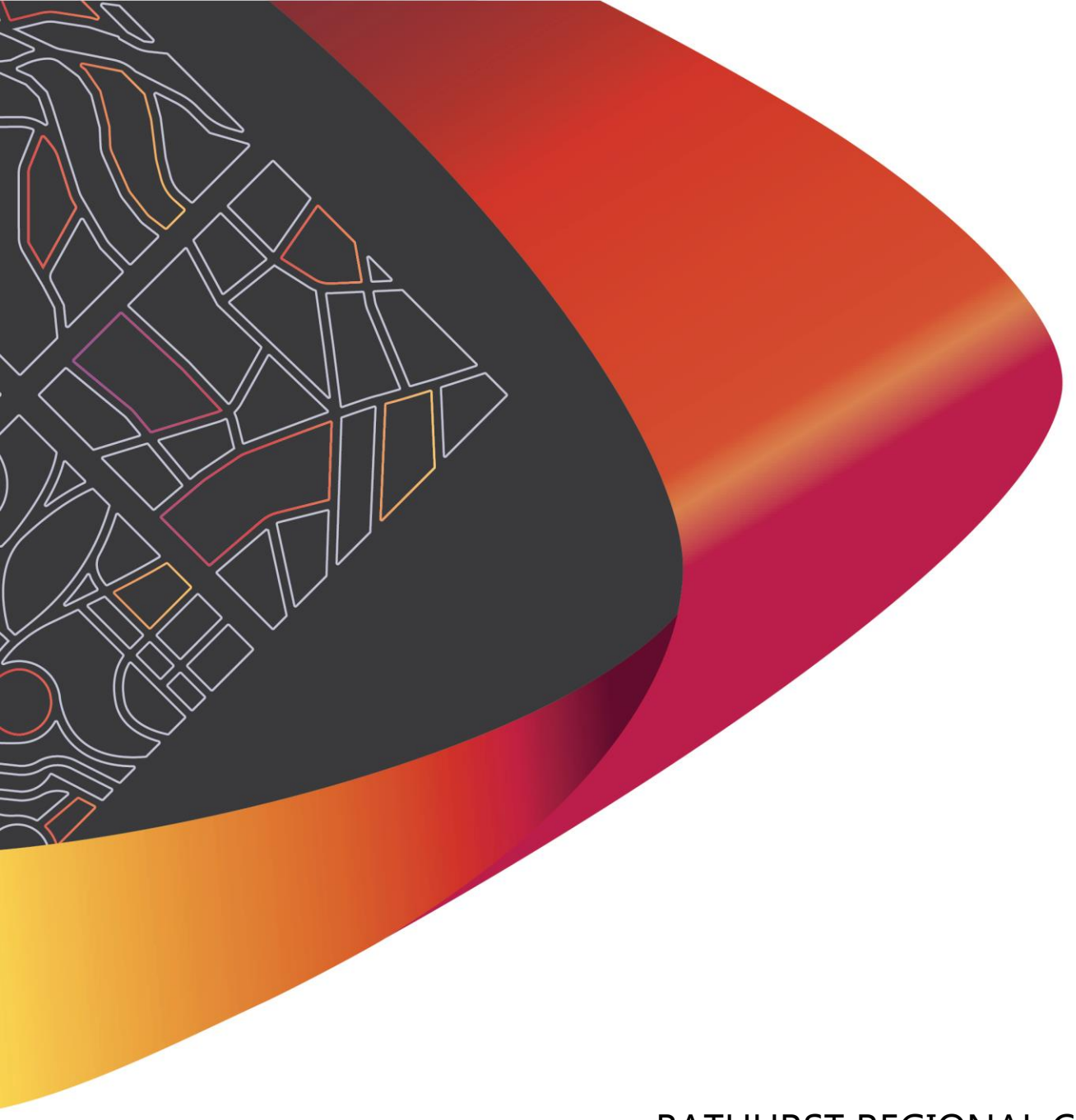

BATHURST REGIONAL COUNCIL

Bathurst Water Harvesting Scheme

REVIEW OF ENVIRONMENTAL FACTORS ADDENDUM

Report No: 220228_REFA
Rev: 001B
19 March 2024

Premise

DOCUMENT AUTHORISATION					
Revision	**Revision Date**	**Proposal Details**			
A	01/03/24	For issue			
B	19/03/24	Final			
Prepared By		**Reviewed By**		**Authorised By**	
Hugh Shackcloth-Bertinetti		David Walker		David Walker	

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TABLES

FOREWORD

This Review of Environmental Factors Addendum (REFA) has been prepared by Premise on behalf of Bathurst Regional Council (BRC) to assess modifications to activities previously determined for the development of the Bathurst Water Harvesting Project (WHP).

The REFA has been prepared in accordance with the relevant provisions of the *Environmental Planning and Assessment Act 1979* (EP&A Act), the *Environmental Planning and Assessment Regulation 2021* (EP&A Regulation), the Guidelines for Division 5.1 Assessments (DPE 2022), the *State Environmental Planning Policy (Transport and Infrastructure) 2021* (Infrastructure SEPP) and other Federal and State legislation including the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

After consideration of key environmental aspects and any specialist studies completed; as well as the information presented in this REFA, it is concluded that by adopting the mitigation measures identified in this assessment it is unlikely that there would be any significant environmental impacts associated with the proposal activity modification.

CERTIFICATION

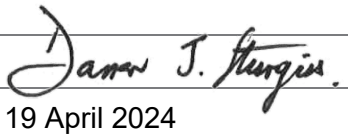
This REFA provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses, to the fullest extent possible, all matters affecting or likely to affect the environment as a result of the proposal. The information contained in this REF is neither false nor misleading.

Table 1 - Certification of Document Author(s)

A) Name of the person(s) who prepared the REF. **I confirm that this REF has been prepared in accordance with the current DPE Guidelines for Division 5.1 assessments (June 2022) as per Section 171(3) of the EP&A regulations:**		
Name, Position and Qualifications of the person(s) who prepared the REF:	Hugh Shackcloth-Bertinetti Environmental Planner B. Science and B. Arts	David Walker General Manager B. Urban and Regional Planning
Signature:		
Date:	28 February 2024	18 March 2024

This REFA has been examined and considered by those duly appointed and authorised persons and has been accepted on behalf of Bathurst Regional Council, as the determining authority, as having satisfied those relevant objects of the EP&A Act and the matters prescribed by Sections 5.5 and 5.7 of the EP&A Act. The proposed activity can proceed, subject to the implementation of the specified Mitigation Measures stated in this REF.

Table 2 - Determination by Delegated Officer

C) Determination by Delegated Officer: **I certify that I have reviewed and endorsed the contents of this REF document and, to the best of my knowledge find it in in accordance with the EP&A Act and the EP&A Regulation. The proposal has been considered against matters listed in Section 171 (Appendix A) and the Guidelines approved under Section 170 of the EP&A Regulation and the information it contains is neither false nor misleading.** **I acknowledge that if the capital investment value of the works is greater than $5 million this REF will be published on either the determining authority's website or the DPE NSW planning portal pursuant to Section 171(4) of the EP&A Regulation.**	
Name and designation of the Delegated Officer of Bathurst Regional Council	Darren Sturgiss Director Engineering Services
Signature:	
Date:	19 April 2024

The estimated capital investment value of the entire proposed activity, as confirmed by BRC, exceeds $5 million. The project also requires approval under Section 60 of the *Heritage Act 1977* therefore the original REF and this Addendum REF should be published pursuant to the requirements of Section 171(4) of the EP&A Regulation.

1. INTRODUCTION

Premise Australia Pty Ltd (Premise) have been engaged by Bathurst Regional Council (BRC) to prepare an addendum to a Review of Environmental Factors (REF) previously prepared to assess the Bathurst Water Harvesting Scheme (WHS). The original REF for the project was approved by Bathurst Regional Council on 15 June 2022.

The proposed activity of the approved REF included the installation and operation of an approximately 5.5 km long water pipeline, including two (2) underbored pipeline alignments passing underneath the Wambuul/Macquarie River and a third underbore of the Queen Charlotte Vale Creek. The proposed pipeline facilitates the transfer of water harvested by the project from the Wambuul/Macquarie River to the Bathurst Water Filtration Plant (WFP) prior to use in the town water supply.

As detailed design has progressed, it has become apparent that the logistical and geotechnical challenges associated with the Wambuul/Macquarie River underbores are significant. The Queen Charlotte Vale Creek underbore can proceed as planned.

The alignments approved by the original REF provided an underbore of approximately 116 metres in the north of pipeline alignment and a second underbore of approximately 80 metres further south near Denison Bridge. The geotechnical investigations have determined that, due to the underlying conditions, both of these underbores needs to be deeper (around 16 m) and longer (around 300 m). The implication of these changes is that the alignment of the pipeline and the size of launch and receival pits must change. There also remains a very high risk of failure of the underbores due to geological conditions and ongoing operational (maintenance) challenges with pipework being located at this depth. Experience with other projects in the central west region, and detailed discussions with underboring experts, reflects that the risk of failure is very real. The impacts associated with significantly larger launch and receival pits also introduces increased potential impacts to areas adjacent to the Wambuul/Macquarie River. The impacts associated with a failed underbore include the risk of frac out, which has the potential to discharge water into the river, which would be a significant issue.

Given the range of challenges associated with the two proposed underbores of the Wambuul/Macquarie River, it is proposed to amend the current approved alignment of the pipeline to avoid underboring requirements. The modification to the approved pipeline route proposes to attach the pipework to two existing bridges passing over the Wambuul/Macquarie River, including at the low-level crossing located at Hereford Street, known as the Gordon Edgell Bridge, and at Denison Bridge, located near Bridge Street. Denison Bridge is a state heritage listed bridge. Gordon Edgell Bridge currently provides vehicular and pedestrian access to the northeast areas of the city of Bathurst. Denison Bridge was closed to vehicular traffic in the early 1990s but remains open to pedestrians. Bridge Street terminates on either side of Denison Bridge. Both of the bridges currently host a number of pipe attachments that cater for Council and other regulatory services, including water and telecommunications, noting that the carriage of services is a key purpose of these bridges, along with carriage of vehicles and/or pedestrians.

This REF Addendum has been prepared to address the alternative option to provide connections across the Wambuul/Macquarie River utilising the existing bridges. It provides an assessment of potential impacts resulting from the modification of the approved pipeline alignment and the proposed replacement of the

underbores with sections of pipe that will pass over the Wambuul/Macquarie River via Gordon Edgell and Denison Bridges. The modification to the approved activity seeks to avoid the above discussed geological constraints and facilitates the delivery of the Bathurst WHS, supporting an objective to improve the water security of Bathurst identified in the adopted Macquarie-Castlereagh Water Sharing Plan.

A geomorphic assessment has been completed to consider the impact of the pipeline alignment changes, including the assessment of pipeline entry and exit of land within the waterfront area.

A statement of heritage impact has been prepared to assess the impact of connecting the pipeline to the Dension Bridge, including engagement with Heritage NSW and the Heritage Council.

1.1 Scope of this Report

This REF Addendum report has been prepared to identify, scope, and evaluate the impacts of the modified activity to ensure that it meets the requirements under Part 5 of the EP&A Act and to provide BRC, and other determining authorities, with sufficient information to ensure that environmental impacts are clearly understood.

This REF Addendum report seeks to:

- Assist the determination of whether an activity should be approved considering, to the fullest extent possible, all matters affecting or likely to affect the environment; and
- Determine whether the activity is likely to have a significant effect on the environment or significantly affect threatened species, populations or ecological communities or their habitats.

The REF Addendum only address the proposed modification to the activity whereby the approved pipeline will be realigned and the pipe strapped to the Gordon Edgell and Denison Bridges passing over the Wambuul/Macquarie River. For a full understanding of the entire Bathurst WHP, including potential impacts associated with other portions of the pipeline route, this REF Addendum report should be read in conjunction with the original approved REF prepared for the Bathurst WHS, dated 6 June 2022 (Version 001C) (Premise, 2022).

2. ACTIVITY DESCRIPTION

2.1 Determined Activity

The key features of the determined activity as described in the original REF include:

- Installation of an approximately 36.5 ML holding pond (PS1 holding pond) at the existing STP site.
- Installation of Pump Station No. 1 (PS1) with a transfer capacity of 200 L/s, to extract water from the river and pump to the proposed 36.5 ML holding pond.
- Installation of a packaged pre-treatment plant for primary treatment of the water.
- Installation of Pump Station No. 2 (PS2) with a capacity of 200 L/s to transfer water from the proposed PS1 holding pond to the proposed WFP balance pond at the WFP.

- Installation of an approximately 5.5 kilometre long water pipeline to transfer water from Pump Station 2 to the proposed WFP balance pond at the WFP.
- Installation of Pump Station No. 4 (PS4) with a capacity of 400 L/s to transfer water from the proposed WFP balance pond to the WFP.

2.2 Proposed modified activity

The modification to the proposed activity involves the following:

- A change to the pipeline alignment to delete the two underbores of the Wambuul/Macquarie River and replace these crossings with an alternative alignment passing over the Wambuul/Macquarie River via the two existing bridges. These two bridges are the low-level crossing of Gordon Edgell Bridge, located along Hereford Street, and Denison Bridge, a historically significant bridge located near Bridge Street.

The modification to the proposed activity, specifically the pipeline alignment, is shown in the drawings provided in **Appendix B**.

2.3 Options considered

The proposed works form part of the approved BRC water harvesting scheme upgrade on the Wambuul/Macquarie River system which aims to improve water security for the city of Bathurst. Several alternatives were originally considered at the initial conception stage of the approved water harvesting project. As detailed via Section 2.3.2 of the original REF, this included a consideration of the following options:

- Chifley Pipeline - connecting a pipeline directly between Chifley Dam and the WFP.
- Increased use of groundwater.
- Purchase Water from Fish River Scheme.
- Water Buyback from Irrigators.
- Irrigation Restrictions.
- Reduce in Riparian Flows from Chifley Dam.
- Water Harvesting for Potable Treatment.
- Connection of Winburndale Dam supply/storage for potable treatment and supply.
- Bathurst City Water Restrictions.
- Regional Pipelines.
- Water carting.
- Effluent re-use.

The preferred and adopted option for the water harvesting scheme was selected following a high level analysis of the initial concept designs, including a consideration of pipeline alignment and holding pond locations that would minimise impacts to landowners, areas of European and Aboriginal heritage significance, areas of flood control and areas of potential biodiversity sensitivity.

During the refinement of detailed design, it has become apparent that the logistical and geotechnical challenges associated with underbored segments under the Wambuul/Macquarie River are significant.

Investigations of underlying geology have revealed a high composition of gravel down to depths of approximately 7-14 metres. Drilling through this gravel layer exposes the project to a high risk of frac out,

that is, an unintentional return of drilling fluids to the surface. In the context of a drilling operation under a river, this is risky approach that risks pollution and impacts to the river and associated aquatic species. Implications of a frac out in the river could include the release of fine particles that can smother plants and animals. If a saltwater polymer fluid is used, salt can impact freshwater systems and terrestrial vegetation. A frac out would be considered a pollution of land or water in the context of the *Protection of the Environment Operations Act 1993*. Bathurst Regional Council would prefer to avoid a scenario where a risk of this nature applies.

With the identification of significant geological constraints to the approved alignment several additional alternatives to underboring have been considered, including:

- Retain the approach to underbore but increase the depth of the underbore so that the drilling is through underlying bedrock. This requires a longer underbore due to geometric requirements. A longer underbore requires much larger launch and receival pits to enable the required depths to be reached and to accommodate the necessary lengths of pipe, which results in increased surface and subsurface impacts in the context of heritage, soils, water and biodiversity;
- Install the pipe via trenching through the river using a coffer dam approach. This approach has been rejected in discussions with DPE Water, who consider this approach unacceptable due to impacts to the river and the associated aquatic environment;
- To realign the pipeline to avoid the crossings of the river. The crossings were originally proposed to avoid building the pipeline through the original development site of the city of Bathurst, which features a large amount of heritage buildings and sites, including the state heritage listed Bathurst showground site, and a high potential for disturbance of relics. An assessment of options in the context of historic heritage was provided by EMM in support of the original REF and an earlier assessment considered the alignment of the pipe to the west of the river. Through careful consideration of risk and cost, it was determined that crossing the river and traversing the less constrained eastern side of the river was the preferred outcome. Heritage impacts (and the need for heritage approval) would result if this option was revisited. There is no guarantee that such approval would be granted given the sensitivity of this part of the city and the high potential for archaeological impacts. This option also required construction of the pipeline through existing roads, at a significantly higher project cost (around $25m compared to around $15-18m for the approved alignment).
- Attach the pipe to existing bridge structures (the preferred option)

The preferred option for addressing the introduction of geological constraints involves the deletion of two underbored alignments and their replacement with two new pipeline alignments. The two new pipeline alignments will pass over the Wambuul/Macquarie River via two existing bridges, including a low level crossing of Gordon Edgell Bridge, located along Hereford Street, and Denison Bridge, a historically significant bridge located near Bridge Street.

The preferred option has been refined and informed through the collaboration of BRC, regulatory authorities, Premise and their consultants, The preferred option has been adopted on the basis that it allows for an efficient delivery of the water harvesting scheme in a manner that minimises the potential for adverse impacts to human health and the environment. Attaching the pipeline to the side of Gordon Edgell Bridge and Denison Bridge is considered the least impactful solution that enables the project to proceed. Without

a viable alternative, the project may not proceed, which places the city of Bathurst at risk from a water security perspective.

2.4 Project Phases

2.4.1 CONSTRUCTION

The construction of the determined activity is outlined in Section 2.4 of the Original REF and includes the following activities.

- Establishment of site compounds and laydown areas;
- Installation of erosion and sediment controls, to be removed on completion of all work;
- Minor vegetation clearance as required in applicable locations;
- Bulk earthworks;
- Trenching for the mains and sub-mains and installation of pipes;
- Underboring of sensitive locations as required;
- Encasement of pipes beneath roads and rail lines;
- Trench backfill upon completion of the main routes
- Reinstatement of land to pre-existing conditions;
- The establishment of vegetation ground cover as required.

Construction activities for the proposed modified activity are consistent with the description provided by the original REF. For the avoidance of doubt the modified activity presents the following changes to construction activities:

- Underboring of sensitive locations would no longer include alignments passing underneath the Wambuul/Macquarie River. The approved underbore at Queen Charlotte Vale Creek is not affected by this modified alignment.
- Additional areas for the installation of temporary erosion and sediment controls, minor vegetation removal, trenching and reinstatement would be implemented to address the new pipeline alignments.
- New pipeline alignments would be installed and strapped to the side of existing bridges.

Further details on the construction of the project including measures to control potential impacts of the project during the construction phase are detailed below.

2.4.1.1 Work Methodology

The work methodology for the proposal would be staged as follows:

- Establishing site delineation.
- Establishing erosion and sediment control.
- Vegetation clearing and earthworks.

- Installation of infrastructure.
- Rehabilitation with grasses to stabilise the areas disturbed by trenching.
- General tidy up of the site including removal of site equipment.

2.4.1.2 Excavation Works

Where excavation works are to occur, a Work Method Statement is to be prepared indicating:

- The name and address of the company/contractor undertaking excavation works.
- The name and address of the company/contractor undertaking off site remediation/disposal of excavated materials.
- The name and address of the transport contractor.
- The type and quantity of material to be removed from site.
- Procedures to be adopted for the prevention of loose or contaminated material, spoil, dust and litter from being deposited onto the public way from trucks and associated equipment and the proposed method of cleaning surrounding roadways from such deposits.

The use of any rock excavation machinery or any mechanical pile drivers or the like is restricted to the hours of 8.00 am to 5.00 pm (maximum) on Monday to Friday only, to minimise the noise levels during construction and loss of amenity to the surrounding areas.

No blasting shall be permitted during excavation works.

2.4.1.3 Plant and Equipment

It is anticipated that on site plant and equipment would include the following:

- Excavators.
- Truck and trailer combinations.
- Bob Cat; and
- Hand tools.

2.4.1.4 Source and Quantity of Materials

The following materials would be required for the proposed works:

- Concrete
- Water supply infrastructure, including pipework and treatment systems.

The majority of construction materials are anticipated to be supplied and transported to the site from suppliers within the Bathurst LGA.

2.4.1.5 Stockpiling

Ground surface and vegetation cover will be reinstated to pre-construction or better condition at the completion of the proposed activity.

To achieve this, soil will be stockpiled so that it can be restored in its original stratification to enable the seedbank to function. The viability of the seed bank declines over time, so materials will not be stockpiled for more than three months.

Stockpiling impact areas will be kept to a minimum and would not involve the disturbance of any previously undisturbed land.

2.4.1.6 Traffic Management and Access

No significant changes to traffic conditions and access are anticipated to occur during the construction and operational phases of the proposed activity. During the construction period, traffic would be managed in the following ways to minimise disruptions to road users:

- All public roads will remain accessible to the public throughout the project, with the exception of brief closures where infrastructure is required to be installed across the carriageway; and
- All property accesses would be maintained throughout construction.

2.4.1.7 Public Utility Adjustment

A Before You Dig Australia (BYDA) search is to be completed by the contractor in advance of any works to confirm whether the proposed upgrade works would affect any services.

It is recommended Council liaise with any affected service providers in advance of any works starting to confirm no objections to the proposed works.

Proposed works may impact on any unknown underground services and prior to construction this information would be communicated to the relevant construction contractor to prevent unnecessary disturbance.

2.4.1.8 Property Acquisition

Based on the current scope of the project, it is understood that no land acquisition is proposed or required for the proposed activity.

2.4.2 OPERATION

The proposed modified activity would not result in any significant changes to the operation of the project detailed in the original REF. Minor changes to maintenance activities associated with the installation of pipelines along existing bridges would be implemented to minimise the potential for adverse impacts, ensuring the pipeline operates as intended.

As detailed in Section 2.9.2 of the original REF, a rigorous water quality monitoring program is proposed for the Bathurst WHP and would include sampling from the Wambuul/Macquarie River together with sampling from the proposed WFP balance pond (Premise, 2022). Maintenance of the new pipeline alignments and associated monitoring measures would be articulated in an operational environmental management plan (OEMP) applying to the broader WHP, prepared in accordance with the requirements of appropriate regulatory agencies.

2.5 Cumulative Impacts

It is unlikely that the change to the proposed activity would result in unmanageable adverse cumulative impacts with other existing or likely future activities. The proposed activity is not anticipated to lead to any significant cumulative impacts.

Any residual impacts associated with the proposed activity would be managed through the implementation of appropriate mitigation measures detailed in the original REF and this REFA.

3. PLANNING CONTEXT

This assessment is prepared subsequent to the original REF and addresses the provisions of Part 5 of the EP&A Act and the Infrastructure SEPP relevant to the proposed modified activity. BRC are defined as a 'public authority' via Section 1.4 of the EP&A Act and represent both the proponent and determining authority for the proposed modified activity.

Part 5 of the EP&A establishes the framework for an activity undertaken by or on behalf of a public authority.

The proposed development is consistent with the definition of a 'water supply system' and is permissible without consent as an 'activity' undertaken by a public authority via Section 2.159 of the Division 24 of the Infrastructure SEPP. The proposed activity is for the purpose of a water supply works and includes water reticulation (i.e pipelines). With respect to the components of the proposed development and the land zone in which they are located:

- Development for the purpose of water reticulation is permitted without consent by a public authority on any land via Section 2.159(1).
- Ancillary construction activities associated with the activity are permitted without consent via Section 2.159(6).

The proposed modified activity is permissible without development consent on the basis that it is to be undertaken by a public authority and is development permitted without consent via the Infrastructure SEPP pursuant to Part 5, Division 5.1, of the EP&A Act. Section 5.5 of the EP&A Act establishes a duty to consider

the environmental impacts of activities under Part 5. This assessment provides consideration of impacts and therefore discharges the requirements of Section 5.5.

Section 171 of the *Environmental Planning and Assessment Regulation 2021* (the EP&A Regulation) provides that a determining authorities consideration of the likely impacts of an activity proposed via Part 5 must take into account the environmental factors specified in guidelines issued by the Planning Secretary for that purpose. The relevant guidelines in this regard are the *Guidelines for Division 5.1 Assessments* (DPE 2022). A checklist of relevant factors provided via the guidelines is provided in Appendix A.

An Environmental Impact Statement (EIS) is required by way of Section 5.7 of the EP&A Act if the REF concludes the activity is likely to have a significant effect on the environment. The assessment of impacts contained within the REF and this REF addendum has determined that significant impacts are not likely and therefore an EIS is not required for the proposed activity.

The proposed modified activity has the potential to require additional approvals under the following legislation:

- Water Management Act 2000
  - The proposed modified activity requires a Water Supply Works Approval pursuant to Section 90 of this Act. This application has been lodged and is pending, subject to the updates reflected via this addendum.
  - The proposed modified activity is associated with an existing Water Access Licence (WAL) for the Bathurst WFP 34452. No changes to the existing WAL were required by the associated WHP except for its inclusion as a nominated water supply work. While no changes to the capacity of the existing WAL are required there is a potential requirement for the proposed modified pipeline alignment as addressed by this REF to be included on the WAL as a nominated water supply work.
- Roads Act 1993
  - The proposed modified activity requires an approval for proposed reticulation connection works that are located within road reserves pursuant to Section 138 of this Act, including the requirement for concurrence of TfNSW in relation to any classified road.
  - It is noted that the proposed change is restricted to works in proximity to Bridge Street near Denison Bridge and Hereford Street near Gordon Edgell Bridge such that no requirement for concurrence is anticipated.
- Heritage Act 1977
  - An application for a Section 60 approval will be obtained for excavation works in relation to works within the curtilage of Denison Bridge and for the strapping of the pipe to Dension Bridge. Initial discussions with the Heritage Council have resulted in the grant of in-principle approval subject to a number of recommendations. This is further discussed in **Section 5.1**.
- Local Government Act 1993
  - The proposed modified activity includes works in relation to an existing water treatment system and therefore requires an approval pursuant to Section 60 of this Act.

- Crown Land Management Act 2016
  - The proposed modified activity includes the realignment of the pipeline through crown land. Concurrence from NSW Department of Industry – Crown Lands for works in relation to crown land is therefore required prior to works commencing.

4. CONSULTATION

Section 4 of the original REF outlines consultation undertaken for the determined activity and considers applicable consultation and notification requirements.

Details of the consultation carried out during the preparation of this REFA is provided in **Table 3** and proposed future consultation is outlined in **Table 4**.

Table 3 – REFA Consultation

Stakeholder	Comment / Reason
Heritage NSW	Assessment of Heritage Impacts associated with Denison Bridge. Advice received with regard to s.60 requirements.
Heritage Council	Pre-application meeting held on the 6 February 2024 to brief the Council on the application. The outcomes of the meeting are further discussed in **Section 5.1**.

Table 4 – Future REFA Consultation

Stakeholder	Comment / Assessment
Heritage NSW	Consultation will be undertaken with Heritage NSW with respect to licencing and approval requirements for the modified pipeline alignments, including requirements for approval under section 60 of the Heritage Act 1977.
Crown Lands	Consultation will be undertaken with Crown Lands to confirm licencing and approval requirements for modified pipeline alignments impacting crown land parcels.
Water NSW	Consultation will be undertaken with WaterNSW with respect to licencing and approval requirements for modified pipeline alignment, including confirmation of any approval requirements under the Water Management Act 2000 and Fisheries Management Act 1994.

5. ADDITIONAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The table below outlines additional environmental impacts that have the potential to result from the proposed change compared to the approved REF and details requirements for additional mitigation measures. All other environmental impacts and mitigation measures identified in the approved REF remain the same and will be incorporated into the contractor's CEMP.

