirely with State funds, a factor in its size.

When opened in 1890, it provided access to Nagambie and the railway for the mining areas of Bailieston and Whroo.

So significant was the access to Nagambie it provided for those living on the west of the Goulburn River, that a threat to the bridge's continuing future in the mid-1950s led to a municipal secession movement that enlarged the Shire of Goulburn at the expense of Kirwans' original builders, the Shire of Waranga. The current narrowed timber deck with passing bays, supported by rolled steel joists placed over the ancient piers, remains a memorial to that municipal protest. No other bridge whose threatened closure has caused a re-drawing of the municipal map of Victoria, as happened around the Goulburn Weir in the mid-1950s, is known.

Criterion B
The importance of a place or object in demonstrating rarity or uniqueness.
It is of scientific (technical) significance as one of only two extant Victorian timber bridges retaining vestiges of a colonial 'strutted-corbel' type of river-bridge design. Although its strutted visual effect is not greatly different from that of the equally rare and historic 'strut-and-straining-piece' design of nearby Chinamans Bridge, the detail and mechanics of the stringer-support system are structurally different. Because of the removal of half of the deck, the remnants of its original squared beams and strutted corbels are clearly visible beside the bridge.

Kirwans Bridge has an exceptionally long timber deck; no road bridge in Victoria is longer.

It is one of Victoria's very oldest timber road bridges still in operation.

Criterion C
The place or object's potential to educate, illustrate or provide further scientific investigation in relation to Victoria's cultural heritage.
Kirwans Bridge has the potential to educate and illustrate the history of timber bridge building in Victoria. Only at Kirwans Bridge and the Jeparit Bridge is it now possible to study examples of this historic European form of timber-bridge craftmanship.

Criterion D
The importance of a place or object in exhibiting the principal characteristics or the representative nature of a place or object as part of a class or type of places or objects.
It is one of a unique group of four large timber road bridges from the 1890s, of contrasting types, located on the Goulburn River between Seymour and Murchison; this is the last remaining group of large old timber river bridges in Victoria.

Criterion E
The importance of the place or object in exhibiting good design or aesthetic characteristics and/or in exhibiting a richness, diversity or unusual integration of features.
Kirwans Bridge is of aesthetic significance as a predominantly-timber structure of exceptional length.

Kirwans Bridge features a dramatic mid-stream bend, and is also unique in its incorporation of two vehicle passing-bays. This is accented by full timber side-rails.

Kirwans Bridge's rare aesthetic quality is accentuated by the its setting just above the broad waters of Lake Nagambie. Lake Nagambie a very popular boating and fishing venue close to Melbourne.

Kirwans Bridge provides a remarkably successful example of engineering adaptation to changing vehicle needs over more than a century.

Criterion F
The importance of the place or object in demonstrating or being associated with scientific or technical innovations or achievements.

Criterion G
The importance of the place or object in demonstrating social or cultural associations.
The distinctive and imposing nature of Kirwans Bridge has seen it feature in State-wide motor-car advertising and social promotions.

Criterion H
Any other matter which the Council considers relevant to the determination of cultural heritage significance

Extent of Registration

Heritage Act 1995
NOTICE OF REGISTRATION

As Executive Director for the purpose of the Heritage Act, I give notice under section 46 that the Victorian Heritage Register is amended by including the Heritage Register Number 1886 in the category described as a Heritage place:

Kirwans Bridge, Over Goulburn River,
Bailieston East, Strathbogie Shire Council.

EXTENT:
All the bridge marked B1 on Diagram 1886 held by the Executive Director.