Table 5 – Assessment of the Modification to the Proposed Activity

Aspect	Additional Impact	Additional Mitigation Measures
Land Use	The original underbored pipeline alignments transected land uses mapped as 'River' and 'Grazing Native Vegetation' via the NSW Land Use 2017 dataset. To enable bridge crossings the modified pipeline alignments will extend further into adjacent land on either side of the Wambuul/Macquarie River. The overall increase in the area disturbed by the activity has the potential to lead to additional land use impacts, although these impacts are generally minor. The realignment of pipelines across bridges, however, through elevating works above the ground's surface will provide increase the separation distance from the Wambuul/Macquarie River, minimising the potential for direct impacts to sensitive land. Notwithstanding, it is noted that both bridges currently accommodate a number of other pipes, all of which are removable should they reach the end of their serviceable life. The proposed works are therefore consistent with the existing use and purpose of each bridge for servicing arrangements, minimising the potential for adverse land use impacts. In comparison to the alternative approach of redesigning underbored segments, the proposed modification is the preferred option to address geological constraints and to limit potential impacts to other environmental constraints, including heritage considerations. As outlined in **Section 2.3**, of the options considered, the proposal to attach the pipe to the bridges represents the option with the least residual impacts. Subject to the implementation of appropriate mitigation measures, no significant land use impacts are anticipated.	No additional mitigation measures are proposed.

Aspect	Additional Impact	Additional Mitigation Measures
Access and Traffic	The modification to the proposed activity, through realigning pipelines and increasing the proximity of roadways and pedestrian walkways, has the potential to increase the risk of access and traffic impacts. Strapping the pipeline to the side of bridges has the potential to result in some temporary disturbance to surrounding roads and pathways. Potential impacts of the modified activity, however, are considered consistent with those already assessed via the approved REF, including the potential for: • Increased driver frustration in areas of concentrated construction activity; • Delays for travelling public; • Reduced road safety; and • Impacts to property accesses. Subject to the implementation of appropriate mitigation measures, the realignment of the pipeline and increased proximity to roadways is not anticipated to result in any significant additional impact to access or traffic conditions.	No additional mitigation measures are proposed.
Utilities	The modification to the proposed activity has the potential to impact on known services as well as unknown underground services during construction. Consistent with measures provided in the approved REF, Before You Dig Australia searches would be completed prior to the installation of the modified alignment with subsequent consultation with utility providers to be provided as required prior to the commencement of works. This would be reflected in the project construction environmental management plan (CEMP).	No additional mitigation measures are proposed.
Water	The realignment of pipelines along bridges poses pollution risks for surrounding watercourses. Construction activities and excavation works have the potential to result in sedimentation and release construction pollutants (i.e., hydrocarbons, chemicals), contaminating nearby watercourses. Following construction, leaks and spills from the realigned pipeline have the potential to lead to adverse water related impacts. Notwithstanding the above, no significant impacts to watercourses in addition to those already assessed by the	To minimise risk, ground surface cover is to be maintained in good condition (whether that be ground vegetation cover, or fortified cover such as rip-rap, concrete or gabions).

Aspect	Additional Impact	Additional Mitigation Measures
	REF, is expected to result from the proposed modification. Of the options considered (**Section 2.3**), the proposed option has the lowest likelihood of impacts to the water environment. As detailed via the original REF, a CEMP would be prepared to minimise the potential for adverse impacts to surrounding watercourses including measures specific to water quality, water flow, aquatic and riparian habitat, erosion and sediment control and contamination. A rigorous water quality monitoring program is additionally proposed and would include sampling from the Wambuul/Macquarie River. Maintenance of the new pipeline alignments and associated monitoring measures would be articulated in an operational environmental management plan (OEMP) applying to the broader WHS, prepared in accordance with the requirements of appropriate regulatory agencies. Geomorphic risk associated with pipe entries and exits in the riparian zone are assessed via the geomorphic assessment provided at **Appendix E** and further discussed in **Section 5.2**.	
Biodiversity	The modification to the proposed activity will result in impacts to mown parkland areas, with no impacts to native vegetation predicted. These areas were initially identified to be retained for the proposed activity. The proposed change, however, removes the requirement to underbore sensitive watercourses and does not require the same level of impact as would occur should the underbore amendments be proposed (as discussed in **Section 2.3**). Consistent with the previous underbore alignments, impacts are limited to mown parkland. No greater impacts are predicted. It should be noted that the realignment of the pipeline across bridges, relocates direct impacts away from sensitive land within and ground directly underneath the Wambuul/Macquarie River towards land already disturbed by urban development/parkland. Elevating works above the ground's surface across bridges will provide increase the separation distance from sensitive land uses (rivers), minimising the potential for direct impacts. Subject to the implementation of appropriate mitigation measures, the realignment of the pipeline is not	No additional mitigation measures are proposed.

Aspect	Additional Impact	Additional Mitigation Measures
	anticipated to result in any significant additional impacts to biodiversity.	
Aquatic Ecology	For the avoidance of doubt, no additional impacts are anticipated with respect to aquatic ecology. No change to the daily extraction levels as provided by the existing REF are associated with the proposed modification. The potential for impacts to aquatic ecology resulting from pollution would be managed in accordance with the existing measures detailed in the REF, including the implementation of a CEMP and OEMP. As noted above with respect to water impacts, no significant impacts to watercourses in addition to those already assessed by the REF, is expected to result from the proposed modification.	No additional mitigation measures are proposed.
Aboriginal Heritage	A Review of Aboriginal Heritage Information Management System (AHIMS) was conducted on the 22 January 2024 to assess the change to the proposed activity (refer to **Appendix D**). No Aboriginal archaeological sites, Aboriginal objects, or Aboriginal heritage items were recorded within the study area. An Aboriginal heritage due diligence assessment (AHDDA) was previously prepared by Extent Heritage to identify and assess the potential aboriginal significance of areas impacted by the pipeline, including whether or not the proposed activities are likely to harm aboriginal objects. While the pipeline alignments in the AHDDA vary compared to the current revised arrangement Extent Heritage have confirmed that that the area of the new pipeline alignment was assessed as part of the Due Diligence process. The revised pipeline alignment was within the buffer and study area used by the AHDDA and was identified to be of low archaeological potential. As confirmed via consultation with Extent Heritage on 12 February 2024, the proposed work may 'proceed with caution' as per the recommendations provided in the original AHDDA. With respect to the completion of an aboriginal cultural heritage assessment report (ACHAR) Extent Heritage have additionally noted that its study area was restricted to areas deemed to contain moderate and high potential in	No additional mitigation measures are proposed. Comply with existing measures provided within the AHDDA and proceed with caution for unexpected finds.

Aspect	Additional Impact	Additional Mitigation Measures
	the due diligence process. Given that the updated alignment only transects land of low (and very low) archaeological potential no further amendment to the ACHAR or additional consultation is required. Subject to the implementation of appropriate mitigation measures, the realignment of the pipeline is not anticipated to result in any significant additional impacts to aboriginal heritage.	
Non-Indigenous Heritage	The realignment of the pipeline route transects land identified with non-indigenous heritage, including: • Denison Bridge, an item of both state and local heritage significance, (I53) and • Portions of parklands collectively identified as the *"Bicentennial, Ohkuma and Peace Parks, Macquarie River and Bathurst Flagstaff site and Declaration Monument, Pillars of Bathurst, Footsteps in Time Pillar and Steam Roller"* that are of local heritage significance (I67) located on the southern side of Gordon Edgell Bridge. Excavation works and the visibility of the pipeline above ground has the potential to disturb and result in adverse impacts to these heritage significant items. A Statement of Heritage Impact (SoHI) has been prepared to assess the impacts of the proposed realignment on the heritage significance of Denison Bridge and is provided as **Appendix C**. The SoHI concludes that the proposed change is unlikely to have an adverse effect on the heritage significance of the Denison Bridge state heritage listed item and includes several recommendations to minimise the potential for impact. In principle approval for these works have been granted by the NSW Heritage Council and the ability to approve a section 60 application under the Heritage Act has been delegated to Heritage NSW, subject to providing some additional information. This is further discussed in **Section 5.1**. With respect to the local heritage significance of parklands south of Gordon Edgell Bridge, the proposed realignment will pass through the southeastern extent of the parkland located northwest of Hereford Street (Lot 1 DP126047). This area was initially unaffected by the proposed activity. The previously approved pipeline route, however. transected land mapped with the same heritage item,	Implement additional mitigation measures detailed within the SoHI provided for Denison Bridge -refer **Section 5.1** and **Appendix C**.

Aspect	Additional Impact	Additional Mitigation Measures
	passing underneath a portion of the parkland located further to the south, southeast of Hereford Street. Given existing servicing arrangements, no significant additional impacts to the parkland are anticipated to result from the proposed activity. Minor excavation and trenching would be designed to avoid heritage significant features of the parkland and would be conducted in accordance with appropriate measures detailed in a CEMP and OEMP minimising the potential for adverse impacts. Trenching of the pipeline beneath the grounds surface would additionally limit the potential for visual impacts to the existing heritage value of the parkland.	
Geology and Soil	The proposed change to the alignment seeks to avoid newly identified geological constraints associated with underboring the Wambuul/Macquarie River. To enable bridge crossing the modified pipeline alignment includes some additional excavation on either side of the Wambuul/Macquarie River. Excavation, however, would be limited to shallow ground disturbance for trenching the pipeline on either side of both Denison Bridge and Gordon Edgell Bridge. No salinity or acid sulfate soils are mapped within areas disturbed by the proposed realignment. Impacts to soil and geology are not expected to be significant and can be managed through existing mitigation measures provided in the approved REF.	No additional mitigation measures are proposed.
Air Quality	Air quality may be impacted by fuel emissions from plant, equipment, and vehicles, and from dust generated by vehicle movements on areas not covered by hardstand. Impacts to air quality are consistent with the current approved arrangement and are not expected to be significant. Residual impacts can be managed through existing mitigation measures provided in the approved REF.	No additional mitigation measures are proposed.
Noise and Vibration	The workforce, equipment and machinery to be used for the modified activity will remain consistent with that previously assessed in the approved REF. Changes to pipeline alignments are generally situated within the same location as the previously proposed route. Subject to the implementation of appropriate mitigation measures, as detailed in the approved REF, no significant	No additional mitigation measures are proposed.

Aspect	Additional Impact	Additional Mitigation Measures
	additional noise and vibration impacts are anticipated to result from the proposed change.	
Visual amenity	The proposed change to pipeline alignments will result in previously underbored pipeline alignments being relocated above ground. The above ground pipeline alignments would be strapped to the low level bridge at Hereford Street and the Denison Bridge and remain visible during the operation of the activity. Above ground portions of the realigned pipelines, however, would be low profile and installed close to the ground surface minimising the potential for visual impacts to the surrounding locality. An assessment of heritage impacts associated with the relocation of the pipeline to Denison Bridge is provided in **Section 5.1** and **Appendix C**. Notwithstanding, it should be noted that the pipeline is capable of being installed in a manner that is consistent and compatible with the existing visual character of bridges passing over the Wambuul/Macquarie River, further minimising the potential for adverse visual impacts.	No additional mitigation measures are proposed.
Greenhouse Gas Emissions	The transport of construction materials and the operation of plant and equipment during the construction phase of the project, would generate direct greenhouse gas emissions. The modification to the proposed activity. however, is not anticipated to generate a significant change to the generation of greenhouse gas emissions. Greenhouse Gas emissions would be limited to temporary emissions from vehicles, plant and machinery during the construction phase. Impacts associated with greenhouse gas emissions are not expected to be significant, and can be managed through existing mitigation measures provided in the approved REF.	No additional mitigation measures are proposed.
Waste	The modification to the proposed activity is not anticipated to generate a significant change in the volume or type of waste generated. Waste impacts are not expected to be significant, and can be managed through mitigation measures in the approved REF.	No additional mitigation measures are proposed.

Aspect	Additional Impact	Additional Mitigation Measures
Hazards	Natural Hazards As detailed above, no salinity or acid sulfate soils are mapped within the areas disturbed by the proposed realignment. Infrastructure The approved REF details proposed activity is located within close proximity to hazardous infrastructure and infrastructure that if damaged, may pose a hazard through the disruption of essential basic services. Both Denison Bridge and Gordon Edgell Bridge are currently used for servicing arrangements such that no significant hazards are anticipated with strapping pipework to the side of each bridge. Notwithstanding, consistent with the approved REF, hazards and risks associated with the construction phase of the proposal are to be detailed in the CEMP prior to works commencing, including relevant Environmental Work Method Statements (EWMS) to ensure that works are conducted appropriately including in accordance with relevant acts, guidelines, and codes of practice (*i.e. *Occupational Health and Safety Act 2000*, Workcover NSW Work Near Overhead Powerlines Code of Practise, 2006). Subject to the implementation of appropriate mitigation measures, as detailed in the approved REF, no additional impacts associated with existing infrastructure are anticipated. Hazardous Materials The modification to the proposed activity is not anticipated to generate any significant changes to the use of hazardous materials or to the volume or type of waste generated. Subject to the implementation of appropriate mitigation measures, as detailed in the approved REF, no additional impacts associated with hazardous materials are anticipated.	No additional mitigation measures are proposed.
Resource Use		No additional mitigation measures are proposed.

Aspect	Additional Impact	Additional Mitigation Measures
Socio Economic Impacts	The majority of impacts associated with the realignment of the pipeline are expected to be short term in nature and limited to the construction phase of the project. Impacts are expected to be restricted to the travelling public and private landowners in proximity to the proposed activity. To minimise the potential for the modified alignments to result in any significant impacts to the existing community the following measures would be implemented: • Dust suppression would be maintained throughout construction; • All equipment would be well maintained to reduce unnecessary noise and air quality impacts; and • Access to properties would be provided throughout construction. Subject to the implementation of appropriate mitigation measures, including those addressing other potential impacts of the project (noise, visual, access and traffic arrangements) no significant socio- economic impacts are anticipated.	No additional mitigation measures are proposed.

5.1 Heritage assessment

A SoHI has been prepared to consider the impact of attaching the pipe to the state heritage listed Dension Bridge – attached as **Appendix C**.

A draft of the SoHI was provided to the Heritage Council and pre-application advise was sought. The project team briefed the Heritage Council via an online meeting on the 6 February 2024. The outcome of the meeting were the following resolutions:

1. *Thanks the representatives of the Bathurst City Council for their presentation on the proposed work at the Denison Bridge.*
2. *Considers the information in the summary paper prepared by Heritage NSW and the attached documents.*
3. *Supports in principle, the proposed installation of the pipeline to the side of Denison Bridge subject to the consideration of the submissions following the public exhibition of the proposal.*
4. *Agrees that the section 60 application for the works to Denison Bridge is determined by Heritage NSW under delegation from the Heritage Council.*

Further to the above, Heritage NSW staff provided a number of additional recommendations, including:

- Dimensioned drawings showing exactly how the pipe will be attached to the bridge. The details of the brackets and how they will attach to the bridge.
- The drawings should clearly identify the SHR boundary and the location of all works in relation to it.
- Please ensure that the comments made by the Approvals Committee are addressed appropriately, including the comment regarding the colour scheme of the pipe.
- The drawings should also show the location entry and exit points on the ground before getting attached to the bridge. Any additional support structures if required need to be adequately documented.

With respect to the SoHI, the following advice was provided:

- Check the *Guidelines For Preparing A Statement Of Heritage Impact 2023* and follow the template
- Clearly define the work that the application is seeking approval for
- The impact assessment section should be strengthened. It should clearly outline how the proposed works would/would not impact the existing original fabric of the bridge, the views, setting of the item, use etc. (refer to the guidelines). Address the concerns regarding the cumulative impact. Detail the mitigation measures if any.
- The SOHI should avoid inconsistent details.

The SoHI has been updated to reflect the resolutions of the Heritage Council and above advice from Heritage NSW officers.

The updated SoHI concludes that the proposed works will not have an adverse effect on the heritage significance of the Denison Bridge State Heritage listed item.

The following recommendations are outlined in the updated SoHI:

- Install the additional service pipe on the northern frontage of the bridge (downstream side) to mitigate visual impacts to heritage and the surrounding landscape.
- Install the pipe below existing infrastructure pipes located on the northern side of Denison Bridge and provide consistency with the existing bridge colour scheme; a grey pipe is recommended.
- Consider the consolidation of existing brackets integrating the new pipeline with the existing structure and minimising the potential for adverse impacts.
- Avoid the original fabric of Denison Bridge and attach new pipework to the non-original fabric where possible.
- Treat and repaint the existing fabric of Denison Bridge, subject to funding. This is proposed to enhance and cohesively connect the heritage item with existing and new fabric, avoiding visual detraction and the juxtaposition between new infrastructure and existing materials. This may occur after pipe installation.
- Implement and replace existing interpretation panels for Denison Bridge. New interpretation panels could be installed in proximity to Denison Bridge, detailing the timeline of the bridge's construction and changes to its use and appearance over time.
- Attain a section 60 approval through Heritage NSW before works proceed.

On the basis of the above, and subject to the gaining of delegated approval from Heritage NSW pursuant to Section 60 of the Heritage Act, the project may proceed with caution.

In addition, it is noted that the proposed realignment of the pipeline will pass through heritage significant parklands located on the southern side of Gordon Edgell Bridge (Lot 1 DP 126047), identified as:

- "Bicentennial, Ohkuma and Peace Parks, Wambuul/Macquarie River and Bathurst Flagstaff site and Declaration Monument, Pillars of Bathurst, Footsteps in Time Pillar and Steam Roller" (I67).

These parklands are collectively listed as an item of local heritage significance via the LEP but are not identified as an item of state heritage significance: Subject to clause 5.10(4) of the BLEP 2014, BRC must consider the effect of the proposed development on the heritage significance of an item or area concerned prior to granting development consent.

The previously approved pipeline route transected this same heritage item, passing underneath a portion of the parkland located further to the south, southeast of Hereford Street.

Given existing servicing arrangements, no significant additional impacts to the parkland are anticipated to result from the proposed activity. Minor excavation and trenching would be designed to avoid heritage significant features of the parkland and would be conducted in accordance with appropriate measures detailed in a CEMP and OEMP minimising the potential for adverse impacts. Trenching of the pipeline beneath the grounds surface would additionally limit the potential for visual impacts to the existing heritage value of the parkland.

For the avoidance of doubt and with respect to works within the locally significant parklands (I67):

- Section 2.10-2.15 of *State Environmental Planning Policy (Transport and Infrastructure) 2021* (the Infrastructure SEPP) provides consultation requirements for development including where it impacts council infrastructure or services, heritage items, flood liable land, is within a coastal zone. Section 2.17 of the Infrastructure SEPP, however, provides that consultation under sections 2.10-2.15 is not required if the relevant council responsible for the development is also the proponent. As BRC is both the proponent and relevant local council, no consultation under Section 2.10-2.15 is required.
- While the proposed activity as modified includes works within the curtilage of a locally significant heritage item (I67), the assessment provided above has considered that the proposed activity is unlikely to result in significant impacts. As such Section 2.11 of the Infrastructure SEPP is not considered to apply and no further assessment of heritage impact to this item is required.
- The proposed development near Gordon Edgell Bridge, including the development of pipelines, is therefore permissible without consent, pursuant to Section 2.159(1) of the Infrastructure SEPP.
- While no formal approval requirements under the Heritage Act apply to the heritage significant parklands (I67), appropriate management measures would be implemented during construction and operation to minimise the potential for adverse impacts.

5.2 Geomorphic assessment

In order to ensure that the proposed change to the alignment did result in an increase geomorphic risk related to the introduction of pipe protrusions in the riparian zone, a geomorphic assessment of the activity was prepared by Fluvial Systems – refer **Appendix E**.

The geomorphic assessment concluded that there was no evidence of the river having exceptional instability at those locations. The alignment of the pipeline in the lee of the bridge structures is such that the pipeline would create very little additional hydraulic, and thus hydrogeomorphic, impact over that of the existing structure. Overall, the geomorphic impact of the proposed pipeline crossings over Deniston and Herford Street bridges was assessed to be negligible.

To minimise this risk it is important to maintain ground surface cover in good condition, whether that be ground vegetation cover, or fortified cover such as rip-rap, concrete or gabions.

6. OTHER APPROVALS

A summary of licensing and approval requirements applying to the water harvesting project is provided in **Table 6.** A description is provided within the table, detailing how the requirement relates to the proposed change addressed by this addendum as compared to the approved REF.

Table 6 – Updated Summary of Licensing and Approvals

Instrument / Entity	Requirement	Timing	Description with respect to proposed change
Rail Infrastructure Manager	Any works conducted within rail land may not proceed without first gaining an access license and Construction Approval from the applicable Rail Infrastructure Manager.	Prior to works commencing in affected areas.	No change to approval requirement. The requirement is unaffected by the proposed change.
Water Management Act 2000	A water supply works approval, or an exemption under clause 39A of the Water Management (General) Regulation 2018, must be gained. [Section 90 of the Act]	Prior to works commencing in affected areas.	The updated design must be assessed as part of this approval requirement. **Note:** No changes to the existing WAL are expected as a result of the proposed change except for the inclusion of the entire pipeline alignment (as modified) as a nominated water supply work.
Fisheries Management Act 1994	The potential requirement to gain a Part 7 permit under the FM Act in	Prior to works commencing	The updated design must be assessed as part of this approval requirement.

Instrument / Entity	Requirement	Timing	Description with respect to proposed change
	relation to dredging and reclamation works in the Wambuul/Macquarie River and other waterways (can potentially be dispensed with subject to the outcome of the WSWA process)	in affected areas.	Given the deletion of underbored segments no significant dredging or reclamation works are anticipated for the proposed modified activity.
Roads Act 1993	Approval under section 138 for works affecting a road, including the need to gain the concurrence of TfNSW in relation to any classified road.	Prior to works commencing	The updated design must be assessed as part of this approval requirement. **Note:** The proposed modified activity requires an approval for works that are located within road reserves pursuant to Section 138 of this Act. The change to the activity, however, does not result in direct impacts to a classified road. Concurrence from TfNSW, nevertheless, is still required for the broader project with other pipeline alignments impacting classified roads.
Heritage Act 1977	An application for a streamlined Section 60 approval under the Heritage Act 1977, should be obtained for the Bathurst water harvesting scheme excavation works in relation to works within the curtilage of the Denison Bridge.	Prior to works commencing in affected areas.	The updated design must be assessed as part of this approval requirement. The proposed activity as modified includes works within the curtilage of two heritage items including: • Denison Bridge (SHR #01665, LEP #I53) and • Heritage significant parklands near Gordon Edgell Bridge (LEP #I67) Denison Bridge is a state heritage listed item. A section 60 approval under the Heritage Act is therefore required for the pipeline realignment crossing Denison Bridge.

Instrument / Entity	Requirement	Timing	Description with respect to proposed change
			No section 60 approval is required for works impacting the locally heritage significant parklands (I67). Appropriate mitigation measures, however, will be implemented to minimise the potential for adverse impacts.
Local Government Act 1993	The potential for the need to gain a section 60 approval under the Local Government Act 1993.	If applicable, prior to operation of the scheme	The updated design must be assessed as part of this approval requirement. The proposed activity as modified includes the extension of an existing water treatment system and therefore requires an approval pursuant to section 60 of this act.
Crown Land Management Act 2016	Concurrence from NSW Department of Industry – Crown Lands for works in relation Crown land.	Prior to works commencing in affected areas	The updated design must be assessed as part of this approval requirement. The proposed activity as modified impacts portions of Crown land and concurrence is therefore required.

7. CONCLUSION

The modification of the proposed activity has been subject to assessment under Part 5 of the EP&A Act. This REF Addendum has fully examined and considered all possible matters affecting or likely to affect the environment by reason of the proposed activity by reference to information available at the time of assessment preparation.

The proposed activity as described in this REF Addendum and the original REF meets the proposed objectives but has the potential to result in some impacts. Mitigation measures as detailed in this REFA and the original REF would minimise the potential for these impacts to occur during the construction and operation of the proposed activity. The proposed activity would ultimately facilitate the delivery of the Bathurst WHP and provide improvements to the water security of Bathurst. On balance the proposed activity is considered justified and subject to the implementation of appropriate mitigation measures is considered unlikely to result in any significant additional impacts.

APPENDICES

APPENDIX A

SECTION 171 CHECKLIST

In accordance with Section 171(2) of the *Environmental Planning and Assessment Regulation 2021,* the following factors, listed via the Guidelines for Division 5.1 assessments (DPIE, 2022), must be taken into account by the determining authority when considering the likley impact of the proposed acitvitiy.

The assessment of likely impacts associated with the porposed activites provided by this REF has been prepared with consideration of the below factors.

Section 171 Factors	Response
(a) the environmental impact on the community	Any adverse environmental impacts to the community will be generally limited to short-term impacts experienced during the construction phase including noise and vibration, air quality amenity and traffic related impacts. These impacts will be minimised and managed through the implementation of appropriate mitigation measures including management plans implemented by the nominated contractor. There is limited potential for the proposed activity to result in significant impacts to the community during operation, in relation to the proposed changes via this addendum, on the basis that the existing bridges currently carry pipe work and infrastructure, and the proposal remains consistent with that. Impacts are acceptable. The delivery of the project, on balance, is considered beneficial for the community of Bathurst aiming to facilitate an improvement of the town's water security.
(b) the transformation of the locality,	The proposed work will not result in the transformation of a locality. The works are confined to pre-disturbed land and existing bridges, which currently host services.
(c) the environmental impact on the ecosystems of the locality,	Vegetation removal is restricted to the excavation of maintained groundcover in the waterfront land areas adjacent to the river. No clearing or pruning of native vegetation is required to enable the development. As detailed in **Table 5** the proposed activity is situated on disturbed land and is therefore considered unlikely to result in significant impacts to ecosystems or biodiversity.
(d) reduction of the aesthetic, recreational, scientific or other environmental quality or value of the locality,	The proposed amendment to the approved scheme requires a realignment of the pipeline to avoid underboring the river, which is a positive outcome through avoidance of impacts to the river and reduces the risks associated with construction. Minor residual impacts to the heritage listed bridge are acceptable in the context of the available options. While some visual impacts for surrounding recreational receivers and passing traffic may be experienced during operation, the activity is consistent with the existing use of the bridge for the transfer of services. No significant impacts to the aesthetic, recreational, scientific or other

Section 171 Factors	Response
	environmental quality or value of the area are therefore anticipated as a result of the activity.
(e) the effects on any locality, place or building that has— *(i) aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance, or* *(ii) other special value for present or future generations,*	The original REF, and this addendum, has determined that the proposed activity is unlikely to result in significant impacts on any aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific, social significance or other special values for present or future generations. The provision of appropriate management measures for visual amenity, noise and vibration, heritage and for socio-economic impacts, as summarised in **Table 5**, will ensure that the potential for any adverse impact is minimised.
(f) the impact on the habitat of protected animals, within the meaning of the Biodiversity Conservation Act 2016,	No adverse impacts on any fauna species or their habitats are anticipated to result from the proposed activity. No clearing or pruning of trees is required to enable the development and the site is currently disturbed by maintenance of waterway areas as parklands.
(g) the endangering of a species of animal, plant or other form of life, whether living on land, in water or in the air,	There will be no significant impacts upon any species of animal, plant or other form of life, whether living on land, in water or in the air. The proposal reduces the likelihood for impacts to the riverine environment that may be caused had underboring occurred as planned.
(h) long-term effects on the environment,	There are no anticipated long-term effects upon the environment anticipated as result of the proposed activity.
(i) degradation of the quality of the environment,	No degradation to the environment during either the construction or the operation is anticipated. The waterfront land is maintained as parkland areas and will be returned to their pre-development state upon completion of the works. Mitigation measures will be implemented to manage any potential impacts.
(j) risk to the safety of the environment,	There is no risk to the safety of the environment.
(k) reduction in the range of beneficial uses of the environment,	The works will not reduce the beneficial use of the environment.
(l) pollution of the environment,	The proposed activity has the potential to result in minor localised pollution including to heritage, air quality, local amenity and surface water (refer to **Table 5**).

Section 171 Factors	Response
	Appropriate management controls would be implemented throughout construction to minimise the potential for pollution of the environment.
(m) environmental problems associated with the disposal of waste,	Waste generated during the proposed activity will be appropriately classified and disposed of at a licence waste facility. It is anticipated that waste produced by the construction and operation of the activity will be handled in accordance with typical waste handling policies including those already implemented by the WFP. Subject to the implementation of waste management measures no significant environmental problems associated with the disposal of waste are expected.
(n) increased demands on natural or other resources that are, or are likely to become, in short supply,	The activity will not result in any adverse impacts to natural resources that are, or are considered likely to become, in short supply.
(o) the cumulative environmental effect with other existing or likely future activities,	The proposed works will not result in any cumulative impacts on any existing or future activities.
(p) the impact on coastal processes and coastal hazards, including those under projected climate change conditions,	Given the site's location, the proposed works will have no impact upon coastal process or contribute to coastal hazards.
(q) applicable local strategic planning statements, regional strategic plans or district strategic plans made under the Act, Division 3.1,	The proposed works have no bearing on the implementation of the local strategic planning statement regional strategic plan or community plan. The proposed activity, nevertheless, general aligns and supports the objectives and planning priorities of these plans. Notwithstanding the above the Macquarie Castlereagh Regional Water Strategy identifies the water harvesting scheme as a key measure in improving urban water security. The changes to the approved pipeline are critical to the successful delivery of the project and thereby deliver improved water security for the city of Bathurst.
(r) other relevant environmental factors.	No other relevant environmental factors are considered as applicable.

APPENDIX B

PROJECT DRAWINGS

APPENDIX C

STATEMENT OF HERITAGE IMPACT

APPENDIX D

AHIMS SEARCH

APPENDIX E

Geomorphic assessment

EXISTING SERVICES

ALL EXISTING SERVICES ARE TO BE LOCATED BY THE CONTRACTOR THROUGH CONTACTING THE RELEVANT SERVICE AUTHORITY PRIOR TO THE COMMENCEMENT OF ANY WORK

N

LEGEND:

- PROPOSED DN450 GRP PN16 STORMWATER RISING MAIN UPDATED ALIGNMENT
- PROPOSED STORMWATER RISING MAIN PREVIOUS ALIGNMENT
- PROPOSED STOP VALVE (WSAA DWG WAT-1304)
- PROPOSED SCOUR VALVE (WSAA DWG WAT-1307)
- PROPOSED AIR VALVE (WSAA DWG WAT-1302)
- PROPOSED THRUST BLOCK (WSAA DWG WAT-1205/1207)
- 650.0 EXISTING MAJOR CONTOUR (1.0m INTERVAL)
- EXISTING MINOR CONTOUR (0.5m INTERVAL)
- LV EXISTING LV ELECTRICAL
- T EXISTING TELECOMMUNICATIONS
- G EXISTING GAS
- dOF EXISTING FIBRE OPTIC CABLE
- W EXISTING WATER PIPE
- S EXISTING SEWER
- D EXISTING STORMWATER
- EXISTING STOP VALVE
- EXISTING SEWER MANHOLE
- EXISTING TELECOMMUNICATIONS PIT
- EXISTING WATER METER
- EXISTING HYDRANT
- EXISTING ELECTRICAL POLE
- EXISTING LIGHT POLE
- EXISTING GRATED INLET PIT
- 'I.L.unk' UNKNOWN INVERT LEVEL
- 'unkDIA' UNKNOWN DIAMETER
- H.DEF HORIZONTAL DEFLECTION
- V.DEF VERTICAL DEFLECTION

INFORMATION - NOT FOR CONSTRUCTION

DATE	REV	DESCRIPTION	REC	APP
22/12/2023	A	ALTERNATIVE PIPELINE ALIGNMENT	IW	DW

REVISIONS

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PROJECT MANAGER: DW

SCALE
0 15 30 45m
SCALE 1:750(A1)
ORIGINAL SHEET SIZE A1

CLIENT: BATHURST REGIONAL COUNCIL
PROJECT: BATHURST STORMWATER HARVESTING SCHEME - STAGE 1
LOCATION: BATHURST, NSW
SHEET TITLE: DENISON BRIDGE - ALTERNATIVE PIPELINE ALIGNMENT

JOB CODE: 220224_13
SHEET NUMBER: C001
REV: 1

EXISTING SERVICES

ALL EXISTING SERVICES ARE TO BE LOCATED BY THE CONTRACTOR THROUGH CONTACTING THE RELEVANT SERVICE AUTHORITY PRIOR TO THE COMMENCEMENT OF ANY WORK

N

LEGEND:

- PROPOSED DN450 GRP PN16 STORMWATER RISING MAIN UPDATED ALIGNMENT
- PROPOSED STORMWATER RISING MAIN PREVIOUS ALIGNMENT
- PROPOSED STOP VALVE (WSAA DWG WAT-1304)
- PROPOSED SCOUR VALVE (WSAA DWG WAT-1307)
- PROPOSED AIR VALVE (WSAA DWG WAT-1302)
- PROPOSED THRUST BLOCK (WSAA DWG WAT-1205/1207)
- EXISTING MAJOR CONTOUR (1.0m INTERVAL)
- EXISTING MINOR CONTOUR (0.5m INTERVAL)
- EXISTING LV ELECTRICAL
- EXISTING TELECOMMUNICATIONS
- EXISTING GAS
- EXISTING FIBRE OPTIC CABLE
- EXISTING WATER PIPE
- EXISTING SEWER
- EXISTING STORMWATER
- EXISTING STOP VALVE
- EXISTING SEWER MANHOLE
- EXISTING TELECOMMUNICATIONS PIT
- EXISTING WATER METER
- EXISTING HYDRANT
- EXISTING ELECTRICAL POLE
- EXISTING LIGHT POLE
- EXISTING GRATED INLET PIT
- 'I.L.unk' UNKNOWN INVERT LEVEL
- 'unkDIA' UNKNOWN DIAMETER
- H.DEF HORIZONTAL DEFLECTION
- V.DEF VERTICAL DEFLECTION

INFORMATION - NOT FOR CONSTRUCTION

DATE	REV	DESCRIPTION	REC	APP
22/12/2023	A	ALTERNATIVE PIPELINE ALIGNMENT	IW	DW

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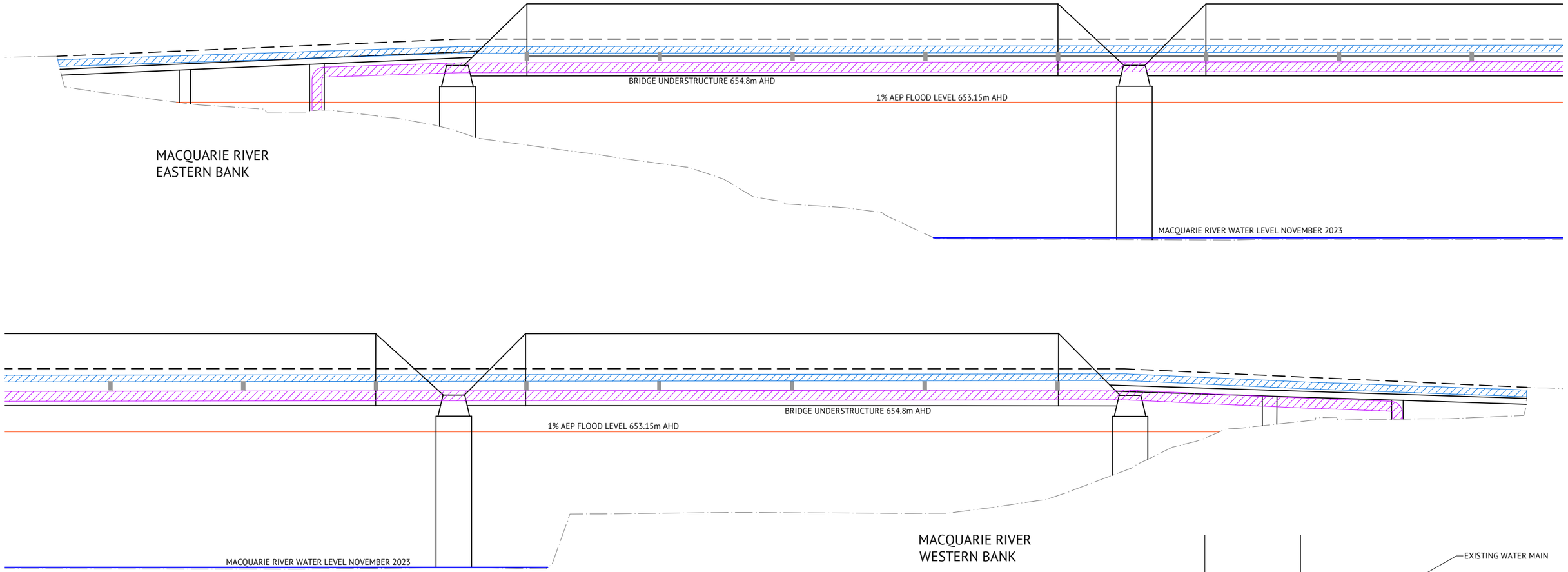
CHECKED: DW
PROJECT MANAGER: DW

SCALE
0 15 30 45m
SCALE 1:750(A1)
ORIGINAL SHEET SIZE A1

CLIENT: BATHURST REGIONAL COUNCIL
PROJECT: BATHURST STORMWATER HARVESTING SCHEME - STAGE 1
LOCATION: BATHURST, NSW
SHEET TITLE: HEREFORD STREET BRIDGE - ALTERNATIVE PIPELINE ALIGNMENT

JOB CODE: 220224_13
SHEET NUMBER: C002
REV: 1



1 C001 SECTION
SCALE 1:250

LEGEND:

- PROPOSED DN450 DICL PN20 STORMWATER RISING MAIN
- EXISTING WATER MAIN
- DENISON BRIDGE (STRUCTURE)
- DENISON BRIDGE (DECK)
- 1% AEP FLOOD LEVEL
- EXISTING GROUND LEVEL
- MACQUARIE RIVER WATER LEVEL NOV 2023
- EXISTING, VACANT MOUNTING POINTS

EXISTING SERVICES

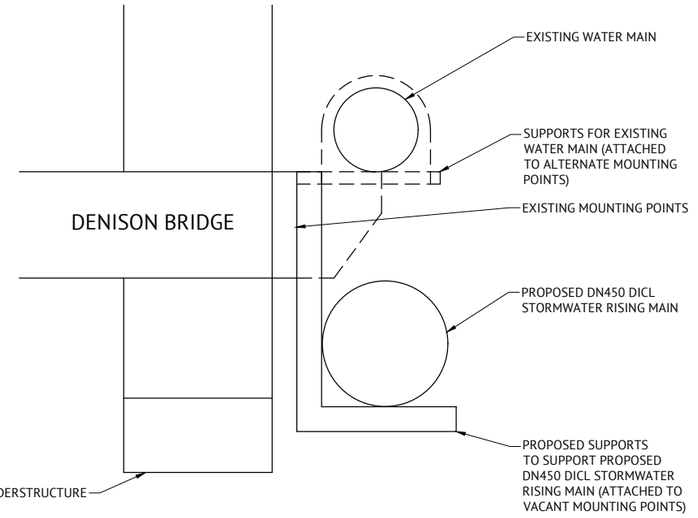
ALL EXISTING SERVICES ARE TO BE LOCATED BY THE CONTRACTOR THROUGH CONTACTING THE RELEVANT SERVICE AUTHORITY PRIOR TO THE COMMENCEMENT OF ANY WORK

NOTE

LOCATION AND EXTENT OF WORKS, BRIDGE STRUCTURE AND NATURAL FEATURES ARE CONCEPTUAL ONLY & SUBJECT TO DETAILED DESIGN.

PRELIMINARY
NOT FOR CONSTRUCTION

PLATE 1: DENSION BRIDGE PROPOSED PIPE MOUNTING LOCATION



2 C001 SECTION TYPICAL PIPE MOUNTING
SCALE NTS

INFORMATION - NOT FOR CONSTRUCTION

DATE	REV	DESCRIPTION	REC	APP
22/12/2023	A	ALTERNATIVE PIPELINE ALIGNMENT	IW	DW

REVISIONS

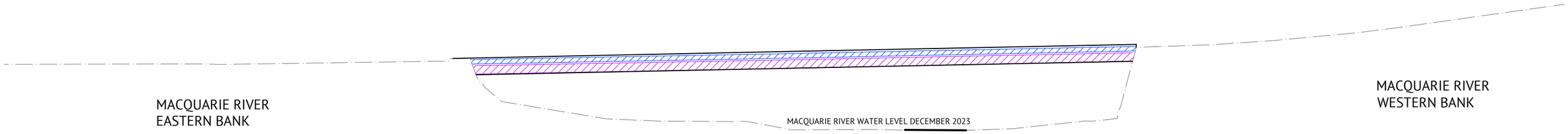
Premise
ORANGE OFFICE
154 PEISLEY STREET
ORANGE, NSW 2800
PH: (02) 6393 5000
WEB: www.premise.com.au

DESIGNED IW
CHECKED DW
PROJECT MANAGER DW

SCALE
0 15 30 45m
SCALE 1:750(A1)
ORIGINAL SHEET SIZE A1

CLIENT BATHURST REGIONAL COUNCIL
PROJECT BATHURST STORMWATER HARVESTING SCHEME - STAGE 1
LOCATION BATHURST, NSW
SHEET TITLE DENISON BRIDGE - TYPICAL SECTIONS

JOB CODE 220224_13
SHEET NUMBER C003
REV A



3 C002 SECTION
SCALE 1:100

LEGEND:

- PROPOSED DN375 DICL PN20 STORMWATER RISING MAIN
- EXISTING WATER MAIN
- HEREFORD STREET BRIDGE (STRUCTURE)
- EXISTING GROUND LEVEL
- MACQUARIE RIVER WATER LEVEL DEC 2023

PRELIMINARY
NOT FOR CONSTRUCTION

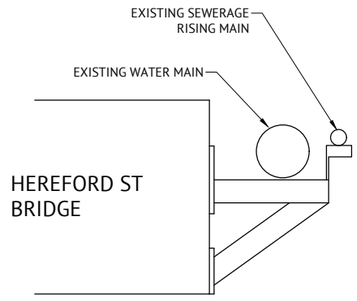
EXISTING SERVICES

ALL EXISTING SERVICES ARE TO BE LOCATED BY THE CONTRACTOR THROUGH CONTACTING THE RELEVANT SERVICE AUTHORITY PRIOR TO THE COMMENCEMENT OF ANY WORK

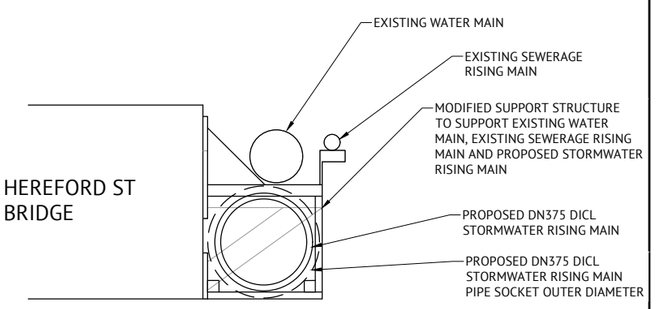
NOTE

LOCATION AND EXTENT OF WORKS, BRIDGE STRUCTURE AND NATURAL FEATURES ARE CONCEPTUAL ONLY & SUBJECT TO DETAILED DESIGN.

PLATE 2: HEREFORD BRIDGE PROPOSED PIPE MOUNTING LOCATION



EXISTING MOUNTING



PROPOSED MOUNTING

4 C002 SECTION TYPICAL PIPE MOUNTING
SCALE NTS

INFORMATION - NOT FOR CONSTRUCTION

DATE	REV	DESCRIPTION		
22/12/2023	A	ALTERNATIVE PIPELINE ALIGNMENT	IW	DW

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DESIGNED IW
CHECKED DW
PROJECT MANAGER DW

SCALE
0 15 30 45m
SCALE 1:750(A1)
ORIGINAL SHEET SIZE A1

CLIENT BATHURST REGIONAL COUNCIL
PROJECT BATHURST STORMWATER HARVESTING SCHEME - STAGE 1
LOCATION BATHURST, NSW
SHEET TITLE HEREFORD STREET BRIDGE - TYPICAL SECTIONS

JOB CODE 220224_13
SHEET NUMBER C004
REV A

BATHURST REGIONAL COUNCIL

Denison Bridge Upgrade

STATEMENT OF HERITAGE IMPACT

Report No: 220228_SoHI
Rev: 001D
1 March 2024

Premise

DOCUMENT AUTHORISATION					
Revision	**Revision Date**	**Proposal Details**			
A	21/12/23	Internal review			
B	22/12/23	For issue to Heritage NSW			
C	10/02/24	Revised draft post Heritage Council meeting			
D	01/03/24	Final			
Prepared By		**Reviewed By**		**Authorised By**	
Tamera Rudd		Latisha Ryall		David Walker	

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1. THE HERITAGE ITEM

1.1 Introduction

Premise Australia Pty Ltd (Premise) have been engaged by Bathurst Regional Council (BRC) to prepare a Statement of Heritage Impact (SoHI) to support an update/addendum to a Review of Environmental Factors (REF) in relation to the Bathurst Water Harvesting Scheme (WHS).

The proposed development is subject to a Heritage NSW Section 60 approval as works will be undertaken on a State Heritage Listed Item SHR ID#01960 'Denison Bridge'. The development is located within the Bathurst Heritage Conservation Area (BHCA).

The proposed works involve installation of a pipe on the western (downstream) elevation of the Denison Bridge to service critical water infrastructure for the city of Bathurst as part of the Bathurst WHS.

1.1.1 AUTHORSHIP AND ACKNOWLEDGMENT

This report was prepared by Tamera Rudd (Graduate Archaeologist, Premise) and Latisha Ryall (Archaeologist, Premise). Management review was undertaken by David Walker (General Manager).

A site inspection was conducted on 7 December 2023 by Tamera Rudd and Latisha Ryall.

Consultation with the Heritage Council of NSW has also been undertaken for the project.

1.1.2 REPORT METHODOLOGY

The objective of the SoHI is to assess the heritage impacts of the proposed works on the state heritage listed Denison Bridge and on the surrounding heritage landscape.

The report has been prepared in accordance with the NSW Department of Planning and Environment (NSWDPE) *Guidelines for preparing a statement of heritage impact 2023* and the *Assessing heritage significance 2023* guidelines. The report also incorporates the best practices outlined in the Burra Charter (Australia ICOMOS 2013).

1.1.3 REPORT LIMITATIONS

This report is limited to the assessment of significance and heritage impacts of the site only and does not address archaeological impacts.

The SoHI does not address Aboriginal cultural heritage.

It is important to note also that the State Heritage Inventory (SHI) contains three separate listings for the Denison Bridge. These include:

- 'Denison Bridge' local government (LEP #I53).
- 'Denison Bridge' Heritage NSW (SHR #01665).
- 'Denison Bridge over Macquarie River at Bathurst (Archived)' state government (heritage study).

The SHI Heritage NSW (SHR#01665) has been consulted for the purposes of this assessment.

1.2 Site Description

1.2.1 HERITAGE ITEM

The site encompasses State Heritage Listed Item (SHR ID#01960) 'Denison Bridge', which is situated on Bridge Street in the suburb of Kelso, approximately 2 kilometres (km) south of the Bathurst CBD. Access to the Denison Bridge is granted from the south via Kendall Avenue and Bridge Street and from the north, via River Road and Lions Club Drive.

The Denison Bridge is a wrought iron Pratt truss bridge which was constructed over the Macquarie River in 1870. The bridge is divided into three spans which are supported by large concrete piers or pylons. There are nine spans in total including three timber spans of 6.7m, three wrought iron spans of 34, 34.5 and 34m and another three timber spans of 6.7, totalling a total bridge length of 143.5m.

The bridge is an American Pratt truss design type and consists of wrought iron pony trusses. There are four pairs of cast iron cylinders (1.83m in diameter) supporting the bridge with wrought iron crossed rods. Timber approach spans are located underneath the bridge made of slab abutments, as well as timber supports made of large trestle frames, cross braced.

There are ten supported, panel Pratt style trusses which have horizontal I-sections from the upper chords which slope to the diagonals at the end, both of which have flat metal strips to help ease any tension. There are metal stringers on the metal cross girders and the piers consists of two metal cylinders of the same dimension and fabric.

Several service pipes are supported off the Denison Bridge on both the eastern and western facades, extending the length of the bridge. . On the upstream side of the bridge (eastern side) there are three sets of service pipes which run along the side of the bridge to the opposite side of the river. Two of these pipes are aligned above the timber beams while one is positioned below. On the downstream side (western side) of the bridge, a large service pipes is located which extends the length of the structure. This pipe is supported by three concrete structures and a metal beam. A second pipe is located below this which runs into the ground. On the eastern side of the Denison Bridge, a number of cement structures and metal beams have been constructed to support the service pipes. The pipe on the upstream side of the bridge meanders underneath the bridge at the eastern side and enters subsurface at ground level, the later section of the pipe is red in colour.

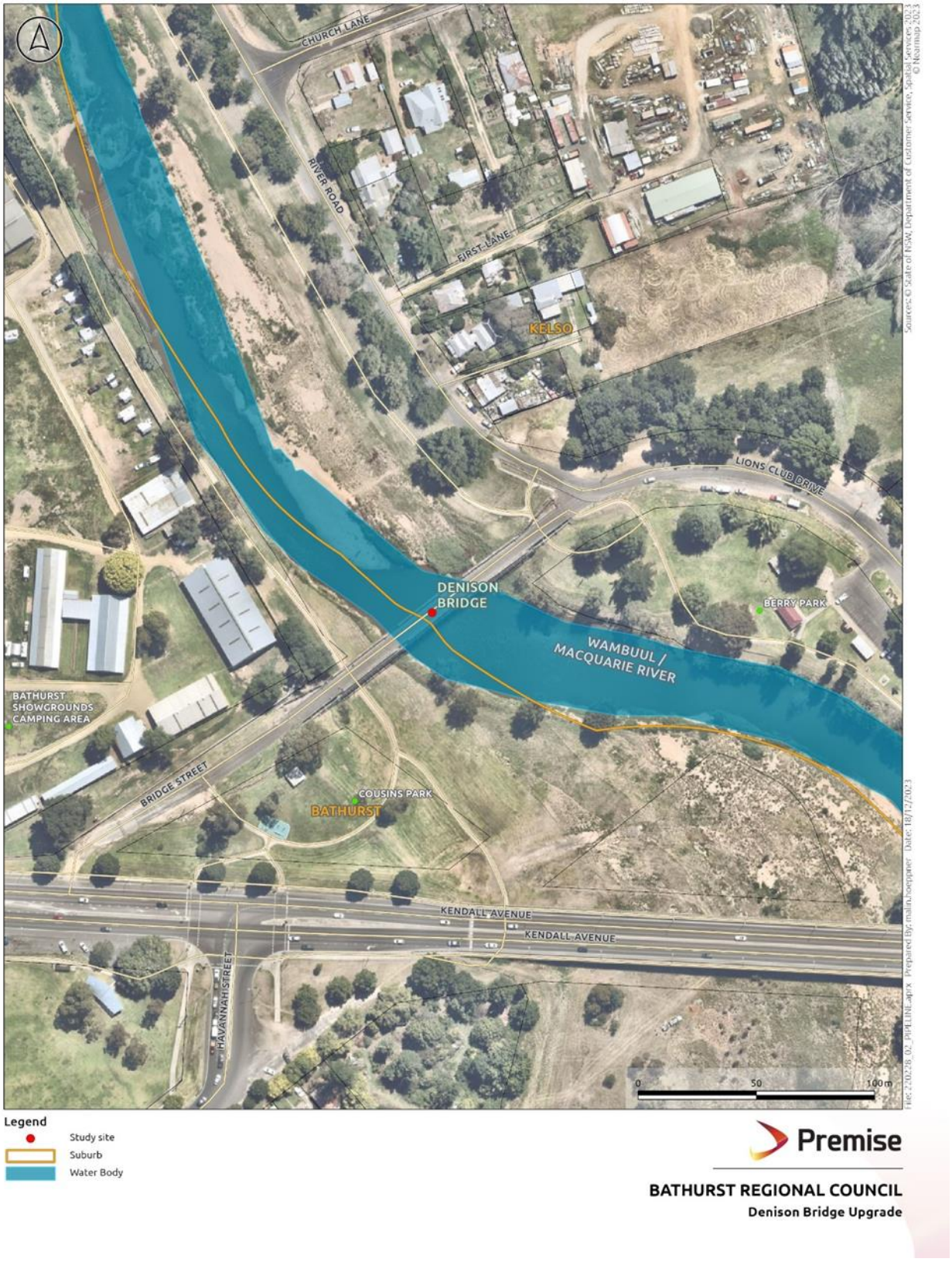
These service pipes and associated structures are not original fabric and were added to the Denison Bridge post construction from the 1960s onwards (**Section 3.2.4**) .

The deck of the bridge was originally made of wood panels however is now covered in bitumen. There are eight steel lamp posts positioned along the deck of the bridge on both the east and western sides which are black in colour. A metal fence (green in colour) has been constructed around the internal deck, most likely at the time the bridge was transformed into a pedestrian bridge. One interpretation panel is located on the western (downstream facing) side of the bridge which depicts a photograph from c.1955 of individuals swimming at the beach along the Macquarie River. The original PN Russell & Co makers plate is located on an iron truss on the downstream side of the bridge (**Figure 24**). At the entrance/egress point of the bridge, four posts have been installed (green in colour), approximately one metre in height which restrict vehicle access along the bridge.

The surrounding area consists of a number of walking paths which have been constructed along the Macquarie River and link to the bridge, emphasising the areas use for recreational activities. It was noted during the site inspection that the context on the upstream (eastern) side of the bridge was less effected by recent alterations and additions to the bridge and nearby areas than the downstream (western) side was. The introduction of the large cement structures on both the southern and northern banks of the of the river (along the downstream side of the bridge) have had the most prominent impact on the context of the bridge, particularly views of the bridge from this angle. While service pipes have been added to the bridge on the upstream side, the effects are more prominent on the downstream.

The site is shown in **Figure 1.**

Figure 1 – The Site



1.2.2 HERITAGE LISTINGS

In NSW cultural heritage is managed under a three-tiered system: National, State and Local heritage. Certain sites and items may require management under all three levels or a combination of state and local or local only. The assessment area falls under the Local Heritage tier.

The legislative framework relevant to the study area is discussed below. The works will be assessed under Division 4.7 of the *Environmental Planning and Assessment Act 1979*.

Heritage listed items relevant to the study area were identified through a search of the following relevant state and federal statutory and non-statutory heritage registers on 1 December 2023:

- World, Commonwealth and National Heritage List;
- State Heritage Register (SHR) or the State Heritage Inventory (SHI) database;
- Section 170 Heritage and Conservation Registers;
- Bathurst Regional Local Environmental Plan 2014;
- National Trust Register; and
- Register of the National Estate (the Australian Heritage Database).

Statutory heritage listing relevant to the site are shown in **Table 1**.

Table 1 – Statutory heritage listings

Listing Type	Item Name and Document Details	Listing Number
State heritage register	*Denison Bridge*	SHR #01665
Local heritage item	*Denison Bridge*	LEP #I53
Local heritage conservation area	Bathurst Heritage Conservation Area	

The site is also listed on two non-statutory registers:

- The study area is listed on the Australian Heritage Database (formerly the Register of the National Estate). The Denison Bridge was listed on the RNE on 21 March 1978 (place ID: 15953) and is recognised for its technical accomplishment and style; and
- The study area is listed on the National Trust of Australia Register (listing ID # 870).

Nearby heritage listed items and the BHCA are shown in **Figure 2**.