Dated: 6 July 2000
RAY TONKIN
Executive Director

ATTACHMENT 2 – EPBC ACT Protected Matters Report

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 13-Jun-2023

Summary

Matters of National Environment Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	6
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	35
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

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

State and Territory Reserves:	1
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	4
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar Wetlands)		[Resource Information]
Ramsar Site Name	Proximity	Buffer Status
Banrock station wetland complex	500 - 600km upstream from Ramsar site	In feature area
Gunbower forest	50 - 100km upstream from Ramsar site	In feature area
Hattah-kulkyne lakes	300 - 400km upstream from Ramsar site	In feature area
Nsw central murray state forests	50 - 100km upstream from Ramsar site	In feature area
Riverland	400 - 500km upstream from Ramsar site	In feature area
The coorong, and lakes alexandrina and albert wetland	400 - 500km upstream from Ramsar site	In feature area

Listed Threatened Ecological Communities			[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	Endangered	Community may occur within area	In feature area
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	Endangered	Community likely to occur within area	In feature area
Natural Grasslands of the Murray Valley Plains	Critically Endangered	Community may occur within area	In feature area
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area	In feature area

Community Name	Threatened Category	Presence Text	Buffer Status
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia			
Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Aphelocephala leucopsis			
Southern Whiteface [529]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Botaurus poiciloptilus			
Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Callocephalon fimbriatum			
Gang-gang Cockatoo [768]	Endangered	Species or species habitat may occur within area	In feature area
Climacteris picumnus victoriae			
Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat known to occur within area	In feature area
Falco hypoleucos			
Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Grantiella picta			
Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hirundapus caudacutus			
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lathamus discolor			
Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Melanodryas cucullata cucullata			
South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat likely to occur within area	In feature area
Neophema chrysostoma			
Blue-winged Parrot [726]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Numenius madagascariensis			
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pedionomus torquatus			
Plains-wanderer [906]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Polytelis swainsonii			
Superb Parrot [738]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis			
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Stagonopleura guttata			
Diamond Firetail [59398]	Vulnerable	Species or species habitat likely to occur within area	In feature area
FISH			
Bidyanus bidyanus			
Silver Perch, Bidyan [76155]	Critically Endangered	Species or species habitat may occur within area	In feature area
Galaxias rostratus			
Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Maccullochella macquariensis			
Trout Cod [26171]	Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Maccullochella peelii](#)			
Murray Cod [66633]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Macquaria australasica](#)			
Macquarie Perch [66632]	Endangered	Species or species habitat may occur within area	In feature area
FROG			
[Crinia sloanei](#)			
Sloane's Froglet [59151]	Endangered	Species or species habitat may occur within area	In feature area
[Litoria raniformis](#)			
Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat may occur within area	In feature area
INSECT			
[Synemon plana](#)			
Golden Sun Moth [25234]	Vulnerable	Species or species habitat may occur within area	In feature area
MAMMAL			
[Dasyurus maculatus maculatus (SE mainland population)](#)			
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area	In feature area
[Pteropus poliocephalus](#)			
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area	In feature area
PLANT			
[Amphibromus fluitans](#)			
River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Brachyscome muelleroides](#)			
Mueller Daisy [15572]	Vulnerable	Species or species habitat may occur within area	In feature area
[Glycine latrobeana](#)			
Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lepidium monoplocoides			
Winged Pepper-cress [9190]	Endangered	Species or species habitat may occur within area	In feature area
Pimelea spinescens subsp. spinescens			
Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea [21980]	Critically Endangered	Species or species habitat may occur within area	In feature area
Senecio macrocarpus			
Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat may occur within area	In feature area
REPTILE			
Aprasia parapulchella			
Pink-tailed Worm-lizard, Pink-tailed Legless Lizard [1665]	Vulnerable	Species or species habitat may occur within area	In feature area
Delma impar			
Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat may occur within area	In feature area

Listed Migratory Species		[Resource Information]	
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Hirundapus caudacutus			
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca			
Satin Flycatcher [612]		Species or species habitat known to occur within area	In feature area
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat likely to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Myiagra cyanoleuca			
Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area
Neophema chrysostoma			
Blue-winged Parrot [726]	Vulnerable	Species or species habitat likely to occur within area overfly marine area	In feature area
Numenius madagascariensis			
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat may occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Goulburn River	Heritage River	VIC	In feature area

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
The Modified Operation of the Goulburn Murray Irrigation District	2009/5123	Controlled Action	Post-Approval	In feature area
Not controlled action				
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

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

Threatened, migratory and marine species

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

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

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

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

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

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

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

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

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

Please feel free to provide feedback via the Contact us page.

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