1.2.3 SITE AND ITS CONTEXT

The site is located in Bathurst, in the Central Tablelands region of New South Wales. The site is located within the Bathurst Local Government Area (LGA) across the Counties of Bathurst and Roxburgh and the Parishes of Bathurst and Kelso. The Macquarie River meanders north to south through the town of Bathurst and can be crossed (within the Bathurst region) from the Denison Bridge (now a pedestrian bridge), Evans Bridge (four-lane vehicular bridge), the Old Bathurst Railway Bridge (railway access only) and the Gordon Edgell Bridge (vehicular and pedestrian access).

The site refers to the Denison Bridge, which is situated over the Macquarie River, along Bridge Street. Denison Bridge is located in the suburb of Kelso and can be accessed from the north via River Road and Lions Club Drive and from the south via Kendall Avenue which traverses onto Bridge Street. Land in surrounding areas is zoned predominately as RE1: Public Recreation under the BRLEP and includes sporting field complexes, parks and the showgrounds. The Macquarie River is utilised for a number of recreational activities also, including fishing.

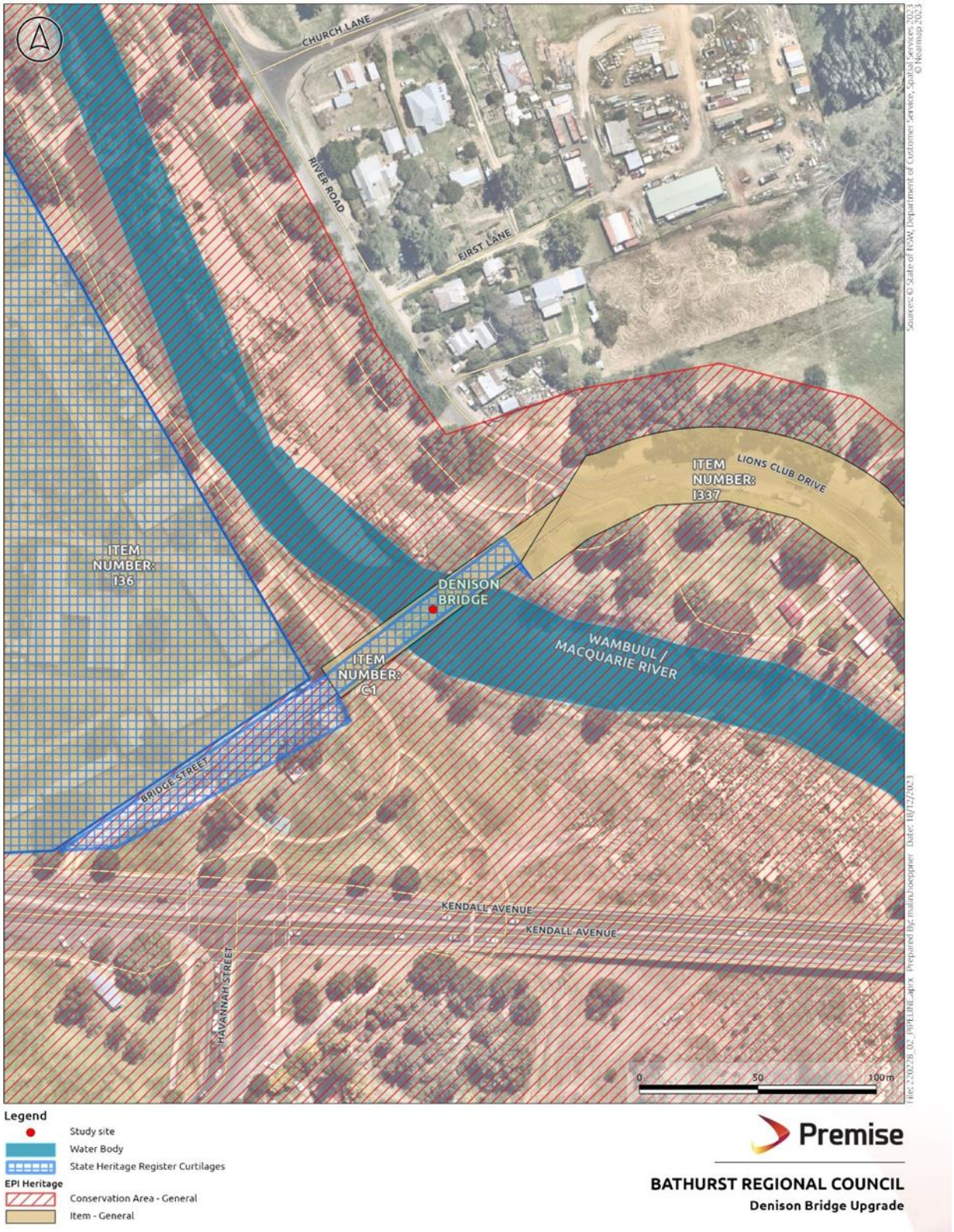
There are several items of heritage significance located in the vicinity of the Denison Bridge. The closest item is the Bathurst Showground, which is located approximately 250m northwest of the bridge and is listed as an item of state heritage significance under the SHR (SHR #01960). The Bathurst Showground complex includes a gravelled racetrack, grassed areas, with thirty-five buildings and plantings across the curtilage.

An associated heritage item related to the broader proposed pipeline works is the Waterworks and Bathurst Pumping Station (Item #I147), which is located approximately 1.8km south east from the Denison Bridge.

1.2.4 THE PROPOSED WORKS AREA

The plans provided at **Appendix A** provide a clear summary of the works proposed.

Figure 2 – Nearby Heritage Items



1.4 Site Summary History

1.4.1.1 Local Context

Bathurst was the first major inland European settlement established west of the divide after the crossing of the Blue Mountains in 1813 by explorers William Charles Wentworth, William Lawson and Gregory Blaxland. Exploration routes soon became roads providing easy access to new areas. After new areas had been surveyed by George Evans, soldier William Cox was commissioned by Governor Lachlan Macquarie to build a twelve-foot-wide road from Emu Plains to the Macquarie River via the Blue Mountains. William Cox also received the first land grant of 2,000 acres (or, 809 hectares) on land west of the mountains.[1] Governor Lachlan Macquarie established the town of Bathurst in 1815 with his exploration and spread of European settlement across Australia becoming one of his major achievements throughout his life. [2]

Bathurst was initially planned as an administrative centre for the expansion of the colony, to service government officials, soldiers and convicts who were stationed on the lands west of the Blue Mountains.[3] However, the major influx of pastoralists to the area created conflict with the traditional Wiradjuri people of the region, which resulted in armed resistance between the two groups, lasting for over a decade.

By 1817, explorer William Lawson also occupied land in the Bathurst region and in 1818 ten small land grants (of 50 acres each) were issued to ten settlers, located on the eastern bank of the Macquarie River, granted by Governor Macquarie. These first ten settlers of Bathurst were William Lee, Richard Mills, Thomas Kite, Thomas Swanbrooke, George Cheshire, John Abbott, John Blackman, James Blackman, John Neville and John Godden (as stated above, William Cox was granted 2000 acres of land previous to this, however, he did not live in Bathurst, only grazed sheep on these lands).[4] These grants were for the purpose of wheat, seed and cattle farming on the land.[5] Government officials settled on the opposite side of the river (western bank of the Macquarie River).[6] The farms owned by John Abbott and John Blackman were located adjacent to the Denison Bridge, on the eastern bank of the Macquarie River.

Larger land grants were acquired in the area as early as the 1820s as Governor Macquarie pushed for increased settlement by the early pioneers, with large areas overrun by stockmen and later permanent settlers.

By the 1820s, several large government buildings were erected in the town including brick barracks for soldiers, a store and granary and a large house for the commandment.[7] No records are available for other built structures at this time. Between 1820 -1840, little development occurred in the area as a result of climatic changes, emergence of bushrangers and continuing conflict with the Wiradjuri people, however the population of Bathurst did increase.[8]

In 1833, the first allotments in the town of Bathurst were sold and the first town plan was developed. The town plan centred on Seymour, Keppel, George, Ranken and Howick Streets and a police barracks, hospital, market, courthouse and gaol were also established during this time.[9]

[1] National Museum of Australia, Founding of Bathurst
[2] Ibid.
[3] Ibid.
[4] EMM, 2022: 29
[5] EMM, 2022: 29
[6] Barker, 1998
[7] Monitor Heritage Consultants, 2020: 8
[8] Ibid.
[9] Ibid.

The town grew steadily over the years and following the gold rush boom at nearby Ophir in the 1850s, many substandard structures for residential dwellings, outbuildings and small business were built, whilst the public buildings were constructed to a better standard.[10]

1.4.2 THE STUDY AREA

Despite the pace at which Bathurst was developing, a bridge was not constructed over the Macquarie River until 1856. The inability to cross over the river posed a number of issues for the settlers of the area who had been waiting for over forty years for a bridge to be constructed.[11] In February 1854, a public meeting took place in Bathurst to discuss the issue; and in March, the Bathurst Suspension Bridge Company was announced with a proposed capital of £10,000. At this time a Government officer was sent to Bathurst to choose a site along the Macquarie River to construct the bridge. The design of the bridge was based off the Yass bridge which had been recently constructed in NSW. By November 1854, carpenters arrived from Yass to begin the planning and construction of the bridge. [12]

In 1855, the construction of a long timber bridge with five laminated arches began. The bridge was reported to have costed £11,000 rather than £10,000 a previously reported. The bridge was designed by William Weaver and supervised by William Christofer Bennett from the Colonial Architects Department. The bridge was subsequently constructed under the supervision of Weaver's 'Clerk of Works' Mr. William Downey.

On the 1 January 1856, Governor Sir William Denison opened the bridge to the public. The event was celebrated by over 3,000 people and included a celebratory banquet with a roasted bullock.[13] The bridge was hereafter named the 'Denison Bridge' after Sir William Denison. The community of Bathurst were so impressed and pleased with the new bridge, that individuals donated money for a testimonial and present for William Downey who constructed the bridge. .

Eleven days after the Denison Bridge was opened, a second bridge was opened approximately 1 km downstream by George Ranken, a local entrepreneur.[14] This bridge was known as the Eglinton Bridge or Rankin's Bridge. However, in 1867, a flood swept through Bathurst which destroyed the Denison Bridge, its debris flowing down the Macquarie River, and destroying the Eglinton Bridge also. The destruction of the towns' only two bridges, left the community with limited means of crossing the river once more (only by ferry or ford). A temporary wooden bridge was placed near the remains of the original Denison Bridge.

Plans for a new bridge begun in late 1867 (just after the flood event) by William Christopher Bennett. The new Denison Bridge was constructed between 1869 to 1870 and was located 100 m downstream from the original bridge site and a new road alignment was created to allow access to the new bridge.[15] This bridge was designed by Gustavus Alphonse Morrell and William Bennett and constructed by Peter Nicol Russell from P.N Russell & Co. The bridge was constructed for £18,818, which consisted of iron which was manufactured in the P.N Russell & Co foundry in Sydney.

[10] Monitor Heritage Consultants, 2020: 8
[11] Engineering Heritage Committee, 1994: 11
[12] Ibid.
[13] SHI, 2003: https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=5051846
[14] Dunn for the State Library of NSW Sydney Dictionary, 2012
[15] Ibid.

Figure 3 – Denison Bridge Bathurst, NSW c.1872 (source: Trove)

1.4.2.1 GUSTAVUS ALPHONSE MORRELL

Gustavus Alphonse Morrell moved to Australia in 1863 and worked as a design engineer for defence installations.[16] This involved planning of the varying defence works in Sydney, Newcastle and Botany under Sir William Jervois and Major General Scratchley.[17] In 1867, Morrell was appointed as the Assistant Engineer to Commissioner Bennett for the Department of Roads. While he was working as an Assistant Engineer, Morrell designed the Denison Bridge, with his signature appearing on the original bridge drawings.

Morrell established his own business in 1879 with John Edward Kemp, as a consulting engineer and architect. During this period, he designed a number of significant buildings across the colony, including the Mutual Fire Assurance Company's office, Circular Quay, Her Majesty's Theatre in Pitt Street, Sydney and the Swifts Mansion in Darlington Point.[18] Morrell also oversaw a Royal Commission into the conditions of various railway bridges across the colony.

Due to his achievements and successes throughout his career, Morrell was elected as one of the founding members of the Engineering Association of NSW which was established on the 25 September 1870.

[16] SHI, 2003: https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=5051846
[17] Engineering Heritage Committee, 1994: 25
[18] State Library of NSW Sydney Dictionary, n.d.

1.4.2.2 WILLIAM CHRISTOPHER BENNETT

William Christopher Bennett (1824 - 1889) was and engineer and surveyor for a number of railways and drainage works, whilst also working on border surveys in Ireland prior to 1852 where he then moved to South America.[19]

In South America, Bennett explored the possibility of a canal link being introduced between the Magdalena River with Bogota. Bennett then moved to England from Cambodia, where he planned an embankment for the river Thames which did not go ahead, and instead Bennett moved back to Ireland to continue to work with railways. In 1853, Bennett once more went on an expedition of Latin America and soon returned back to England. In 1854, Bennett went to New Zealand in search of work, however, could not find any and arrived in Sydney in early 1855.

Upon Bennetts arrival to Sydney, he met Sir Thomas Mitchell and accepted a position in the Survey Department and nine months later, became an assistant engineer on sewage works, under Edward Bell. In 1857, Bennet was in charge of the railway extension in Campbeltown. In 1858, Bennett was made the assistant engineer of the main roads where he was worked on damaged roads and bridges. In 1859, Bennett became an engineer for the Department of Roads (which he was a founding member of). Bennett was in charge of a number of Commissions into water supply in sewage in Sydney and provided advice on a number of railways across NSW.[20]

Bennett became the Commissioner and Engineer for Roads and soon initiated plans for the new Denison Bridge shortly after the flood event destroyed the original. Bennett's signature is also on the drawings for the Denison Bridge (alongside Morrells), and it was Bennett's decision to construct a bridge that was of a high technical level but also economically beneficial to the community by ensuring it did not wash away in another flood event.

1.4.2.3 PN RUSSELL & CO

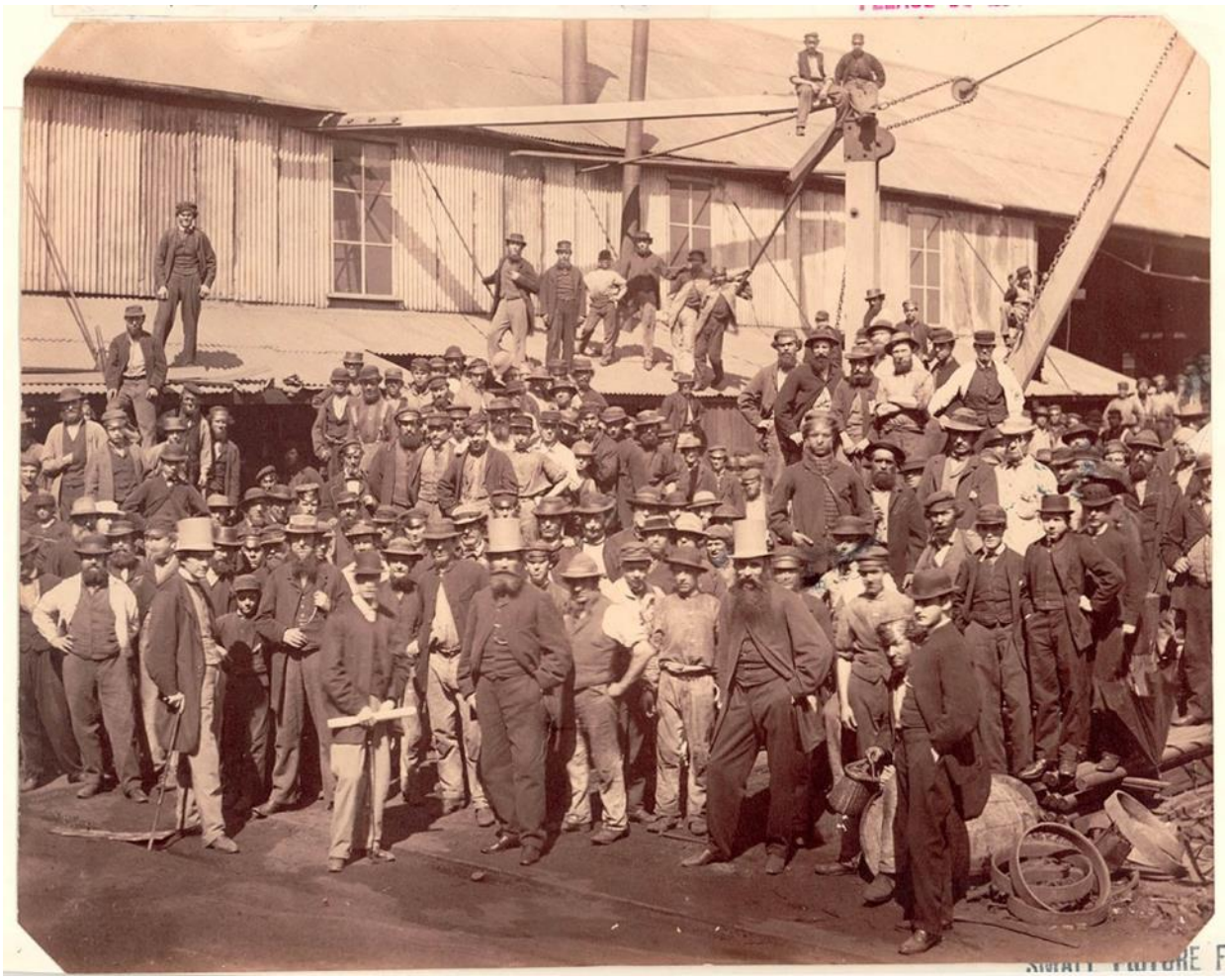
In 1832, Peter Nicol Russell (1816 – 1905), his father Robert Russell, and brothers Robert Jnr, Peter, George and John moved from England to Hobart, Tasmania, and opened a foundry and engineering business. As the settlement of Hobart was small, the business was not able to grow as speedily as the family would have liked and so, in 1838, they moved to Sydney, New South Wales. The family re-established their company in Sydney and named it 'Russell Bros' following their fathers' retirement. At their foundry, they manufactured iron work and sold imported machinery (including gas fittings, and steam engines from Scotland).[21] The company slowly expanded and in 1842, Peter Russell purchased a second foundry in George Street (without the support of his two brothers). Here, Peter worked on casting iron and brass into kitchen ranges, hot plates, parlour grates, balcony and tomb railings, stairs and palisades. At this time, the original foundry (now Russell & Co) which was run by Robert Jnr and John, also expanded into shipbuilding. However, in 1843, Russell & Co went into insolvency and shut down. Robert and John then joined Peter at his foundry and the fourth brother, George, operated the marine engineering works shipyard in Sussex Street, Sydney (referred to as George Russell & Co). In 1855, George Russell & Co was absorbed by PN Russell & Co who was thereafter run by all Russell brothers (aside from Robert who died in 1949) and JW Dunlop who was the company's foreman.

[19] Engineering Heritage Committee, 1994: 18
[20] Ibid.
[21] Dunn for the State Library of NSW Sydney Dictionary, 2012

PN Russell & Co operated as a foundry and an importing and exporting business. Their site in Darling Harbour became one of the largest engineering facilities in Australia and manufactured rail cars, rolling stock, road and railway brides, columns and ornamental architectural iron work, steam dredges, engines, gun boats for New Zealand and also crushed batteries for gravel and mining activities.[22] The company closed down in 1875 due to industrial unrest and a division between the owners of the company. At this time, the company had 1,000 staff and had a reported capital of £250,000.

Peter Russell donated £50,000 to the University of Sydney in 1895 (and a second donation in 1904) to endow the School of Engineering which was soon renamed the Peter Nicol Russell School of Engineering. Peter was also one of the founding members of the Engineering Association of NSW, alongside Gustavus Alphonse Morrell.

Figure 4 – The PN Russel & Co (source: State Library of NSW)[23]



[22] Ibid.
[23] State Library of NSW (n.d.) [Assembled workmen, P.N. Russell & Co., engineers & iron founders]

Figure 5 – Markers Plate on the Denison Bridge (source: Engineers Australia)

1.4.2.4 THE DENISON BRIDGE

After completion of the new structure in 1870, The Denison Bridge was officially opened by the Governor, who at this time, was the Earl of Belmore. The bridge opened one year after the death of Sir William Denison however, the bridge retained its original name, 'The Denison Bridge'. The establishment of a second bridge was necessary for the continued access and easy communication with nearby towns within the colony.

During the late 1800s, developments, including bridges, were heavily influenced by British technologies.[24] This bridge was the first America Pratt truss bridge constructed in New South Wales and emphasises an open design and construction which allowed for easy maintenance. This ability to easily maintain the bridge is likely part of the reason the Denison Bridge could carry traffic for over 130 years (and 153 years for pedestrians).[25]

The bridge is 337 feet long and consisted of three openings of approximately 100 feet each. The bridge was supported by cast iron piers which were formed of 6 feet cylinders bolted together, forming long pillars (as was the standard practice at the time, and for the thirty years following). Each pillar was filled with brick and cement to support a capstone at the top.[26] The bridge consists of six timber beam approach units with a 6.7m (or 22 foot). There are three iron trusses on the bridge, two of which span 33.82m (111 foot) and the third, 34.44m (113 foot).[27] The original deck of the bridge was constructed of timber.

[24] Engineers Australia, n.d.
[25] Ibid.
[26] Illustrated Australian News for Home Readers, 1872: 209
[27] Engineering Heritage Committee, 1994: 15

Following the construction of the Denison Bridge, the suburb of Kelso located on the eastern bank of the Macquarie River began to grow throughout the 19th and 20th centuries. This area was dominated by market gardens and some small pastoral holdings, which helped to support the towns commercial centre over this period. [28]

Footways were incorporated into the original design of the Denison Bridge, however, were not built when the bridge was constructed. In 1950, the Department of Main Roads installed a steel footbridge on the upstream side of the bridge. [29]

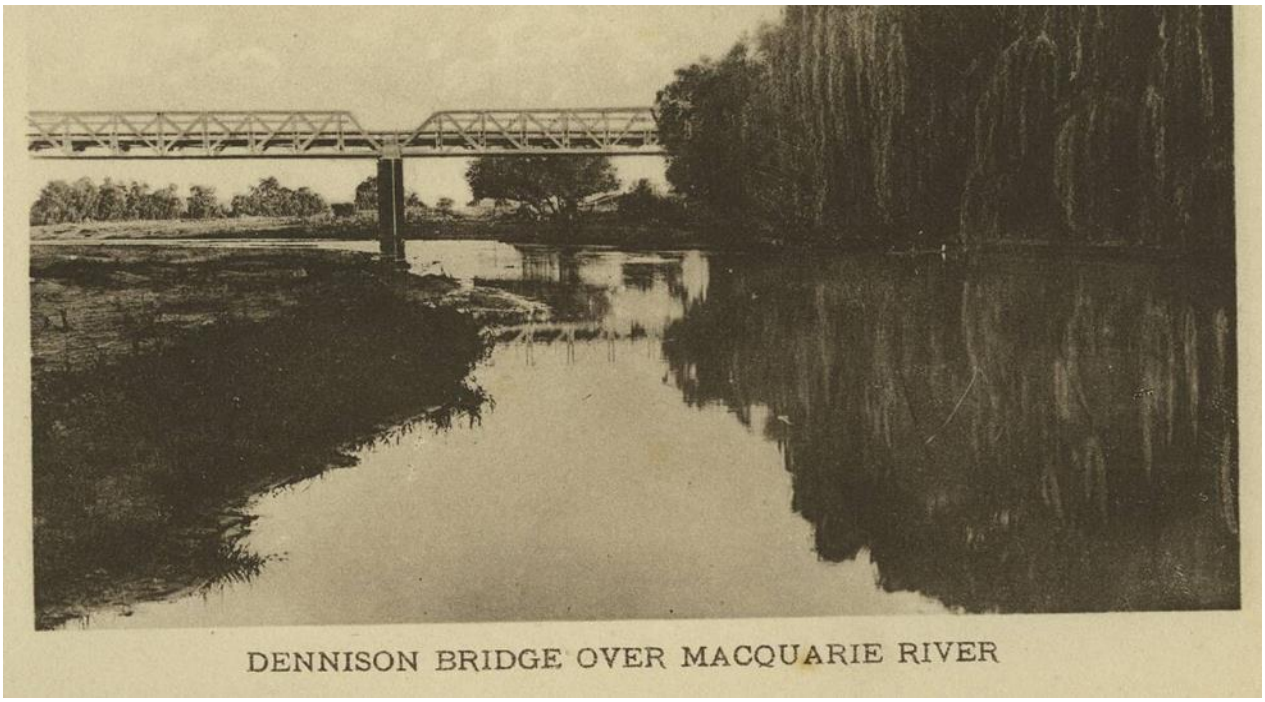
As per government policies at the time, materials used for the construction of the Denison Bridge were sourced from local firms to reduce the cost of imports. Iron bars were supplied by the Fitzroy Iron Works who were based in Mittagong, which were then formed into structural shapes at the Pyrmont Rolling Mills and the erection of the bridge. Construction of the bridge was conducted by PN Russell & Co who were a Sydney based company. [30]

In 1963, a 300 mm diameter sewer pipeline was installed on the western side of the Denison Bridge. Electric mains and cables were also installed, and the bridge soon evolved into a significant carrier of utility between Bathurst and Kelso. Between 1964 to 1965, further alterations were made to the bridge. During this period, twenty-three of the stringers on the bridge were replaced and six piles were added under the timber approach spans. The expansion bearings were repaired while one of the girders were also replaced. Six of the round timber girders were also renewed while the timber decking was replaced with high tensile bolts and the deck was emulsion sprayed and grit covered. In 1981, a concrete deck was then introduced. [31]

In March 1990, the blade of a road-hauled bulldozer damaged one of the trusses of the Denison Bridge. Eleven iron truss members which were rivetted tightly between nearby iron members were damaged in the accident and were removed.[32] Repair works were undertaken by the Lithgow Division Department of Roads and Traffic, supervised by Foreman Garry Dennis. Seven of these members were replaced with fabricated plates or angles while all new members were bolted into place with high tensile bolts. Lattice type bracing pieces were also damaged in the accident and replaced with fabricated pieces, bolted to new members. All new replacement members were fabricated locally by Carter Bros. Engineering of Kelso (instead of being transported from Sydney as most of the original materials had been). The new sections were painted in the original colour of the bridge and the Denison Bridge opened to the public nine days after the incident without any restrictions.[33] This emphasises the robustness of Morrell's bridge design and PN Russell & Co's construction.[34]

[28] EMM, 2022: 30
[29] SHI, 2003: https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=5051846
[30] Engineering Heritage Committee, 1994: 15
[31] SHI, 2003: https://www.hms.heritage.nsw.gov.au/App/Item/ViewItem?itemId=5051846
[32] Engineering Heritage Committee, 1994: 52
[33] Ibid.
[34] Engineering Heritage Committee, 1994: 16

Figure 6 – Denison Bridge Postcard (source: private collection)[35]



In 1992, the Denison Bridge becomes redundant as a vehicular bridge due to the construction of a new concrete, four-lane bridge located upstream (Evans Bridge). Up until this time, the Denison Bridge was the main entrance into Bathurst from Sydney (by road), which evidently had a major impact on the economy and development of the town over the years. Hereafter, the Denison Bridge ceased its use as a road bridge and was adapted as a footbridge.

In 2009, a second 300 mm sewer main was installed on the eastern elevation of the Denison Bridge. This pipeline was secured to the walkway and metal framework (which was installed in the 1950s) to ensure it did not impact upon the significant fabric of the bridge. The colour of the pipe also remained complimentary to those on the bridge. This water main replaced a 300mm raising main which was located under the 300mm water main on the western side of the bridge which had become disused.[36]

In 2013, an emergency sewer pipe was also installed on the Denison Bridge which was recommended by the Bathurst Regional Council's Heritage Advisor, to be basic in colour (i.e. a grey to black or natural steel colour).[37]

Today, the Denison Bridge remains the second oldest metal truss bridge in all of NSW (second to the Prince Alfred Bridge in Gundagai which was constructed in 1867). The Denison Bridge has retained almost all original fabric and remains in excellent condition. Overall, the purpose and use of the Denison Bridge has evolved over time with the installation of service pipes. The Denison Bridge began as an essential piece of infrastructure which allowed for transport from one side of the Macquarie River to the other, and in the 1960s, became an essential piece of infrastructure for the transportation of utilities across the Bathurst region.

[35] McRae, accessed from the Western Advocate, 2019: https://www.westernadvocate.com.au/story/5943507/yesterday-today-long-wait-to-get-a-safe-macquarie-crossing/
[36] Bathurst Regional Council, 2009: 2-3
[37] Bathurst Regional Council, 2013, 1

1.5 Physical Analysis

The site is located in the city of Bathurst, located approximately 200km west of Sydney, in the Central Tablelands of New South Wales. The city is situated along the south and western banks of the Macquarie River which meanders north to south. The site is located within the County of Bathurst and Parish of Bathurst on the southern side of the Macquarie River and on the northern side of the river the site is located within the County of Roxburgh and Parish of Kelso and is situated within the Bathurst Local Government Area (LGA).

An inspection of the Denison Bridge was undertaken by Latisha Ryall (Archaeologist, Premise) and Tamera Rudd (Graduate Archaeologist, Premise) on 7 December 2023. The inspection was non-intrusive and included a photographic record of the Denison Bridge and associated service pipes (non-original fabric).

The proposal to install the new service pipe on the downstream side (northern side) is supported as this will assist to mitigate further visual impacts to the heritage significance of the site. Further to this, it is recommended that the original fabric of the bridge be avoided, and that the new pipework be attached to non-original fabric where possible. The proposed works will involve the design of an appropriate bracket to attach the service pipe below the extant infrastructure.

A description of the Denison Bridge is provided in **Section 1.2.1**.

The Denison Bridge and associated features are shown below in **Figure 7** to **Figure 24.**

Figure 7 – Denison Bridge View South

Figure 8 – Denison Bridge View Southwest

Figure 9 – Denison Bridge View East (West Bank)

Figure 10 – Denison Bridge View Northeast

Figure 11 – West Side Service Pipes (Upstream)

Figure 12 – West Side Service Pipes (Upstream)

Figure 13 – West Service Pipes (Downstream)

Figure 14 – West Service Pipes (Downstream)

Figure 15 – East Service Pipes (Upstream)

Figure 16 – East Service Pipes (Upstream)

Figure 17 – East Service Pipes (Upstream)

Figure 18 – Pipes & Additional Fabric (East Side)

Figure 19 – West Service Pipe View Northeast

Figure 20 – West Service Pipes View Northeast

Figure 21 – Service Pipes View From Bridge Deck

Figure 22 – Denison Bridge Pedestrian Crossing/Deck

Figure 23 – Northeast View Across Denison Bridge

Figure 24 – Makers Plate In Context

2. SIGNIFICANCE ASSESSMENT

2.1 Statement of Significance

A statement of significance has been prepared for the Denison Bridge as provided by the SHR Heritage Inventory sheet for the item (SHR #01665). It should be noted that there are some discrepancies in the description relating to the age of the bridge between heritage database inventories.

The information has been replicated below as stands on the SHI.

> *The Denison Bridge, a three-span wrought iron bridge, is an early metal truss bridge built in 1870. Its advanced design was a major engineering achievement at the time and represents the maximum achievable by truss spans. The bridge is associated with three important colonial engineers: William Christopher Bennett (Commissioner and Engineer for Roads), Gustavus Alphonse Morrell (Assistant Engineer and designer) and Peter Nicol Russell (P N Russell & Co). The bridge is a prominent local landmark which has played an important role in the history of Bathurst and the Central West. It was the fifth oldest metal truss bridge in Australia until recently but is still the second oldest in NSW (after Gundagai 1867).*

A second statement of significance has also been prepared for the Denison Bridge and is listed on the Australian Heritage Database (RNE):

> *The bridge is a significant technical accomplishment. Completed in 1870, it replaces an earlier bridge that was opened in 1856 and destroyed in 1867. The present bridge is a metal truss bridge and is the fourth oldest of existing Australian metal trusses, following Hawthorn (1861), Gundagai Road Bridge (1867) and Redesdale (1868).*

Figure 2 identified the heritage curtilage of the Denison Bridge in blue hashing.

2.1.1 SIGNIFICANCE ASSESSMENT

Determining the significance of heritage items or a potential archaeological resource is undertaken by utilising a system of assessment centred on the Burra Charter (Australia ICOMOS 2013). The principles of the charter are relevant to the assessment, conservation and management of sites and relics. The assessment of heritage significance is outlined through legislation in the Heritage Act and implemented through the *Guidelines for preparing a statement of heritage impact 2023* (NSW DPE) and the *Assessing heritage significance 2023* (NSW DPE) guidelines.

Heritage impacts that arise from both visual and/or physical changes to a place must be assessed against the identified significance of the place. Not all impacts are negative and having an impact does not mean that a proposal cannot proceed. Sufficient information regarding the proposed heritage impacts is required to determine if the overall impact is acceptable and the long-term conservation of the place has been considered.

An assessment of significance for the Denison Bride is provided in **Table 2,** based off the SHR heritage listing, and, in accordance with heritage significance criteria outlined in *Assessing heritage significance 2023* (NSW DPE).

Table 2 – Heritage Significance

Criteria	Description
Criterion (a) Historical significance	The Denison Bridge has a high level of historic significance as one of the earliest bridges to be constructed in Bathurst, replacing the original Denison Bridge (the first bridge in Bathurst) following its destruction in 1867. The Denison Bridge is the fourth oldest metal truss in all of Australia, the second oldest metal truss bridge in all of NSW and the oldest Pratt style truss bridge in NSW. There are four colonial bridges extant in Bathurst today, the Denison Bridge being the oldest of these. The erection of the Denison Bridge similarly impacted heavily on the economy of Bathurst during the late 1800s and onwards, as it increased access through the town to nearby settlements (especially important for the trading of goods across NSW) and because it was constructed with local materials, by nearby business. Moreover, the bridge was used for 120 years as a road bridge and remains in use today as a footbridge. This contributed to the social stability of Bathurst and the development of the town.
Criterion (b) Historical association	The Denison Bridge has strong associations with three important colonial engineers including Gustavus Alphonse Morrell, Peter Nicol Russell and William Lawson Bennett. Morrell and Russell were both founding members of the Engineering Association of NSW with Russell also being a major benefactor of the School of Engineering at the University of Sydney. The bridge also holds associative significance to the Governor of NSW from 1855 to 1861, Sir William Denison, whom the bridge was named after.
Criterion (c) Aesthetic/creative/technical achievement	The Denison Bridge has a high level of aesthetic significance, particularly for its technical sophistication and innovation in design. During the late 1800s, there was an evident problem with the lateral bulking of the compression top chords of the trusses of bridges. The design of the Denison Bridge incorporated an innovative solution to this issue which allowed the length of the bridge to reach the structural limits of truss bridge technology. Overall, the bridge is a prominent engineering landmark set amongst an aesthetic context along the Macquarie River.
Criterion (d) Social, cultural and spiritual	The Denison Bridge holds social significance as an engineering landmark within the Bathurst landscape, which has existed for 150 years. The bridge has also been included in the Bathurst Heritage study, emphasising its importance to the local community. Moreover, the Denison Bridge is registered as an important heritage item under the National Trust and the National Estate as an item of local significance to the community.
Criterion (e) Research potential	The Denison Bridge has a moderate level of research potential as a late 18th century engineering achievement. The Denison Bridge is an example of the different types of forces, compression and tensions generated in bridge trusses during this period, and emphasises the fabrics used to create them (iron) and where they were sourced from. The Denison Bridge does, however, have a low level of archaeological research potential as it is located on a riverine environment which is subject to erosion. This

	means that any archaeological remains from the earlier Denison Bridge or from any activities which took place here, are likely to have washed away or been destroyed.
Criterion (f) Rare	The Denison Bridge is a rare as it represents the second oldest metal truss bridge in New South Wales (behind the bridge in Gundagai built three years earlier). The Denison Bridge also represents the fifth oldest metal truss bridge in all of Australia and more importantly, was the first ever American style Pratt truss bridge in all of Australia. Moreover, the Denison Bridge was in use for over 120 years for vehicular access, and remains not only in use today, but also remains in good condition over 150 years later.
Criterion (g) Representative	There are multiple metal truss bridges located across Australia dating to early European settlement. The Denison Bridge is the fifth oldest of these and is representative of other bridges from this period whilst being considered technologically more advanced and innovative than the others. The Denison Bridge also represents the growing influence of other nations (including America) in colonial Australia, as opposed to British technologies.

3. PROPOSED WORKS

3.1 The proposal

The proposed works form part of a larger scope of works associated with the Bathurst WHS pipeline route and is necessary to provide critical water infrastructure services for the Bathurst region. A detailed assessment of the pipeline proposal is provided in the REF prepared for the broader project.

In regard to the works proposed for the Denison Bridge, a pipe is proposed to be attached to the downstream side of the bridge so as to allow the approved pipeline to be constructed in an efficient manner to minimise environmental risks and impacts associated with pollution of land as a result of geological (fracout) construction methods and underboring along the Macquarie River.

3.1.1 CONSIDERATION OF ALTERNATIVES

The alternatives to underboring through the underlying geology have been considered and include:

- Retain the approach to underbore but increase the depth of the underbore so that the drilling is through underlying bedrock. This requires a longer underbore due to geometric requirements which would increase surface and subsurface impacts the context of heritage, soils, water and biodiversity;
- Install the pipe via trenching through the river using a coffer dam approach. This approach has been rejected in discussions with DPE Water, who consider this approach unacceptable due to impacts to the river and the associated aquatic environment;
- Realignment of the pipeline to avoid crossings of the river, to avoid building the pipeline through the original development site of the city of Bathurst, which features a large amount of heritage buildings and sites, including the state heritage listed Bathurst showground site, and a high potential for disturbance of relics. An assessment of options in the context of historic heritage was provided by EMM in support of the original REF and an earlier assessment considered the alignment of the pipe to the west of the river. Through careful consideration of risk and cost, it was determined that crossing the river and traversing the less constrained eastern side of the river was the preferred outcome.

Heritage impacts (and the need for heritage approval) would be result if this option was revisited. This option also required construction of the pipeline through existing roads, at a significantly higher project cost (around $25m compared to around $15-18m for the approved alignment).

- Attach the pipe to existing bridge structures (the preferred option).

The capacity of the Denison Bridge to accommodate the proposed loads associated with attaching the pipe has been considered by Premise engineers and it is determined that the bridge is structurally capable of accommodating the pipe on the basis of the following:

- The pipe represents an approximately 100 metre length, with weight contributions from the pipe itself (approximately 8.6 tonnes) and the weight of water being carried within the pipe (approximately 18.5 tonnes).
- The bridge, when operational for vehicles, was capable of accommodating dynamic loads associated with passing traffic, including heavy vehicles up to b-double in size (i.e., up to 32 tonnes per vehicle). Noting the 100 metre length of the bridge, it is possible that the bridge could host up to 8-10 x 19 m vehicles (4-5 per lane), with an overall dynamic load of over 250 tonnes.
- Essentially the pipe and water have a static weight equivalent to a one (1) heavy vehicle.

The proposed pipe would be attached to the bridge using purpose built brackets that would be connected to the bridge using existing plates located on the bridge (refer to **Appendix A**). It is understood that these plates historically accommodated brackets similar to those on the upstream side, which were removed at some time to accommodate bespoke brackets for the existing pipe on the downstream side (refer **Figure 25** and **Figure 26**). **Figure 17** shows these brackets in place on the upstream side of the river and **Figure 27** shows the plates that the new brackets would be connected to.

The new brackets are proposed to be designed with a bespoke aesthetic to tie in with the heritage aesthetic of the structure.

Figure 25 – Original design drawings (USYD)

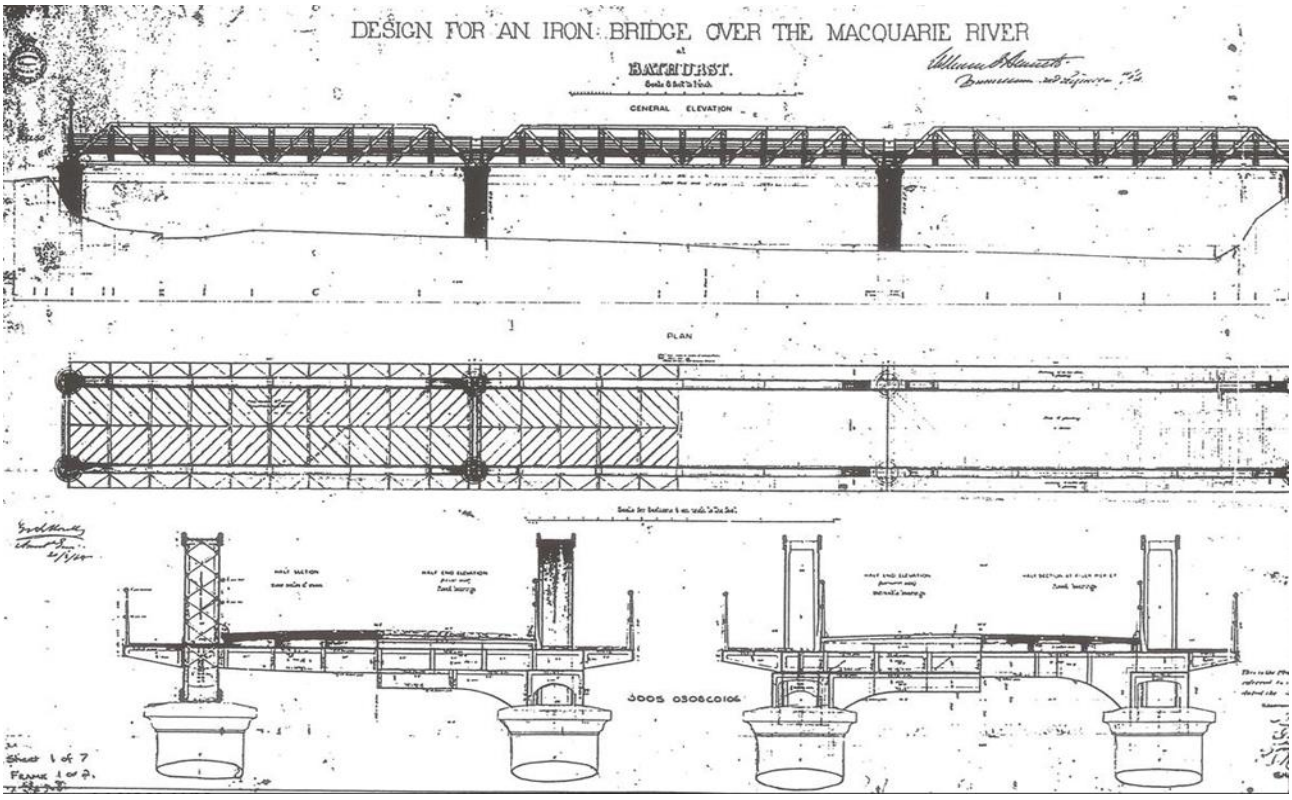


Figure 26 – Brackets

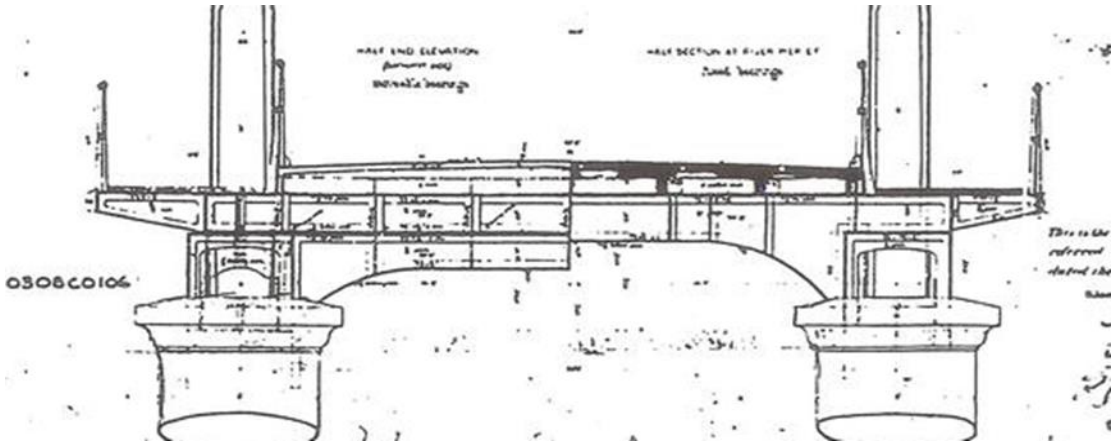


Figure 27 – Existing plates

Finally it is noted that the bridge currently accommodates a number of other pipes (in line with its intended vehicle and pedestrian traffic and servicing purpose), all of which are removable should they reach the end of their serviceable life, making any residual impacts reversible.

3.1.2 BACKGROUND

3.1.2.1 Pre-lodgement consultation

Pre lodgement consultation was undertaken for the proposed works with BRC, Premise and the Heritage Council of NSW..

Prior to Section 60 Approval, consultation with members of the Heritage Council of NSW approval committee, Premise and Bathurst Regional Council was held online on 6 February 2024. The objective of the meeting was to address heritage impacts associated with the proposed development and to gain an understanding of the proposed development.

The following items have been actioned in this report as an outcome of the meeting.

Table 3 – Heritage Council Considerations and Recommendations

Item #	Discussion item	Outcome and response
1	How did the design process discount alternative options for the route as historically under boring was approved for the works.	Premise and BRC advised that several options of the pipeline route were proposed at the concept design stage as part of the REF process, however geotechnical advice received for the project indicated that under boring would be more detrimental to the project. An alternative for installation of the pipes on the underside of the bridge was also discounted due to the levels of impact to the heritage fabric of the Denison Bridge, which would also result in permanent impacts, rather than the current proposal which can be removed with minimal impact.
2	Will the proposed works impact on the historical significance of the surrounding area?	Premise advised that there would be no impacts to the historical significance of the surrounding area. There would be no physical impacts to adjacent heritage curtilages of the showground and areas considered to be the earliest settlement phase of Bathurst. No adverse visual impacts will occur as a result of the installation of a new pipe.
3	Will there be any archaeological impacts?	Premise advised that during site observations, impacts would occur in areas that had previously been disturbed, with unlikely impacts to archaeological deposits or significant relics. Both the northern and southern embankments have historically been disturbed for the implementation of existing infrastructure.
4	Will the existing pipe be redundant?	Premise and BRC advised that the existing pipe carries potable water to the eastern side of the city, and the new pipe proposed is for untreated water, and as such, the two pipes are not interchangeable. The inclusion of this pipe is for critical service infrastructure.
5	Would BRC consider bespoke brackets to be included in the design elements. This would minimise impacts of nesting animals	BRC commit to ensuring the design of brackets is consistent with the heritage significance of the bridge and that these are designed to the satisfaction of a qualified heritage officer.
6	Would there be a consideration for the bridge to be repainted prior to installation of new infrastructure? If so, treatment of the existing bridge fabric would be required.	Bathurst Regional Council is supportive of the bridge treatment and repainting as part of the proposed works, however funding is not available at the present time for the whole bridge to be painted prior to installation of the new pipe. Several options could be considered in this instance: • The pipe and bracket design colour is aesthetically sympathetic to the bridge when installed.

		• The bridge and pipe are repainted at a later date when funding becomes available on construction • Heritage Grant approvals to aid in funding should be considered. The proposed works would not detract from the visual aesthetic of the extant bridge.
7	How has the infrastructure been designed for aesthetic values?	As above, considerations have been made within the design process to ensure that similar colour schemes are used for new infrastructure. With a recommendation to treat the existing fabric and repaint the extant bridge prior to installation of the new brackets and pipe should minimise aesthetic impacts to the surrounding area.

4. HERITAGE IMPACT ASSESSMENT

4.1 Matters for consideration

4.1.1 FABRIC AND SPATIAL ARRANGEMENT

The proposed works do not include the removal of any fabric from the Denison Bridge.

The proposed works will have a direct impact on Denison Bridge as it involves additions to the state listed heritage item itself. These additions will have a minor to moderate impact to the heritage significance of the Denison Bridge however, these impacts are partially mitigated as the proposed pipes are removable and are considered a slight alteration to the structure. To further mitigate these impacts, the pipes should also be placed on non-significant (that is, non-original) fabric of the bridge

4.1.2 SETTING, VIEWS AND VISTAS

The proposed pipe will not affect views or vistas towards the Denison Bridge from the north and northeast aspects. A negligible change in the visual setting will occur on the south and southwestern aspects with the addition of infrastructure, however this is considered negligible in nature and would not result in adverse cumulative vista impacts to the heritage item or surrounding landscape

The new pipe will be seen when viewing the bridge from the surrounding landscape and likely will also be viewed from pedestrians whilst viewing from the bridge platform. The bridge is located within the BHCA , however, is not considered to be located in a cultural landscape. Views and vistas towards the structure are shown in **Section 1.2**.

Visual impacts from the nearby state heritage listed item (Showground SHR #01960) located to the southwest of the bridge will not be impacted. There will be no impacts to the BHCAin which the heritage item is positioned.

Historically, additional service pipes have been attached to the original fabric. of the Denison Bridge, therefore, the site has already been altered from its original context and setting. To further mitigate impacts to the heritage significance of the site, the pipe is proposed to be placed on the downstream side of the bridge so as to minimise visual impacts from the south and south eastern impacts, this placement is considered to have the least visual impacts for the items setting.

The proposed addition of the new pipe has been designed sympathetically so as not to detract from this item. It is recommended that the existing bridge be maintained with the existing fabric treated and repainted prior to installation of new infrastructure so as to not detract from the item and its setting.

4.1.3 LANDSCAPE

No significant landscape works are proposed.

4.1.4 USE

The proposed works will not trigger any change of use classification under the *National Construction Code*. Furthermore, the Denison Bridge is currently being used to support service pipes, including carrying potable water and telecommunications services, among others.

4.1.5 DEMOLITION

No demolition works are proposed.

4.1.6 CURTILAGE

No impacts to curtilage are proposed.

4.1.7 MOVEABLE HERITAGE

N/A.

4.1.8 ABORIGINAL CULTURAL HERITAGE

The Denison Bridge is an item of both state and local European heritage significance and does not hold any Aboriginal cultural heritage values.

Separate Aboriginal heritage investigations have been undertaken for the broader BRC water harvesting scheme as addressed in the supporting REF for the works (EMM).

4.1.9 HISTORICAL ARCHAEOLOGY

Observations undertaken on site indicate ground disturbance activities have historically occurred within the items heritage curtilage, with the connection of existing infrastructure into the ground subsurface on both the northern and southern embankments (both upstream and downstream) of the bridge. It is proposed the new pipe will not impact on intact archaeological deposits. Impacts would therefore not occur to potential archaeological remains located within the curtilage boundaries of the heritage item.

4.1.10 NATURAL HERITAGE

N/A

4.1.11 CONSERVATION AREAS

The Denison Bridge is located within the heritage curtilage of the Bathurst Conservation Area. The proposed alterations and additions to the Denison Bridge are consistent with previous alterations to the heritage item. The proposed pipes will be implemented 'like for like' and will not result in major aesthetic or visual impacts. It is therefore, considered that the proposed activity will not impacts the Bathurst Conservation Area.

4.1.12 CUMULATIVE IMPACTS

The proposed works do not pose any cumulative impacts to the heritage item, HCA or heritage listed sites in close proximity. The proposed works are considered very minor in nature. The proposed works are designed in a way that will ensure fabric can be removed without altering or impacting on original fabric of the structure. The new pipe will be sympathetic to design and style so as not to detract from the visual context of the item, to avoid juxtaposition between new and old infrastructure. There are no cumulative impacts of concern.

4.1.13 THE CONSERVATION MANAGEMENT PLAN

The relevant heritage conservation management plan (CMP) for the Denison Bridge is the *Bridges Conservation Management Plan* which refers to all heritage listed bridges in the Bathurst region.[38] Policies within this CMP are detailed below in **Table 4.**

Table 4 – Consistency with CMP policies

Policy no.	CMP Policy	Consistency Assessment
1	Work in a manner that will retain the significance of the bridge by managing the components that make this bridge important e.g. original fabric.	The proposed works do not include the removal of any original fabric to the bridge. The importance of the bridge also relates to the utilities which have been implemented since the late 1900s. the addition of further utilities pipes will add to the ongoing significance and importance of the bridge to the local community.
2	Assess the relative importance or significance of all the components that make up the bridge and its context so that the most significant components are retained and conserved, while those elements that detract from its significance can be changed or removed.	The most significance fabric on the Denison Bridge are the metal pratt trusses which will not be impacted upon by the development.
3	Undertake best practice to conserve the bridge work including conservation, reconstruction, repairs, etc.	The development will not impose upon the ability to perform conservation works or repairs on the bridge.
4	Where necessary, make specific decisions regarding components such as original stone or timber abutments, timber decking, supporting piers, wing walls and balustrades.	No impacts will occur to original fabric. Brackets will be designed to be removable and sympathetic to the existing structure.
5	Ensure that the work is carried out by a suitably qualified person(s) for the particular component in a manner that is best practice.	The proposed works will be conducted by an adequately qualified person engaged by BRC
6	Assess the comparative value of the work to be undertaken and identify its urgency and priority.	The proposed works are considered to be a priority for the Bathurst community as it will assist in the critical supply of water to the region.
7	If significant elements must be removed or a bridge replaced, retain evidence of their	No elements of the Denison Bridge will be removed.

[38] Hickson and Murphy (2010) prepared for Bathurst Regional Council

Policy no.	CMP Policy	Consistency Assessment
	original location through photography, drawings and sketches or the retention of components in-situ.	
8	Consider works required for the management of the curtilage of a bridge to maintain existing and significant visual and physical links, significant views and preserve its historic location.	The proposed works will not impact upon the curtilage of the Denison Bridge heritage site.
9	Where possible, retain the relevance of the bridge for the movement of vehicles, pedestrians and services.	The proposed works will not impede on existing pedestrian access. Existing services will continue to operate.
10	If additional services are added to a bridge consider methods that minimise visual impact.	Measures to mitigate visual impacts to the bridge have been provided in **section 4.1.2**.
11	Comply with any statutory requirements that apply to the bridge.	The development will require a Section 60 approval under the Heritage Act prior to works commencing.
12	Consider the requirements of the owner of the bridge.	BRC are required to maintain the bridge as it serves as a public accessed structure and would be required to maintain the associated pipe infrastructure as a critical water source for the community, however the bridge is also to be maintained so as to conserve the original fabric with repainting of the bridge as an option when funds are available. Therefore, Heritage Grant funding would be suitable for the upgrades or maintenance of this item. At the time this report was prepared, bracket designs had not yet to be prepared but will have the objective of ensuring effective integration of the infrastructure without degradation of the appearance or maintenance of the bridge.
13	Consider the requirements of other interested persons including the local community, adjoining owners, historical groups and tourists.	The addition of water infrastructure on the Denison Bridge benefits the community as it aids in the provision of water across the region. The proposed works will have minor impacts on the visual amenity of the building which will be undertaken in a 'like for like' manner so limit impacts to the community. Proposed upkeep of the bridge, repainting and the implementation of updated interpretation panels would also benefit the community.

Policy no.	CMP Policy	Consistency Assessment
14	Consider work safe practices.	The development will be carried out in accordance with all relevant work health and safety policies and guidelines.
15	Consider value for money on work carried out and grant opportunities.	The opportunity for Heritage Grant funding is supported, for repainting of the bridge and ongoing maintenance. At the current time, funding is not available through BRC for the bridge to be repainted and will need to be undertaken at a later stage.

4.1.14 OTHER HERITAGE ITEMS IN THE VICINITY

Nearby state heritage listed items include the Showground (SHR #01960) located to the southwest of the Denison Bride. The proposed works will result in indirect impacts to the Showground including visual impacts. However, these impacts are considered negligible as the new pipes will not be viewed from the Showgrounds site. Nearby heritage sites are shown in **Figure 2**.

4.1.15 COMMONWEALTH/NATIONAL HERITAGE SIGNIFICANCE

N/A

4.1.16 WORLD HERITAGE SIGNIFICANCE

N/A

4.1.17 OTHER GENERAL CONSIDERATIONS

A section 60 approval from Heritage NSW will be required (under the Heritage Act 1977) prior to the proposed works commencing at the Denison Bridge.

No additional controls are required for the proposed works under the Bathurst DCP. The works will be approved via a state regulatory authority being Heritage NSW.

The proposed works will not result in adverse heritage impacts. Although the proposed works will result in a direct impact to the Denison Bridge, this infrastructure is critical for servicing water in the Bathurst district.

The proposed works will be mitigated by the extant service pipes which have been introduced to the bridge from the 1960s onwards. Furthermore, the proposed pipe will be detachable. To further mitigate these impacts, it is recommended that the pipe be constructed on the downstream side of the bridge to minimise visual impacts, as the context of the upstream side is more consistent with the original setting of the area. This original setting should be retained as much as possible, with no detrimental impacts to the original built fabric or the landscape surrounding it. The new pipework should be painted in similar colours to align with the colour scheme of the existing Denison Bridge. It is also recommended that the bridge in its entirety be treated and repainted, however this is subject to available funds and can be undertaken at a later stage This will avoid a visual detraction and juxtaposition between the new infrastructure against existing

materials. The proposed pipe materials should be matched to the bridge so as to have a 'like for like ' approach.

4.1.18 ASSESSMENT OF SPECIFIC WORKS

4.1.18.1 Alterations and additions

The impacts of the proposed alterations and additions to the Denison Bridge is provided in **Table 5**.

Table 5 – Proposed Development Heritage Impact Assessment

Proposed Change to Heritage Item	Statement of Heritage Impact Considerations	Comments
Alterations and additions	Do the proposed works comply with Article 22 of *The Burra Charter*, specifically *Practice note* article 22 — *new work* (Australia ICOMOS 2013b)?	Article 22 practice note states: new work should respect the significance of a place through consideration of its siting, bulk, form, scale, character, colour, texture and material. Imitation should generally be avoided. The proposed works are consistent with the current use of the bridge for supporting other critical infrastructure service pipes. To ensure that the proposed works comply with the Burra Charter, it is recommended that the new pipe maintains a modest size and shape and appropriate colour scheme. This will ensure that the significance of the Denison Bridge and its original fabric is not distracted by new infrastructure. The proposed placement of the 450 mm pipe is considered sympathetic to the above. It is proposed that bespoke brackets would be installed to accommodate the pipe. Prior to any additions, the extant bridge and fabric is also to be treated and repainted so that the proposed pipe integrates effectively with the bridge appearance and does introduce a discordant appearance. This would be subject to available funding. Heritage Grant fund applications would be suitable for this project. Similarly, it is recommended that an interpretation panel be introduced at the site to recognise the services pipes on the bridge as recent additions which have benefited the Bathurst community since their installation on the bridge.
	Are the proposed alterations/additions sympathetic to the heritage item? In what way (e.g.	The proposed additions have been designed sympathetically to the bridge design, the appropriate form, proportion and scale are to match existing infrastructure added to the bridge historically. The method of attachment will be consistent with the style

	form, proportion, scale, design, materials)?	and form of existing pipe attachments (bespoke brackets) and is consistent with the current appearance of the bridge, which hosts a number of other service pipes. As mentioned above, it is also recommended that the bridge undergo painting, noting this could occur at a later date.
	Will the proposed works impact on the significant fabric, design or layout, significant garden setting, landscape and trees or on the heritage item's setting or any significant views?	The proposed works will not impact on significant or original fabric of the Denison Bridge. Installation will occur in areas that have been subject to previous disturbance through the c.1963, 2009 and 2013 pipe installation, and/or additions to original fabric. The pipe would be attached on the downstream side to minimise visibility to the general public.
	How have the impact of the alterations/additions on the heritage item been minimised?	Impacts to the Denison Bridge have been minimised by ensuring that the pipe is removable, is sympathetic in design and will not impact on the significance of the item.
	Are the additions sited on any known or potentially significant archaeological relics? If yes, has specialist advice from archaeologists been sought? How will the impact be avoided or mitigated?	There is a low likelihood for archaeological potential at the site due to its location along a river which is prone to flooding and heavy erosion. The additions to the Denison Bridge are therefore also unlikely to impact any archaeological relics at the site. It is noted that both embankments have been subject to previous ground disturbance where existing pipes enter the ground subsurface. Archaeological relics are unlikely to be insitu where this disturbance has previously occurred.
Physical changes to fabric identified as significant	Has the fabric that will be impacted by the proposed works been assessed and graded according to its significance?	An assessment of the Denison Bridge's significance and fabric is provided in **Section 2.**
	Has specialist advice from a heritage professional, architect, archaeologist or engineer been sought?	This report has assessed the impacts of the proposed works on the heritage item and has been prepared by a qualified Archaeologist in consultation with the Heritage Council of NSW. The nature of the works will not adversely affect the heritage item. A heritage architect has not been engaged; however engineers have consulted with the Archaeologist on the best approach for design and location.
New services and service upgrades	Are any of the existing services of significance? In what way are they affected by the proposed works?	Yes, existing service pipes are located on both the upstream and downstream locations of the Denison Bridge and provide critical services for the community. however, the fabric of these services is not considered significant

		Original construction elements of the bridge are considered significant and will not be impacted on. The proposed works are to minimise impacts to this significant fabric.
	How have the impacts of the installation of new services on heritage significance been minimised?	The impacts of the introduction of a new service pipe to Denison Bridge will be minimised by ensuring the pipe is removable. This means that the Denison Bridge could be returned to its original state if required. Similar strapping elements are proposed to attach the pipe to existing infrastructure.
	Are any known or potential archaeological deposits affected by the proposed new services?	There are no known archaeological deposits at the site nor are they likely to be identified in the future. The proposed pipe will have no impact to potential archaeological relics.

5. SUMMARY AND RECOMMENDATIONS

The proposed works are considered minor to moderate in nature and will not have adverse impacts to the heritage significance of the Denison Bridge State Heritage listed item. The proposed works are required to service water for the city of Bathurst and are considered critical infrastructure as part of a broader scope of works being the Bathurst WHS

It is recommended that the installation of the additional service pipe be positioned on the northern frontage of the bridge (downstream side) to mitigate visual impacts to the heritage context of the Denison Bridge and its surrounding landscape. Views from the southwestern location likely represent the original context of the bridge when constructed in 1870, however, it has been assessed that the installation of new infrastructure will not adversely impact on nearby state heritage listed items (Showground SHR #01960) or impact on the BHCA.

The Denison Bridge has been subject to previous additions including service pipes located on both frontages and the erection of cement piers associated with the abovementioned infrastructure. The installation of these service pipes has become an important aspect of the history of the Denison Bridge which has evolved into a significant structure for utility supply across the region. The addition of the proposed pipe to the Denison Bridge is therefore consistent with past alterations and additions and to the historic significance of the bridge.

It is proposed to install the pipe below existing infrastructure pipes located on the northern side. Consolidation of existing brackets would also be considered in detailed design and a recommendation for bespoke elements to be included in this design. A concept bracket attachment design is provided in the project drawings. This would be further refined through engagement with a heritage professional. The pipe should also be consistent with the existing bridge colour scheme; a grey colour pipe is recommended. It is recommended that the Denison Bridge be treated and repainted so as to enhance and cohesively connect the heritage item with existing and new fabric, noting this would be subject to available funds and could be completed at a later date. Heritage Grant applications would be suitable for the maintenance and upkeep of this heritage item.

A recommendation for updated interpretation signs for the bridge is proposed. Interpretation panels could be installed in the immediate locality to show a timeline of the bridge construction and change in use over time as well as the aesthetic changes. It is noted that the existing interpretation panels have deteriorated and should be replaced.

The proposed works will be subject to a section 60 approval through Heritage NSW before works can proceed. It is expected that conditions of consent will be imposed to ensure Heritage NSW sign off of final bracket design and pipe placement.

6. REFERENCES

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APPENDICES

APPENDIX A

DESIGN DRAWINGS

EXISTING SERVICES

ALL EXISTING SERVICES ARE TO BE LOCATED BY THE CONTRACTOR THROUGH CONTACTING THE RELEVANT SERVICE AUTHORITY PRIOR TO THE COMMENCEMENT OF ANY WORK

N

LEGEND:

- PROPOSED DN450 GRP PN16 STORMWATER RISING MAIN UPDATED ALIGNMENT
- PROPOSED STORMWATER RISING MAIN PREVIOUS ALIGNMENT
- PROPOSED STOP VALVE (WSAA DWG WAT-1304)
- PROPOSED SCOUR VALVE (WSAA DWG WAT-1307)
- PROPOSED AIR VALVE (WSAA DWG WAT-1302)
- PROPOSED THRUST BLOCK (WSAA DWG WAT-1205/1207)
- 650.0 EXISTING MAJOR CONTOUR (1.0m INTERVAL)
- EXISTING MINOR CONTOUR (0.5m INTERVAL)
- LV EXISTING LV ELECTRICAL
- T EXISTING TELECOMMUNICATIONS
- G EXISTING GAS
- dOF EXISTING FIBRE OPTIC CABLE
- W EXISTING WATER PIPE
- S EXISTING SEWER
- D EXISTING STORMWATER
- EXISTING STOP VALVE
- EXISTING SEWER MANHOLE
- EXISTING TELECOMMUNICATIONS PIT
- EXISTING WATER METER
- EXISTING HYDRANT
- EXISTING ELECTRICAL POLE
- EXISTING LIGHT POLE
- EXISTING GRATED INLET PIT
- 'I.L.unk' UNKNOWN INVERT LEVEL
- 'unkDIA' UNKNOWN DIAMETER
- H.DEF HORIZONTAL DEFLECTION
- V.DEF VERTICAL DEFLECTION

INFORMATION - NOT FOR CONSTRUCTION

DATE	REV	DESCRIPTION	REC	APP
22/12/2023	A	ALTERNATIVE PIPELINE ALIGNMENT	IW	DW

REVISIONS

Premise

ORANGE OFFICE
154 PEISLEY STREET
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DESIGNED: IW
CHECKED: DW
PROJECT MANAGER: DW

SCALE
0 15 30 45m
SCALE 1:750(A1)
ORIGINAL SHEET SIZE A1

CLIENT: BATHURST REGIONAL COUNCIL
PROJECT: BATHURST STORMWATER HARVESTING SCHEME - STAGE 1
LOCATION: BATHURST, NSW
SHEET TITLE: DENISON BRIDGE - ALTERNATIVE PIPELINE ALIGNMENT

JOB CODE: 220224_13
SHEET NUMBER: C001
REV: 1

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- PROPOSED AIR VALVE (WSAA DWG WAT-1302)
- PROPOSED THRUST BLOCK (WSAA DWG WAT-1205/1207)
- EXISTING MAJOR CONTOUR (1.0m INTERVAL)
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- EXISTING GAS
- EXISTING FIBRE OPTIC CABLE
- EXISTING WATER PIPE
- EXISTING SEWER
- EXISTING STORMWATER
- EXISTING STOP VALVE
- EXISTING SEWER MANHOLE
- EXISTING TELECOMMUNICATIONS PIT
- EXISTING WATER METER
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22/12/2023	A	ALTERNATIVE PIPELINE ALIGNMENT	IW	DW

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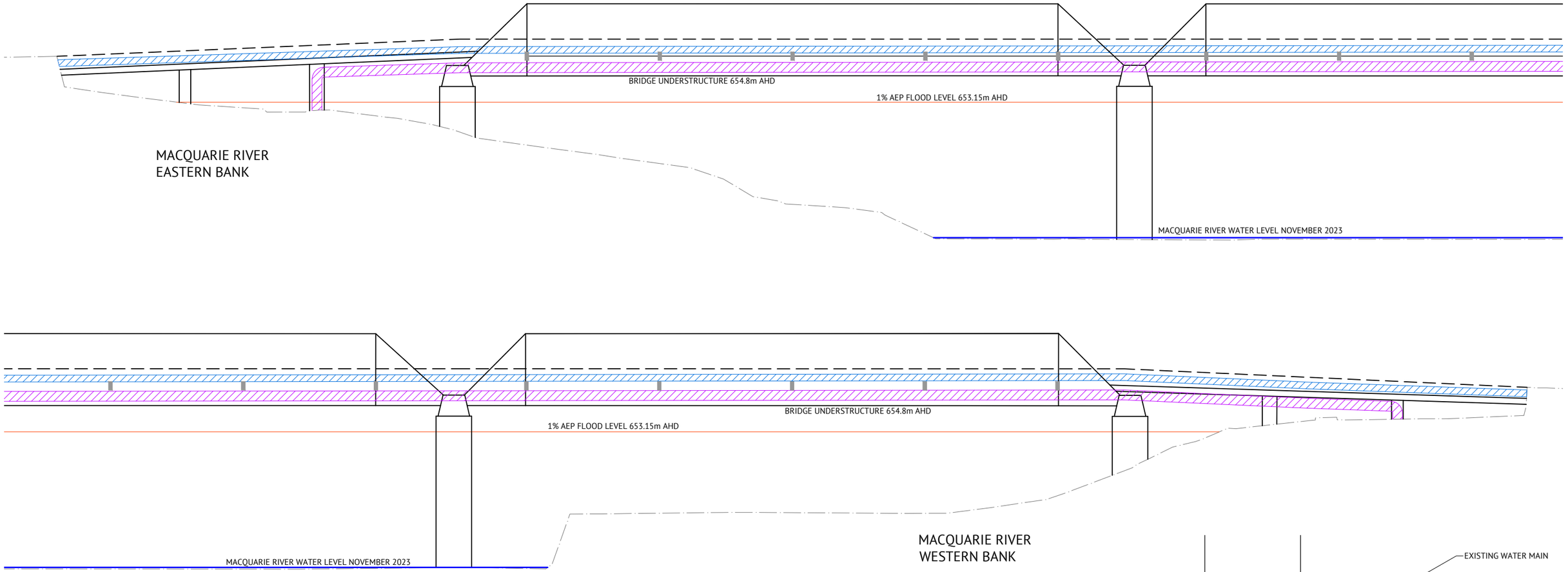
PROJECT MANAGER: DW

SCALE
0 15 30 45m
SCALE 1:750(A1)
ORIGINAL SHEET SIZE A1

CLIENT: BATHURST REGIONAL COUNCIL
PROJECT: BATHURST STORMWATER HARVESTING SCHEME - STAGE 1
LOCATION: BATHURST, NSW
SHEET TITLE: HEREFORD STREET BRIDGE - ALTERNATIVE PIPELINE ALIGNMENT

JOB CODE: 220224_13
SHEET NUMBER: C002
REV: 1



1 C001 SECTION
SCALE 1:250

LEGEND:

- PROPOSED DN450 DICL PN20 STORMWATER RISING MAIN
- EXISTING WATER MAIN
- DENISON BRIDGE (STRUCTURE)
- DENISON BRIDGE (DECK)
- 1% AEP FLOOD LEVEL
- EXISTING GROUND LEVEL
- MACQUARIE RIVER WATER LEVEL NOV 2023
- EXISTING, VACANT MOUNTING POINTS

EXISTING SERVICES

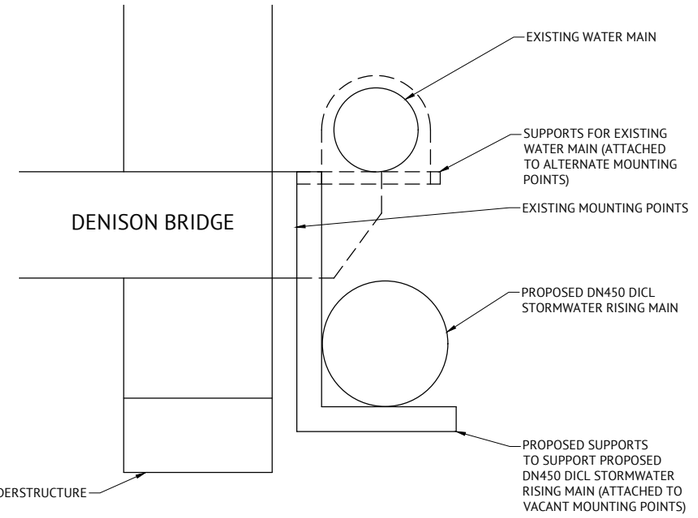
ALL EXISTING SERVICES ARE TO BE LOCATED BY THE CONTRACTOR THROUGH CONTACTING THE RELEVANT SERVICE AUTHORITY PRIOR TO THE COMMENCEMENT OF ANY WORK

NOTE

LOCATION AND EXTENT OF WORKS, BRIDGE STRUCTURE AND NATURAL FEATURES ARE CONCEPTUAL ONLY & SUBJECT TO DETAILED DESIGN.

PRELIMINARY
NOT FOR CONSTRUCTION

PLATE 1: DENSION BRIDGE PROPOSED PIPE MOUNTING LOCATION



2 C001 SECTION TYPICAL PIPE MOUNTING
SCALE NTS

INFORMATION - NOT FOR CONSTRUCTION

DATE	REV	DESCRIPTION	REC	APP
22/12/2023	A	ALTERNATIVE PIPELINE ALIGNMENT	IW	DW

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DESIGNED IW
CHECKED DW
PROJECT MANAGER DW

SCALE
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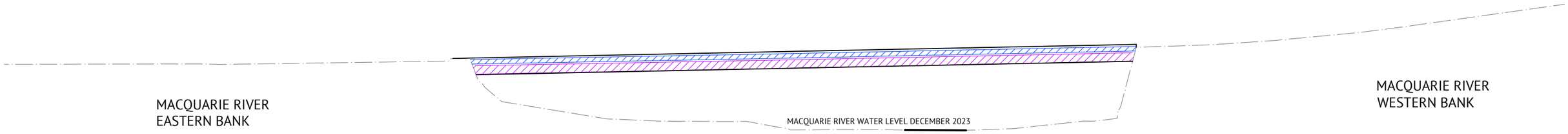
SCALE 1:750(A1)
ORIGINAL SHEET SIZE A1

CLIENT BATHURST REGIONAL COUNCIL
PROJECT BATHURST STORMWATER HARVESTING SCHEME - STAGE 1
LOCATION BATHURST, NSW
SHEET TITLE DENISON BRIDGE - TYPICAL SECTIONS

JOB CODE 220224_13
SHEET NUMBER C003
REV A



3 C002 SECTION
SCALE 1:100

LEGEND:

- PROPOSED DN375 DICL PN20 STORMWATER RISING MAIN
- EXISTING WATER MAIN
- HEREFORD STREET BRIDGE (STRUCTURE)
- EXISTING GROUND LEVEL
- MACQUARIE RIVER WATER LEVEL DEC 2023

PRELIMINARY
NOT FOR CONSTRUCTION

EXISTING SERVICES

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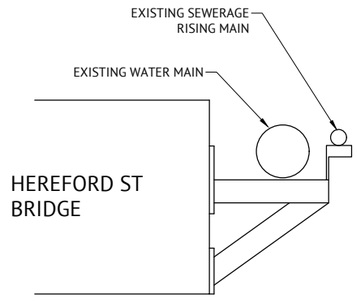
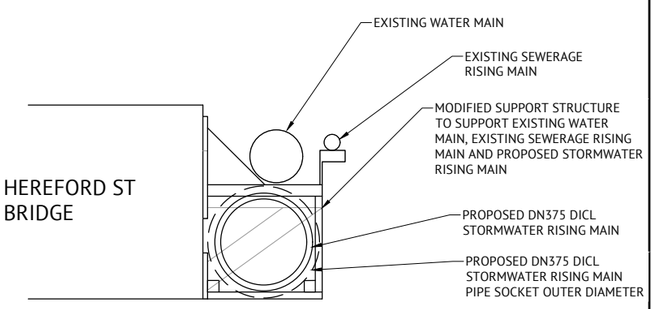
NOTE

LOCATION AND EXTENT OF WORKS, BRIDGE STRUCTURE AND NATURAL FEATURES ARE CONCEPTUAL ONLY & SUBJECT TO DETAILED DESIGN.

PLATE 2: HEREFORD BRIDGE PROPOSED PIPE MOUNTING LOCATION



EXISTING MOUNTING



PROPOSED MOUNTING

4 C002 SECTION TYPICAL PIPE MOUNTING
SCALE NTS

INFORMATION - NOT FOR CONSTRUCTION

DATE	REV	DESCRIPTION		
22/12/2023	A	ALTERNATIVE PIPELINE ALIGNMENT	IW	DW

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ORIGINAL SHEET SIZE A1

CLIENT BATHURST REGIONAL COUNCIL
PROJECT BATHURST STORMWATER HARVESTING SCHEME - STAGE 1
LOCATION BATHURST, NSW
SHEET TITLE HEREFORD STREET BRIDGE - TYPICAL SECTIONS

JOB CODE 220224_13
SHEET NUMBER C004
REV A

APPENDIX B

HERITAGE INVENTORY LISTING

Item Details

Name

Denison Bridge

SHR/LEP/S170

SHR #01665

Address

Macquarie River Great Western Highway BATHURST NSW 2795

Local Govt Area

Bathurst Regional

Local Aboriginal Land Council

Bathurst

Item Type	Group/Collection	Category
Built	Transport - Land	Road Bridge

All Addresses

Addresses

Records Retrieved: 3

Street No	Street Name	Suburb/Town/Postcode	Local Govt. Area	LALC	Parish	County	Electorate	Address Type
	River Road	BATHURST/NSW/2795	Bathurst Regional	Unknown			BATHURST	Alternate Address
	Bridge Street	BATHURST/NSW/2795	Bathurst Regional	Unknown			BATHURST	Alternate Address
Macquarie River	Great Western Highway	BATHURST/NSW/2795	Bathurst Regional	Bathurst			BATHURST	Primary Address

Significance

Statement Of Significance

The Denison Bridge, a three-span wrought iron bridge, is an early metal truss bridge built in 1870. Its advanced design was a major engineering achievement at the time and represents the maximum achievable by truss spans. The bridge is associated with three important colonial engineers: William Christopher Bennett (Commissioner and Engineer for Roads), Gustavus Alphonse Morrell (Assistant Engineer and designer) and Peter Nicol Russell (P N Russell & Co). The bridge is a prominent local landmark which has played an important role in the history of Bathurst and the Central West. It was the fifth oldest metal truss bridge in Australia until recently but is still the second oldest in NSW (after Gundagai 1867).

Criteria a)

Historical Significance

Denison Bridge is of state significance as the fifth oldest metal truss bridge in Australia until recently and the second oldest in NSW (after Gundagai 1867). Further, the bridge is a significant technical accomplishment in the management of compressive and tension forces in metal truss members. Its design and innovative solution to the pressures of compression and tension is of historical significance in demonstrating the development of engineering and truss bridge technology.

Completed in 1870, it replaces an earlier bridge that was opened in 1856 and destroyed in 1867. The present bridge is a metal truss bridge and is currently the fourth oldest existing Australian metal trusses, following Hawthorn (1861), Gundagai Road Bridge (1867) and Redesdale (1868).

It is the oldest Pratt type truss bridge in NSW and the oldest of four colonial bridges in Bathurst. Its fabrication and erection are important as it used substantial amounts of materials and skills already available in the colony with subsequent economic benefits to the government. It is significant for being in almost continual use throughout its 120 year history as a road bridge which contributed significantly to the social stability and growth of Bathurst, making possible the continuous flow of people and goods between Sydney and the western districts of New South Wales.

Criteria b)

Historical Association
Significance

The Denison Bridge is of state significance for its associations with three important colonial engineers: the government engineers W. C. Bennett and G. A Morell; and P N Russell, who formed P. N. Russell and Co and was a major benefactor of the University of Sydney.

The Denison Bridge is also significant for its association, through its name, with Sir William Denison, Governor of New South Wales 1855-1861.

Criteria c)

Aesthetic/Technical Significance

The Denison Bridge is of state significance for its technical sophistication and innovation. The structure incorporates an innovative and practical solution to the problem of lateral buckling of the compression top chords of each truss, which was years ahead of the theoretical solution and is of historical significance in demonstrating the development of engineering and truss bridge technology. This solution allowed the length of the bridge to approach the structural limit of truss bridge technology. The clean, open arrangement of members and joints made for easy maintenance which contributed greatly to its long service life.

Spanning the Macquarie River and Morse and Berry Parks, the Denison Bridge is locally significant as a prominent engineering landmark and enjoys a picturesque setting.

Criteria d)

Social/Cultural Significance

The Denison Bridge has local significance as a engineering landmark. This significance is demonstrated by its inclusion in the Bathurst Heritage Study, the Register of the National Trust, an Historic Engineering Marker plaque from Engineers Australia (formerly IE Aust) in 1994 and the Register of the National Estate.

Criteria e)

Research Potential

The Denison Bridge is of state significance as an engineering achievement. Through the distribution of its ironwork the fabric displays the types of forces, compression and tension generated in the members of trusses.

It is unlikely to display any archaeological significance in relation to previous occupation due to the riverine environment and unlikely to display any archaeological potential in relation to the earlier bridge.

Criteria f)

Rarity

The Denison Bridge is rare. It is of state significance as the fifth oldest early metal truss bridge in colonial Australia, and second oldest in NSW after Gundagai (built 1867).

Criteria g)

Representative

The Denison Bridge is one of a number of early metal truss bridges in colonial Australia and is representative of its type. It is, however, the second oldest in New South Wales (after Gundagai) and is technologically innovative. This bridge was the first American type Pratt truss in NSW.

Integrity/Intactness

Fair - Good

Owners

Records Retrieved: 0

Organisation	Stakeholder Category	Date Ownership Updated
No Results Found		

Description

Designer	Builder/Maker
Gustavus Alphonse Morrell	P. N. Russell & Co

Physical Description **Updated**

This is an early metal truss bridge that carries 6.1 metres of roadway and a footpath. It has nine spans in all, three timber spans of 6.7m then three wrought iron trusses: 34m, 34.5m, 34m and then three again in timber at 6.7m. Total length of the bridge is 474ft (143.5m).

The main spans consist of wrought iron pony trusses of the Pratt type. Support piers consist of timber piles under the approach spans and four pairs of cast iron cylinders 1.83m diameter braced with wrought iron crossed rods. The ten panel Pratt trusses are simply supported and have horizontally positioned I-sections for the upper chords and sloping end diagonals, but flat metal strips for the tension bottom chords and for the tension diagonals. There are metal stringers on metal cross girders, the whole being located at about the mid depth of the main trusses. The piers are twin metal cylinders.

The bridge has four lamp standards, two at each end, and in the centre two signs. On an interpretive sign about the river and people swimming there, and the original makers sign stating : 'DENISON BRIDGE P. N.RUSSELL & Co. BUILDERS - SYDNEY 1870' . Beside the bridge and supported off it, are service pipes.

Physical Condition **Updated** 04/23/2003

Fair to good, in need of regular maintenance.

Modifications And Dates

1856: First Denison Bridge (timber, des: William Weaver) opened.

1867: First Denison Bridge washed away in a storm.

1869-70: Second Denison Bridge (des. G.A. Morrell) built. This bridge has had periodic maintenance.

1964-65: six piles were driven under the timber approach spans, 23 stringers were replaced, 6 round timber girders renewed, longitudinal sheeting replaced and deck bitumen sealed, timber decking replaced by high tensile bolts in three top chord joints, expansion bearings were repaired and one girder replaced. The deck was emulsion-sprayed and grit-covered.

1975-76: repairs cost $11,377.

1981: A concrete deck was laid.

Early 1990s: closed to vehicular traffic and adapted for use as a footbridge.

Further Comments

supported as high significance by Bathurst/Evans focus group 27/3/2002

Current Use

footbridge, annual festivities

Former Use

Aboriginal land, riparian vegetation / floodplain, Main road bridge

Listings

Listings

			Records Retrieved: 3		
Heritage Listing	**Listing Title**	**Listing Number**	**Gazette Date**	**Gazzette Number**	**Gazzette Page**
National Trust of Australia register		870	5/18/1987 12:00:00 AM		
Heritage Act - State Heritage Register		01665	8/1/2003 12:00:00 AM	121	7597
Heritage study		A 261 L			

Procedures/Exemptions

Records Retrieved: 1

Section of Act	Description	Title	Comments	Action Date	Outcome
57(2)	Exemption to allow work	Standard Exemptions		11/9/2020 12:00:00 AM	

History

Historical Notes or Provenance **Updated**

Aboriginal people and colonisation.
Aboriginal occupation of the Blue Mountains area dates back at least 12,000 years and appears to have intensified some 3000-4000 years ago. In pre-colonial times the area now known as Bathurst was inhabited by Aboriginal people of the Wiradjuri linguistic group. The clan associated with Bathurst occupied on a seasonal basis most of the Macquarie River area. They moved regularly in small groups but prefered the open land and used the waterways for a variety of food. There are numerous river flats where debris from recurrent camps accumulated over a long period. European settlement in this region after the first documented white expedition west of the Blue Mountains in 1813 was tentative because of apprehensions about resistance from Aboriginal people. There was some contact, witnessed by sporadic hostility and by the quantity of surviving artefacts manufactured by the Aborigines from European glass. By 1840 there was widespread dislocation of Aboriginal culture, aggravated after 1850 by the goldrush to the region (HO and DUAP, 1996, 88).

Prior to European settlement in Australia, the Wiradjuri Aboriginal group lived in the upper Macquarie Valley. Bathurst was proclaimed a town by Lachlan Macquarie on 7 May 1815, named after Lord Bathurst, Principal Secretary of State for the Colonies (Barker 1992:25). Bathurst is Australia's oldest inland township. It was proclaimed a town in 1815 with the discovery of gold.

Bathurst:
Governor Macquarie chose the site of the future town of Bathurst on 7 May 1815 during his tour over the Blue Mountains, on the road already completed by convict labour supervised by William Cox. Macquarie marked out the boundaries near the depot established by surveyor George Evans and reserved a site for a government house and domain. Reluctant to open the rich Bathurst Plains to a large settlement, Macquarie authorised few grants there initially, one of the first being 1000 acres to William Lawson, one of the three European explorers who crossed the mountains in 1813. The road-maker William Cox was another early grantee but later had to move his establishment to Kelso on the non-government side of the Macquarie River (GAO, 2005, 8).

A modest release of land in February 1818 occurred when ten men were chosen to take up 50 acre farms and 2 acre town allotments across the river from the government buildings. When corruption by government supervisor Richard Lewis and acting Commandant

William Cox caused their dismissal, they were replaced by Lieutenant William Lawson who became Commandant of the settlement in 1818 (ibid, 8).

Macquarie continued to restrict Bathurst settlement and reserved all land on the south side of the Macquarie River for government buildings and stock, a situation that prevailed until 1826. In December 1819 Bathurst had a population of only 120 people in 30 houses, two thirds being in the township of Kelso on the eastern side of the river and the remainder scattered on rural landholdings nearby. The official report in 1820 numbered Bathurst settlers at 114, including only 14 women and 15 children. The government buildings comprised a brick house for the commandant, brick barracks for the military detachment and houses for the stock keeper, and log houses for the 50 convicts who worked the government farm. Never successful, the government farm was closed by Governor Darling in 1828 (ibid, 8).

Governor Darling, arriving in Sydney in 1825, promptly commenced a review of colonial administration and subsequently introduced vigorous reforms. On advice from Viscount Goderich, Darling divided colonial expenditure into two parts: one to cover civil administration, funded by New South Wales; the other for the convict system, funded by Britain (ibid, 10).

By this time, J.McBrien and Robert Hoddle had surveyed the existing grants in the vicinity. Surveyor James Bym Richards began work on the south side of the river in 1826. But the town was apparently designed by Thomas Mitchell in 1830 and did not open until late 1833 after Richards had completed the layout of the streets with their two-road allotments. The first sales were held in 1831 before the survey was complete (ibid, 10).

In 1832 the new Governor, Major General Sir Richard Bourke, visited Bathurst in October. He instructed the Surveyor General Major Thomas L. Mitchell to make arrangements for 'opening the town of Bathurst without delay' and he in turn instructed the Assistant Surveyor at Bathurst J.B. Richards to lay out the blocks and streets. This was done in September 1833. It is believed that Major Mitchell named the streets, with George Street being named after King George III.

The very architecture of the city (of Bathurst) is a gallery in itself,, Georgian Colonial, Victorian and Edwardian buildings feature in the panoply of architecture, that was classified by the National Trust (of Australia (NSW)) in the 1970s. Bathust can lay claim to some of the oldest buildings in the colony; first Church of England over the Blue Mountains, once part of the Bishopric of Calcutta, Holy Trinity...on the hill at Kelso, St. Steven's Presbyterian, while not the original church, is still one of the oldest Presbyterian churches in the colony, Old Government Cottage, near the Macquarie River is part of the original government enclave. Not only is it the first inland European settlement, but it has museum collections of national significance... (Friend, 2021).

Bridging the Macquarie River:
Despite the growing importance of Bathurst as the principal urban centre over the Blue Mountains, the Macquarie River, which flows past the town on the Sydney side, was not bridged until 1856.

After years of local agitation, a long timber bridge with five laminated timber arches was started in 1855 and was opened on 1 January 1856 by the Governor, Sir William Denison. A bullock was roasted on a spit and 3000 people celebrated the new bridge, named after the Governor.

This was the last 'official' bridge designed by the Colonial Architect's Department under its brief direction by architect and engineer, William Weaver (1828-68). It was supervised by his Clerk of Works, WIlliam Downey, during 1855 (Maguire, 1984, 46).

Eleven days later another bridge over the Macquarie River a kilometre downstream was opened by a local entrepreneur, George Ranken (frequently quoted as Rankin): this bridge was known as the Eglinton Bridge or Rankin's Bridge.

The Denison Bridge was washed away by the great flood of 1867 and its debris also destroyed Rankin's Bridge, so after eleven years of having two bridges, Bathurst again found itslelf with only a ford or a ferry to cross the Macquarie. A narrow temporary wooden bridge was put across near the remains of the Denison Bridge later in 1867, but this was closed for safety reasons in June 1868. The government recognised that a permanent replacement was urgently needed. A new site was chosen 100 metres downstream from the first Denison Bridge and a realignment was made to the road approaches.

The new Denison Bridge was designed by Gustavus Alphonse Morrell, Assistant Engineer to the Department of Roads and foundation member of the Engineering Association of NSW. The bridge contract drawings bear Morrell's signature and that of William Christopher Bennett, Commissioner for Roads.

The bridge was constructed in 1869 to 1870 by the prominent engineering firm, P. N. Russell & Co at a cost of 18,818 pounds through the NSW Public Works Department. Most of the angle irons and bars were specially rolled for the job at P. N. Russell & Co's Pyrmont Rolling Mills and at Bathurst's two iron foundries of that time, including the nearby Denison Foundry. Only heavy iron plates and bars were imported.

Like the first bridge, the new one was opened by the Governor of the time, who was now the Earl of Belmore. Denison had left the colony in 1861 for Madras and then to retirement in England, where he died in 1871. But the new bridge, opened in June 1870, was the replacement of the Denison Bridge of 1856 and the name of Denison was retained.

Although incorporated in the original design, footways were never built as part of the bridge. A steel footbridge was erected in 1950, on the upstream side, by the Department of Main Roads.

In use for over 120 years as a road bridge, its service life was interrupted only for a 9-day repair period in the 1960s. It was superseded by a prestressed concrete bridge upstream and closed to vehicular traffic in the early 1990s and adapted for use as a footbridge.

HISTORICAL NOTES ON KEY INDIVIDUALS

The supervisor of the original bridge design was engineer, William Christopher Bennett. Bennett came from Ireland where he worked on railway and drainage works, and in South America on canal works. Arriving in Sydney in 1855 he met Sir Thomas Mitchell, Colonial Surveyor, and joined the Department. He worked on sewerage and railway works before being appointed Assistant Engineer of Main Roads.

On 1 January 1859 Bennett became Engineer to the Department of Roads which he helped to form and eventually was appointed Commissioner for Roads on 1st November 1862. In his term of office, roads were extended nearly 6,000 miles (9,600km) 2,000 miles (3,200 km) surfaced, with a total length of bridges of 40 miles (64 km). Bennett's signature appears on the Denison bridge contract drawings as commissioner, dated 20th August, 1868. A steel footbridge was erected in 1950 on the upstream side by the Department of Main Roads.

The bridge designer, Gustavus Alphonse Morrell, arrived in Australia in 1863 and initially worked on defence installations. He was appointed Assistant Engineer on 13 June 1867. After establishing his own business he presided over a Royal Commission into the condition of railway bridges in the colony. He was also a foundation member of the Engineering Association of New South Wales formed on 24 September 1870. Morrell, as Assistant Engineer, also signed the Denison bridge drawings.

The Russell brothers and P. N. Russell and Co: The Russell brothers arrived with their father in 1838 and established a foundry and engineering works on the banks of the tank stream. In 1842 Peter started his own business, the Sydney Foundry and Engineering Works. In 1855 P. N. Russell & Co was formed comprising Peter Russell who served in London as the overseas representative, and John and George Russell and J. W. Dunlop (the works foreman) . The firm flourished, establishing workshops on a large waterfront area at Darling Harbour and by the 1870s employing 850 men. During this period, the firm completed the contracts for the Denison Bridge in 1870 and the Hume Bridge at Yass in 1871. However, industrial trouble beginning in 1873 saw the closure of the company in 1874.

In 1896 P. N. Russell endowed the School of Engineering at Sydney University with $100,000, followed by a second bequest of $100,000 in 1904. John Russell was also a foundation member of the Engineering Association of New South Wales.

Historic Themes

Records Retrieved: 18

National Theme	State Theme	Local Theme
8. Culture	Creative endeavour	Technological innovation and design solutions
3. Economy	Transport	Unknown
3. Economy	Transport	Engineering the public road system
3. Economy	Technology	Technologies of bridge building
3. Economy	Environment - cultural landscape	Developing local, regional and national economies
2. Peopling	Aboriginal cultures and interactions with other cultures	Wiradjuri Nation - lines of communication
1. Environment	Environment - naturally evolved	River flats
1. Environment	Environment - naturally evolved	Cultural: Rivers and water bodies important to humans
1. Environment	Environment - naturally evolved	Changing the environment
8. Culture	Defence	Technological innovation and design solutions
3. Economy	Aboriginal pre-contact	Unknown
3. Economy	Aboriginal pre-contact	Engineering the public road system
3. Economy	Utilities	Technologies of bridge building
3. Economy	Events	Developing local, regional and national economies
2. Peopling	Aboriginal post-contact	Wiradjuri Nation - lines of communication
1. Environment	Exploration	River flats
1. Environment	Exploration	Cultural: Rivers and water bodies important to humans
1. Environment	Exploration	Changing the environment

Recommended Management

Management Summary

Management

Records Retrieved: 0

Management Category	Management Name	Date Updated
No Results Found		

Report/Study

Heritage Studies

Records Retrieved: 0

Report/Study Name	Report/Study Code	Report/Study Type	Report/Study Year	Organisation	Author
No Results Found					

Reference & Internet Links

References

Records Retrieved: 18

Type	Author	Year	Title	Link
Written	Field, Samantha	2021	Bathurst: City of Museums	www.history.org.au
Tourism	Attraction Homepage	2007	Denison Bridge	http://www.bathurst.nsw.gov.au/community/1464.html
Tourism		2007	Denison Bridge	http://www.visitnsw.com.au/Operator.aspx?ProductId=9019437
Tourism	Bathurst Regional Council	2006	Denison Bridge Visitor Information	http://www.bathurst.nsw.gov.au/community/1464.html
Written	Government Architect's Office	2005	Bathurst Hospital Conservation Management Plan	
Written	Jacinta Carroll	2003	Lamps set for heritage listing (West. Advocate 29/3/03)	
Written	Barbara Hickson	2002	Denison Bridge SHI form and ICMS Strategy	
Written	Irwin Johnston & Partners	1994	Conservation Guidelines for Denison Bridge	
Written	Inst, Engrs, Australia, Syd. Div.	1994	Nomination Report for plaquing Denison Bridge	
Written	Theo Barker	1992	A History of Bathurst, Vol 1	
Written	Bathurst City Council	1989	Heritage Trail	
Written	Damaris Bairstow	1989	Bathurst Archaeological Inventory	
Written	entry on Morrell, Gustavus A	1988	Proc. Engineering Association of NSW, Vol IV	
Written	Maguire, Roslyn	1984	'Introducting Mr William Weaver, architect and engineer'	
Written	entry on Russell, Peter Nicol	1972	Australian Dictionary of Biography, Vol III	
Written	entry on Bennett, William C	1972	Australian Dictionary of Biography, Vol III	
Written	III. Sydney News, 10 October, p.209	1872	New iron bridge over Macquarie River	
Written	Sydney Mail, June 18, p.10	1870	Denison Bridge Completion	

Data Source

The information for this entry comes from the following source:

Data Source	Record Owner	Heritage Item ID
Heritage NSW	Heritage NSW	5051846

Every effort has been made to ensure that information contained in the State Heritage Inventory is correct. If you find any errors or omissions please send your comments to **heritagemailbox@environment.nsw.gov.au**

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : 220228_Bathurst REFA-1

Client Service ID : 856932

Premise Australia Pty Ltd

154 Peisley Street
Orange New South Wales 2800

Attention: Hugh Shackcloth-Bertinetti

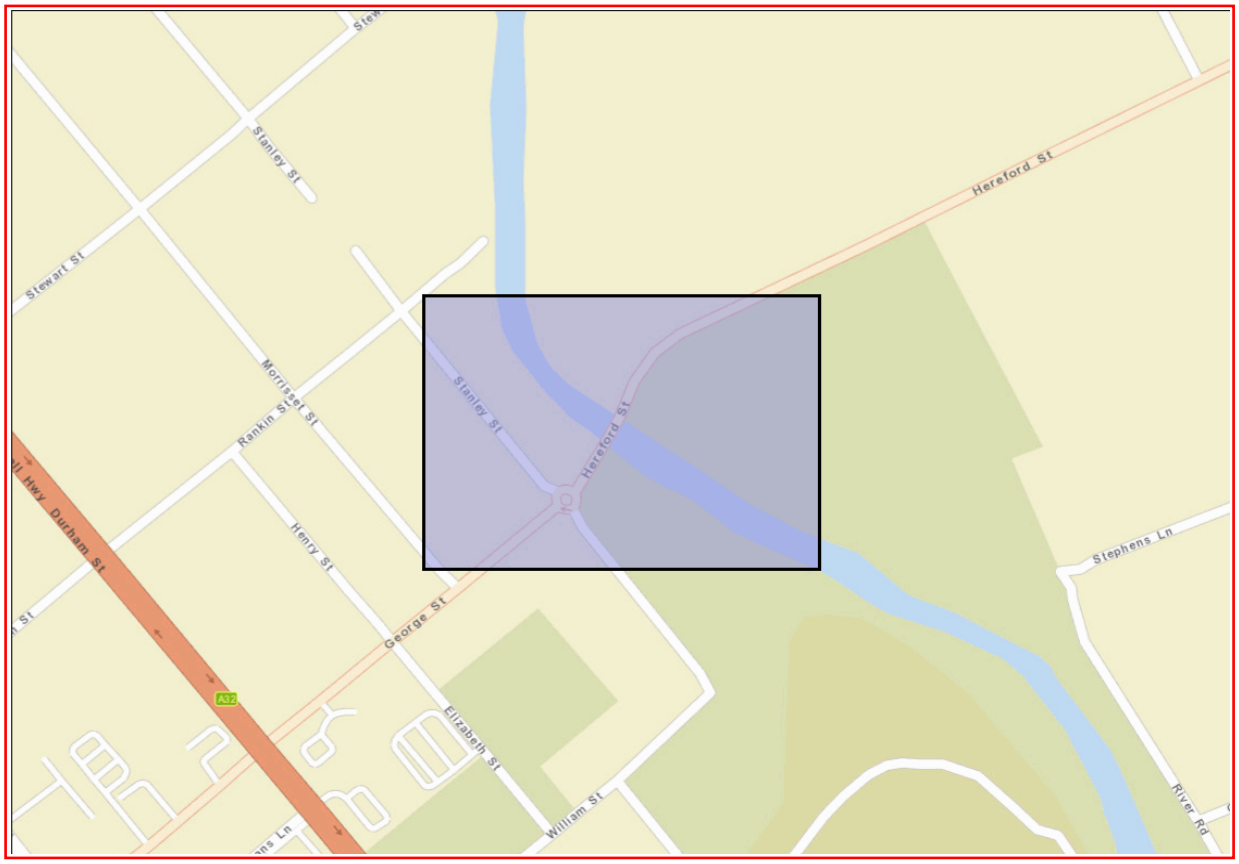
Email: hugh.bertinetti@premise.com.au

Date: 22 January 2024

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -33.4129, 149.5835 - Lat, Long To : -33.4106, 149.5874, conducted by Hugh Shackcloth-Bertinetti on 22 January 2024.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of Heritage NSW AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	**Aboriginal sites are recorded in or near the above location.**
0	**Aboriginal places have been declared in or near the above location. ***

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (https://www.legislation.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Heritage NSW upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Heritage NSW and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date. Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

Level 6, 10 Valentine Ave, Parramatta 2150
Locked Bag 5020 Parramatta NSW 2124
Tel: (02) 9585 6345

ABN 34 945 244 274
Email: ahims@environment.nsw.gov.au
Web: www.heritage.nsw.gov.au

AHIMS Web Services (AWS)
Search Result

Your Ref/PO Number : 220228 Bathurst REFA-2

Client Service ID : 856934

Premise Australia Pty Ltd

Date: 22 January 2024

154 Peisley Street
Orange New South Wales 2800

Attention: Hugh Shackcloth-Bertinetti

Email: hugh.bertinetti@premise.com.au

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -33.4196, 149.588 - Lat, Long To : -33.4151, 149.5957, conducted by Hugh Shackcloth-Bertinetti on 22 January 2024.

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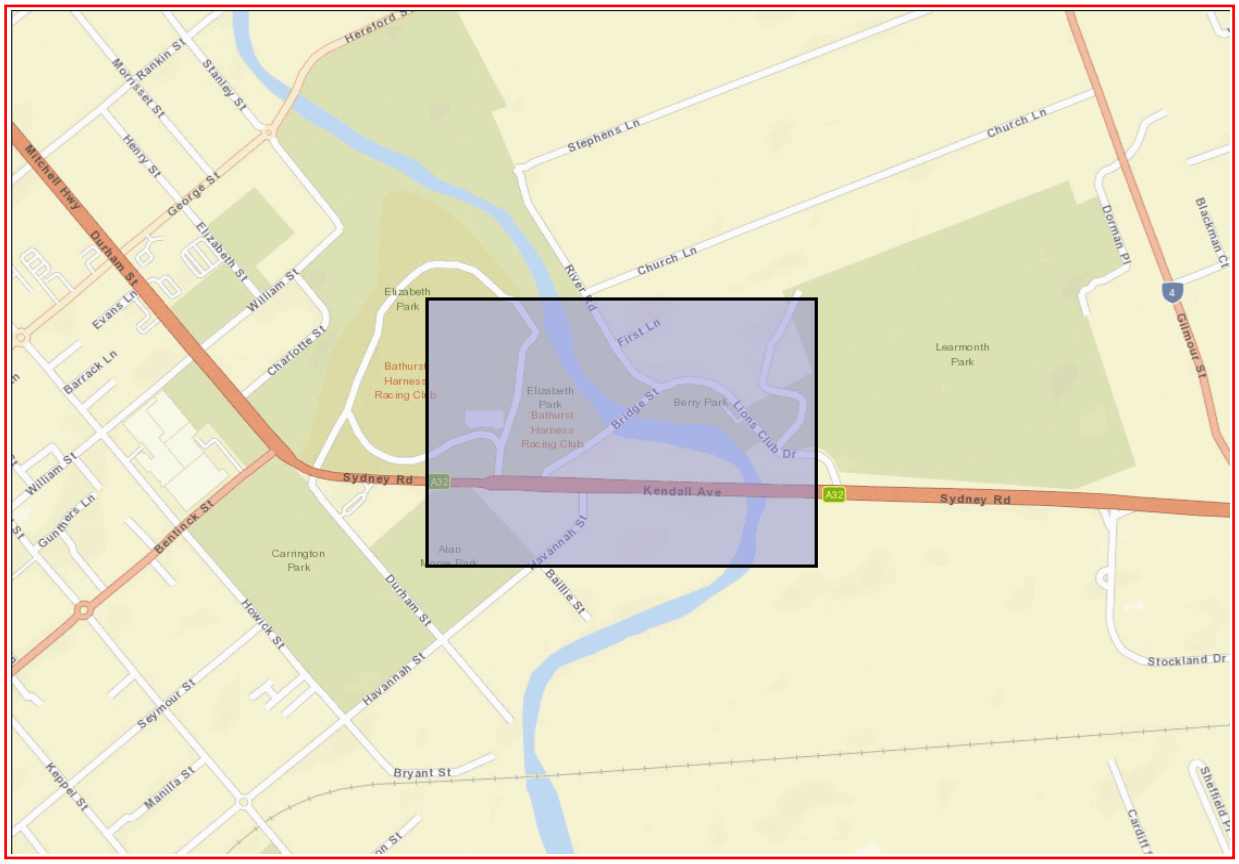

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0	**Aboriginal places have been declared in or near the above location. ***

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Bathurst Water Harvesting Scheme

Geomorphic assessment of pipeline alignment potential impacts

Dr Christopher J Gippel

March 2024

Premise
Bathurst Regional Council

FLUVIAL SYSTEMS

Bathurst Water Harvesting Scheme

Geomorphic assessment of pipeline alignment potential impacts

Prepared for:

Premise and

Bathurst Regional Council

Prepared by:

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ABN: 71 085 579 095

March 2024

Please cite as follows:

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Document History and Status

Document	Bathurst Water Harvesting Scheme, Geomorphic assessment of pipeline alignment potential impacts
Ref	d:\fluvial systems\consulting\21010_Bathurst WHS
Date	18/03/2024
Prepared by	Christopher Gippel
Reviewed by	David Walker, Premise

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	6/03/2024	Draft for Review	Chris Gippel Director	
B	18/03/2024	Final	Chris Gippel Director	

Table of Contents

Executive Summary

The objective of this report was to assess geomorphic risks associated with the operation of the 5.5 km long water pipeline to transfer water from PS2 to the proposed WFP Balance Pond at the WFP, with a focus on the two locations on the pipeline where it will cross the Wambuul/Macquarie River using existing bridges and the one location where it will be underbored to cross Queen Charlottes Creek.

The methodology employed was to review, map and analyse all available literature, drawings and data, including topography, geology, channel geomorphic type, bed material calibre and depth, structure and extent of riparian vegetation cover, channel morphology, and historical channel position stability. In addition, an assessment was made of potential bed scour depth under high flood conditions, based on available empirical relationships. Geomorphic risks associated with the two proposed Macquarie River bridge crossings, the proposed underbore at the Queen Charlottes Creek crossing site, and proposed trenching of the pipeline between Denison Bridge and Gordon Edgell Bridge, were assessed on the basis of evaluation of the compiled and analysed data.

The majority of the pipeline route passes within alluvium, with the remainder passing within basalt geology. The alluvium is unconsolidated and at risk of scour when subject to flood waters, especially if vegetation cover is poor. River Styles assessment suggests that Wambuul/Macquarie River at the two bridge crossing sites, which was in moderate condition due to disturbed riparian vegetation, would be relatively resistant to geomorphic change over time, and does not appear to be under threat of a bed instability migrating from the downstream reach. Queen Charlottes Creek at the underbore crossing site is more prone to geomorphic adjustment of the bed than Wambuul/Macquarie River, although the banks are relatively stable, despite the disturbed state of the riparian vegetation. The vegetation structure data suggest that, across the study area, the riparian vegetation is in poor condition relative to the forest that would be expected in an undisturbed riparian zone in this location.

Historical imagery of the area of the Wambuul/Macquarie River between the two bridge pipeline crossing sites suggests that the position of the river channel was relatively stable between 1964 and 2022. Between 1984 and 1989 there was a noticeable straightening of the low flow channel in the middle of the reach between Denison Bridge and Gordon Edgell Bridge, near Stephens Lane. This change appears to have been engineered to reduce the threat posed by potential channel migration to the road on the edge of the right bank, rather than being a natural change. By 2013, the right side of the channel between Denison Bridge and Gordon Edgell Bridge had been landscaped, grassed and a shared pathway installed. The historical imagery suggested that the position of Queen Charlottes Creek channel in the vicinity of the underbore pipeline crossing site was stable between 1964 and 2022. There was a noticeable change to the channel position about 500 m downstream of the pipeline crossing site some time between the 1998 and 2013 images. This involved channel straightening in association with construction of a 480 m long levee on the right bank between south of Russell Street to Upfold Street, to protect adjacent buildings.

Between the bridge pipeline crossing sites (between Denison Bridge and Gordon Edgell Bridge) it is proposed to route the pipeline within the main river channel, at ground level around 2 – 3 m above the base of the channel. Along this 816 m length of pipeline it is proposed to bury the pipeline using the trenching method. A buried pipeline positioned within the channel has a higher risk of being exposed due to erosion compared to when positioned on the floodplain, but this risk is relatively low over the expected lifetime of the pipeline. This risk must also be balanced with much higher risks to Aboriginal heritage, existing road infrastructure, private land and dwellings, and sporting facilities associated with excavation of the floodplain adjacent to the river.

Statistical analysis of the thalweg profiles suggested that, at the locations of the bridge pipeline crossing sites, the expected maximum vertical variation in the elevation of the bed at any point over

time would be 0.79 m on Wambuul/Macquarie River and 0.85 m on Queen Charlottes Creek. These variations in bed level do not pose a geomorphic risk to the pipeline alignment.

On the Wambuul/Macquarie River, mean bed scour depth that could be expected during a large flood ranges from 0.5 m to 0.8 m, and the maximum scour depth ranges from 2.4 m to 3.5 m. For a sand bed stream, which could apply to Queen Charlottes Creek, the predicted mean scour depth that could be expected during a large flood exceeds 0.8 m and the maximum scour depth exceeds 3.5 m. These predicted scour depths would be an over-estimate of potential maximum scour of the sand-bed Queen Charlottes Creek, as the empirical data to develop the equations used were considerably larger than Queen Charlottes Creek, and the phenomenon of scour is scale-dependent. The depth of drilling under the bed of Queen Charlottes Creek is adequate to achieve a low geomorphic risk.

The geomorphic risk to the ground and vegetation cover of the Macquarie River around the four instances (one on each side of the two bridges) where the pipe emerges from the ground to the bridge structures within the riparian zone was assessed to be negligible. Maintenance of this level of risk requires that the ground surface cover is maintained in good condition (grass, trees, paving).

1 Introduction

1.1 Brief history of the Water Harvesting Scheme (WHS) and Environmental Assessment (EA)

Bathurst Regional Council (BRC) currently benefit from Water Access Licence 34452, which permits the extraction of up to 17,500 ML/year for the purpose of town water supply. This water is extracted from the Wambuul/Macquarie River via an offtake point located closed to the Bathurst Water Filtration Plan (WFP). The maximum capacity of the existing pump(s) at the WFP is approximately 93.5 ML/day. This maximum extraction rate is rarely required, with peak extraction up to 50 ML/day, being limited by peak demand. Bathurst recently experienced the worst drought since records began in 1890, and the area was listed as a critical locality in NSW. Given that City of Bathurst area is predicted to continue moderate growth on a yearly basis for the next 10 years and beyond, and the certainty of future droughts, a water harvesting scheme (WHS) proposed by BRC was included as a critical project under the relevant Schedules of the *Water Supply (Critical Needs) Act 2019* (WSCN Act) by the NSW Government. The WSCN Act was withdrawn after two years and the project was transferred to Part 5 of the *Environmental Planning and Assessment Act 1979*.

BRC's objective is to construct and operate a water harvesting scheme on the Wambuul/Macquarie River system downstream of the WFP to augment the potable water supply in a manner that protects both public health and the downstream environment. This would be achieved by:

- Efficiently capturing river flows occurring as a result of release from Chifley Dam under normal operating conditions;
- Capturing a portion of high flows from the river associated with stormwater flows from the urban catchment;
- Capturing a portion of high flows from the river occurring as a result of storm events higher in the catchment;
- Establishing adequate risk management systems in place to meet water quality objectives; and
- Adaptively managing the scheme so that its impact is not significant.

Premise Australia Pty Ltd (Premise) prepared a Review of Environmental Factors (REF) for BRC to meet the requirements of Part 5 of the EP&A Act to seek approval for the construction and testing/commissioning of stage 1 of the Bathurst WHS on the Wambuul/Macquarie River. The objective of the WHS is to augment the existing City of Bathurst potable water supply as a component of a broader suite of measures aimed at providing improved water security for the city. The scheme is proposed to be delivered over two stages. The approval granted under Part 5 of the Environmental Planning and Assessment Act 1979 was for stage 1 only. Consent is sought via this application for stage 1 only, and this report is only concerned with stage 1 impacts. Details about stage 2 are include in Premise (2021).

Stage 1 includes the following main components:

- Installation of an approximately 36.5 ML holding pond [termed Pumping Station No. 1 (PS1) Holding Pond] at the existing Sewerage Treatment Plant (STP) site;
- Installation of Pump Station No. 1 (PS1) with a transfer capacity of 200 L/s, to extract water from the Wambuul/Macquarie River and pump to the proposed PS1 holding pond;
- Installation of a packaged pre-treatment plant for primary treatment of the water;
- Installation of Pump Station No. 2 (PS2) with a capacity of 200 L/s to transfer water from the proposed PS1 Holding Pond to the proposed WFP Balance Pond at the WFP;
- Installation of an approximately 5.5 kilometre long water pipeline to transfer water from PS2 to the proposed WFP Balance Pond at the WFP (Figure 1); and

- Installation of Pump Station No. 4 (PS4) with a capacity of 400 L/s to transfer water from the proposed WFP Balance Pond to the WFP.

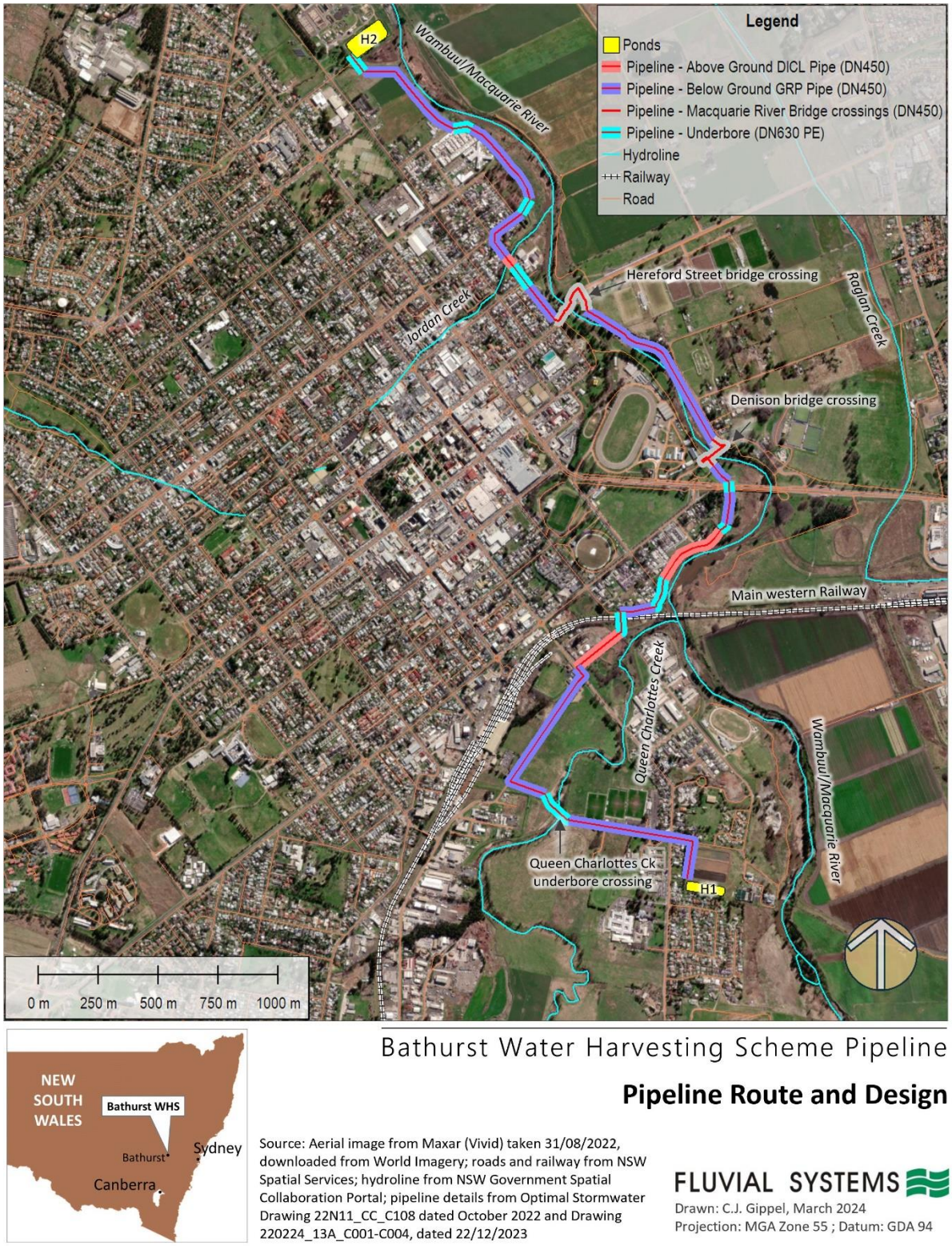


Figure 1. Route and design of pipeline to transfer water from PS2 to the proposed WFP Balance Pond at the WFP.

The REF prepared for the WHS comprised assessment of construction and operation phase impacts covering the conventional range of users and disciplines, including: upstream users, aquatic ecology, water quality, terrestrial ecology, aboriginal heritage, non-Indigenous heritage, contamination, and socio economic (Premise, 2021). A fluvial geomorphological assessment of the installation of the proposed PS1 Holding Pond adjacent to the STP was included as Appendix L of the REF (Player, 2021). The assessment of Player (2021) was concerned with local-scale geomorphic impacts of the proposed PS1 Holding Pond adjacent to the STP. The other geomorphic contribution to the REF was the assessment by Gippel (2022) of the catchment-scale impact of altered river flow regimes due to operation of the WHS on fluvial geomorphic processes.

1.2 Revised alignment to avoid underboring Macquarie River

In a letter to The General Manager, BRC, dated 19 May 2023, Anisul Afsar, A/Team Leader, Licensing/SSD, Licensing and Approvals, Department of Planning and Environment – Water noted that the WHS pipeline will cross Queen Charlotte's Vale Creek and the Wambuul/Macquarie River in two places, which, at that time, involved underboring the creek and river. Dr Afsar stated that the REF (Premise, 2021) did not provide adequate assessment of the geomorphological impacts on the creek or river and requested further information to support the application.

As detailed design has progressed, it has become apparent that the logistical and geotechnical challenges associated with the proposed underbores of the Macquarie River are significant. The alignments approved by the original REF provided an underbore of approximately 116 metres in the north of entire pipeline alignment near Hereford Street Bridge and a second underbore of approximately 80 metres further south near Denison Bridge. The geotechnical investigations have determined that, due to the underlying conditions, both of these underbores would need to be deeper (around 16 m) and longer (around 300 m). The implication of this is that the alignment of the pipeline and the size of launch and receival pits would have to change. There would also be a very high risk of failure of the underbores due to geological conditions, and ongoing operational (maintenance) challenges with pipework being located at this depth. Experience with other projects in the central west region, and detailed discussions with underboring experts, suggested that the risk of failure would be very real. The impacts associated with significantly larger launch and receival pits would also introduce increased potential impacts to areas adjacent to the Macquarie River. The impacts associated with a failed underbore include the risk of frac out, which has the potential to discharge water into the river, which would be a significant issue.

Given the range of challenges associated with the two originally proposed Macquarie River underbores, it is proposed to amend the current approved alignment of the pipeline to avoid underboring the Macquarie River. The modification to the approved pipeline route proposes to attach the pipework to two existing bridges passing over the Macquarie River, including at the low-level crossing located at Hereford Street, known as the Gordon Edgell Bridge, and at Denison Bridge, located near Bridge Street (Figure 1). Denison Bridge is a state heritage listed bridge. Gordon Edgell Bridge currently provides vehicular and pedestrian access to the northeast areas of the city of Bathurst. Denison Bridge was closed to vehicular traffic in the early 1990s but remains open to pedestrians. Bridge Street terminates on either side of Denison Bridge. Both of the bridges currently host a number of pipe attachments that cater for Council and other regulatory services, including water and telecommunications, noting that the carriage of services is a key purpose of these bridges, along with carriage of vehicles and/or pedestrians.

Premise (2024a) has prepared a REF Addendum to address the alternative option to provide connections across the Macquarie River utilising the existing bridges. This report supports that REF Addendum. It provides an assessment of potential impacts resulting from the modification of the approved pipeline alignment and the proposed replacement of the underbores with sections of pipe that will pass over the Macquarie River via Gordon Edgell (Hereford Street) and Denison Bridges. The modification to the approved activity seeks to avoid

the above discussed geological constraints and facilitates the delivery of the Bathurst WHS, supporting an objective to improve the water security of Bathurst.

1.3 Background to this geomorphology assessment

In a letter to The General Manager, BRC, dated 19 May 2023, Anisul Afsar, A/Team Leader, Licensing/SSD, Licensing and Approvals, Department of Planning and Environment – Water noted that the proposed WHS pipeline will cross Queen Charlotte's Vale Creek and the Wambuul/Macquarie River in two places which will require underboring the creek and river. Dr Afsar stated that the EA (Premise, 2021) did not provide adequate assessment of the geomorphological impacts on the creek or river and requested further information to support the application. The revised proposal replaces the two originally proposed underbored crossings of the Macquarie River with bridge crossings whilst retaining the underbored crossing of Queen Charlottes Creek. The primary purpose of this report is to assess the potential geomorphic impacts of these three crossings.

1.4 Description of the proposed pipeline crossings

The focus of this report is assessment of geomorphic risks associated with the operation of the WHS water pipeline at the three locations on the pipeline where it will be underbored to cross Queen Charlottes Creek and attached to the existing Denison Bridge and Hereford Street Bridge to cross the Wambuul/Macquarie River (Figure 1).

Optimal Stormwater prepared 'for construction' drawings of the pipeline in October 2022 for Hynash Constructions using Voerman and Ratsep Land Surveyors. Optimal Stormwater Drawing 22N11_CC_C146 (A) shows detail of the Queen Charlottes Creek underbore crossing, labelled U7. The section of the crossing constructed using directional drilling is 94.91 m long. The depth of the pipeline from the bed of the creek appears to have been estimated, as there are no bed elevation data over the majority of the width of the channel. The available LiDAR from 2019 (detail provided later in this report) suggests that between top of left and right bank, the pipeline route covers a distance of 27 metres, although Drawing 22N11_CC_C146 (A) suggest that the distance is longer, around 45 m. This over-estimation of channel width is probably explained by the missing survey data from within the channel. LiDAR data indicate that the lowest bed elevation on the channel bed over the pipeline route is 651.41 mAHD. This is comparable with the lowest bed elevation on Drawing 22N11_CC_C146 (A) of 651.26 mAHD. The right top of bank elevations on Drawing 22N11_CC_C146 (A) are consistent with those of the LiDAR, however the left top of bank elevations are 653.89 mAHD on Drawing 22N11_CC_C146 (A) compared to around 654.6 mAHD on the LiDAR. Drawing 22N11_CC_C146 (A) suggests that the depth of the pipeline from the ground surface to the top of pipe cover in the vicinity of the bank tops is about 4.5 - 5.3 m, with a minimum depth of 2.6 m in the centre of the channel.

The plans for the pipeline alignments at the two Macquarie River bridge crossings were provided by Premise as Drawing 220224_13A_C001-C004, dated 22/12/2023 (Figure 2, Figure 3, Figure 4 and Figure 5). From a geomorphic perspective, the most relevant characteristics of the pipeline alignments are:

- The pipelines cross the river on the downstream sides of the bridge decks, attached within supports that will be affixed to existing mounting points on the side of the bridge structure.
- The proposed pipelines, mounting and support structures are no wider or taller than the existing pipe mounting and support structures.
- The proposed pipelines, mounting and support structures are no taller than the existing bridge deck in the case of Hereford Street Bridge, and combined deck and understructure in the case of Denison Bridge, i.e. from the perspective of hydraulic blockage effect, the surface area of the bridges facing the river (note: proposed pipeline crossings face the river on the downstream side of bridges) will not be materially increased by the presence of the pipeline, mounts and support structures, i.e. the proposed pipeline alignment is completely in the lee of the existing structure.
- On the eastern side of Denison Bridge, the vertical section of the pipe from ground to bridge emerges from the ground on the top of the bank, where the ground slopes towards the river at less than 5%

gradient, at an elevation higher than the 1%AEP flood level (Figure 4); and on the western side the pipeline emerges from the ground near the top of the bank, where the ground slopes towards the river at approximately 10% gradient, and at an elevation of approximately 3 – 4 m below the 1%AEP flood level (Figure 4).

- On the eastern and western sides of Denison Bridge, in the vertical sections of the pipe from ground to bridge structure, the pipeline is fixed against the downstream sides of concrete pylons that support the approach road (Figure 4), with the pipeline being no wider than these pylons (in the direction facing the river), i.e. from the perspective of hydraulic blockage effect, the surface area of these vertical sections of the bridge facing the river (note: proposed pipeline crossings face the river on the downstream side of bridges) will not be materially increased by the presence of the pipeline, i.e. the proposed vertical section of the pipeline alignment is completely in the lee of the existing pylons.
- On the eastern and western sides of Hereford Street Bridge, the pipeline emerges directly from the bank horizontally onto the bridge deck structure, i.e. the proposed pipeline alignment is completely in the lee of the existing structure.

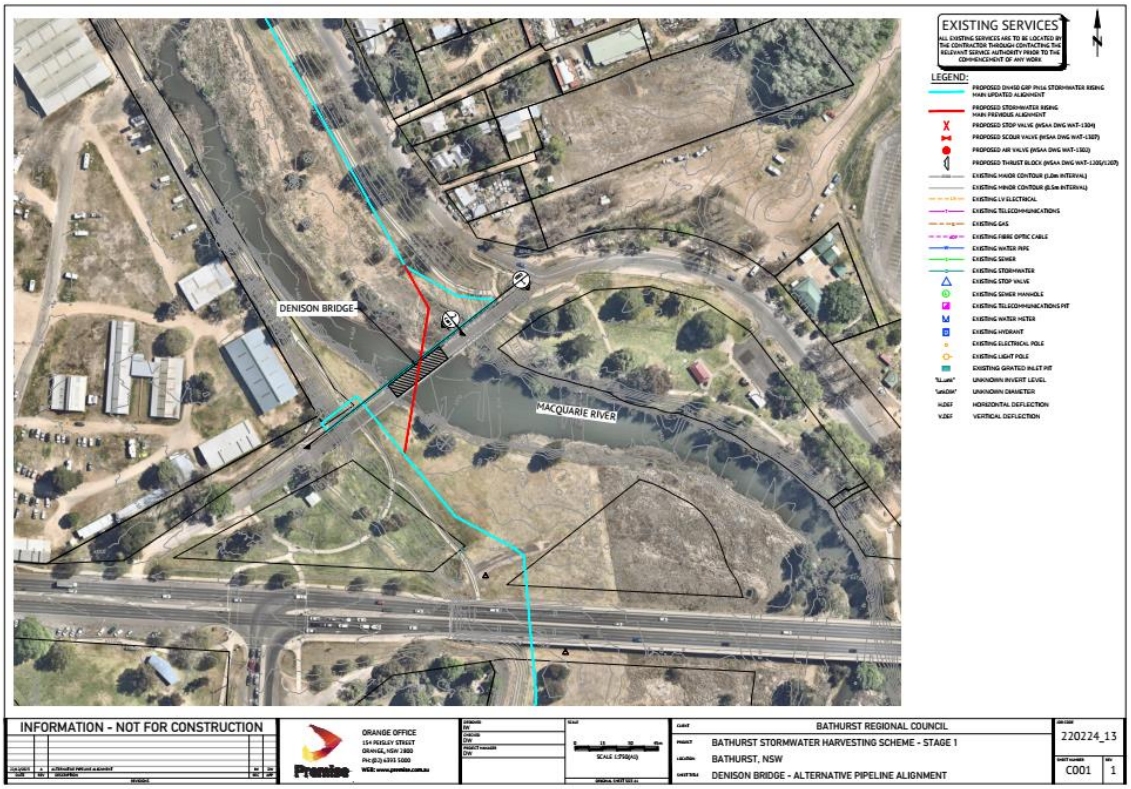


Figure 2. Drawing C001, Bathurst Stormwater Harvesting Scheme – Stage 1, Denison Bridge – Alternative Pipeline Arrangement. Source: Premise.

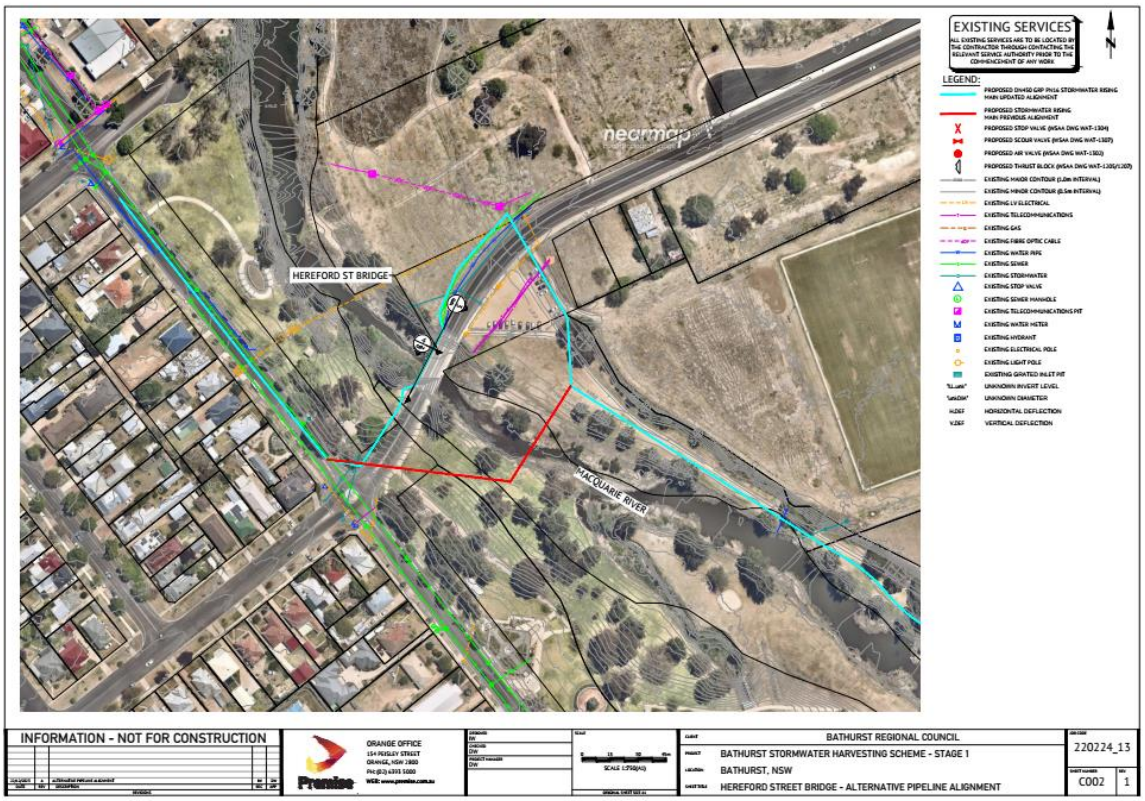


Figure 3. Drawing C002, Bathurst Stormwater Harvesting Scheme – Stage 1, Hereford Street Bridge – Alternative Pipeline Arrangement. Source: Premise.

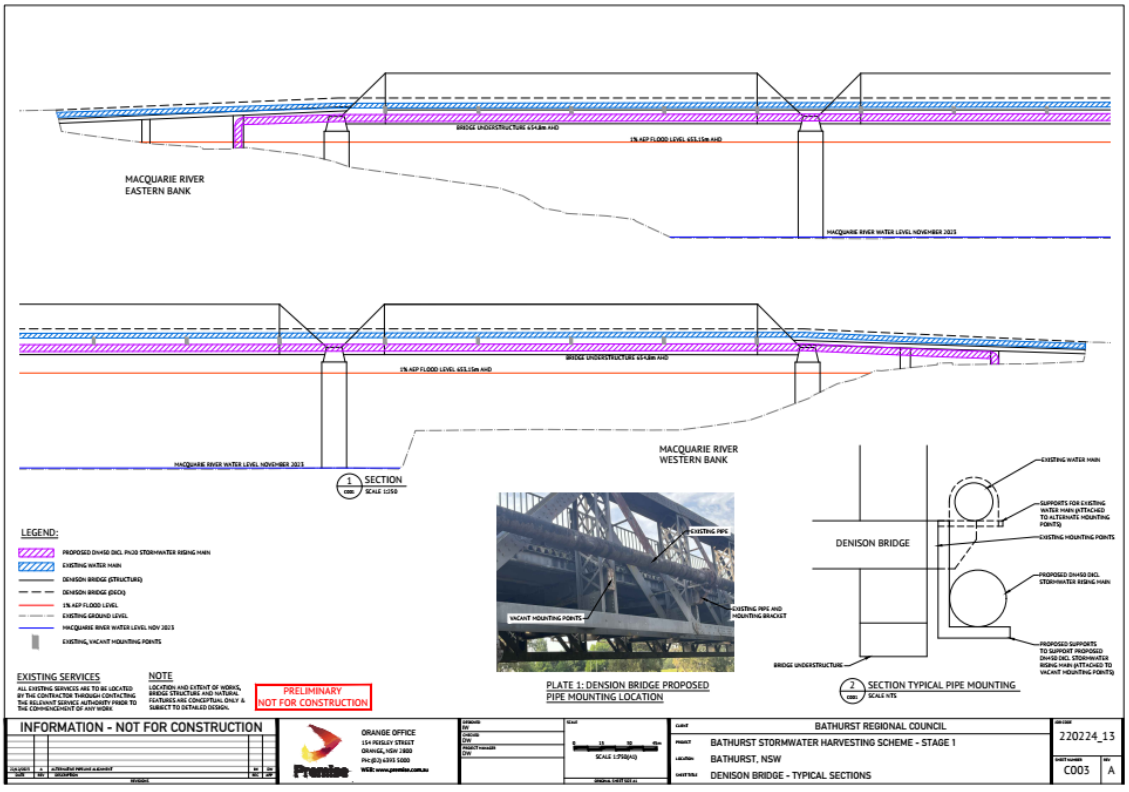


Figure 4. Drawing C003, Bathurst Stormwater Harvesting Scheme – Stage 1, Denison Bridge – Typical Sections. Source: Premise.

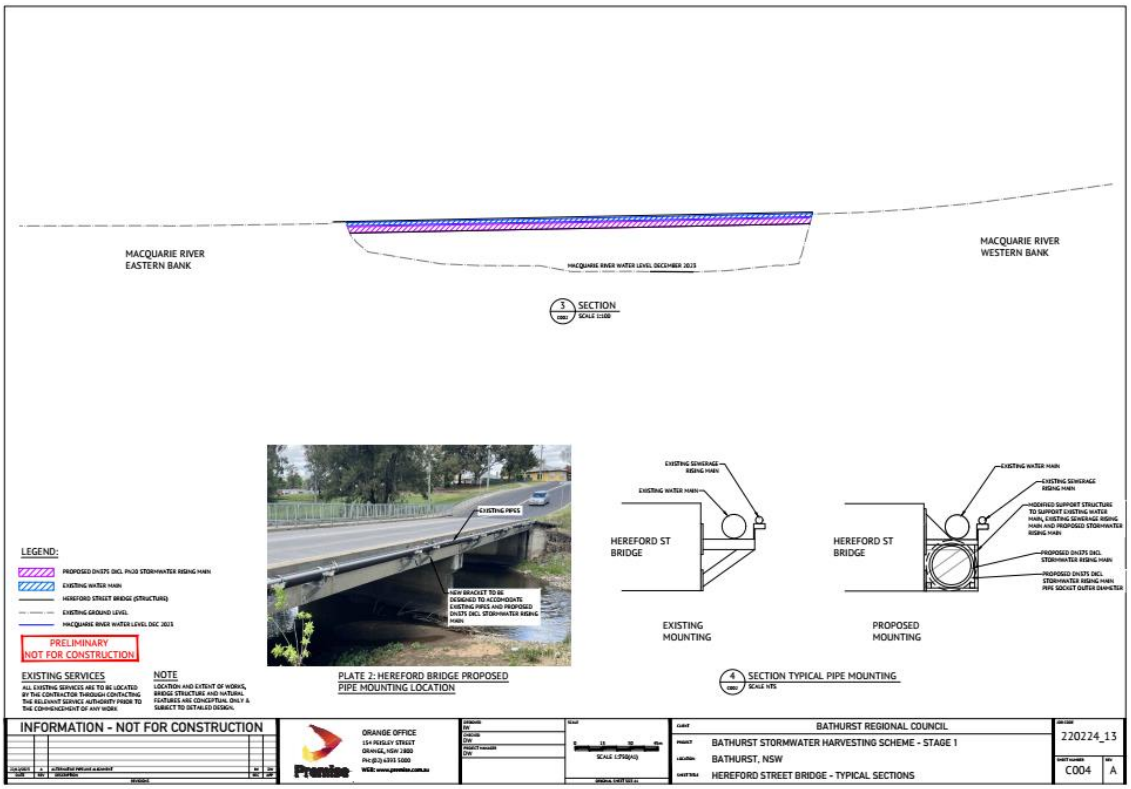


Figure 5. Drawing C004, Bathurst Stormwater Harvesting Scheme – Stage 1, Hereford Street Bridge – Typical Sections. Source: Premise.

1.5 Scope of this report

The scope of work included, but was not limited to:

- Review relevant literature, drawings and data.
- Map geomorphic characteristics of Wambuul/Macquarie River[1] and Queen Charlottes Creek[2] in the vicinity of the pipeline route and crossings. This includes channel morphology, River Styles and alluvium extent, and potential rate of channel change.
- Map existing riparian vegetation structure in vicinity of pipeline crossings.
- Assess potential impacts and geomorphic risks associated with underboring Queen Charlottes Creek and using existing bridges to cross Wambuul/Macquarie River. The geomorphic risk assessment is primarily concerned with instances where a pipe goes into or comes out of the ground within the riparian zone.
- Propose modifications to the design if considered beneficial from the geomorphic impact perspective.

[1] In December 2021 the Macquarie River became known as Wambuul or Macquarie River after the Geographical Names Board endorsed dual naming.
[2] Also known as Queen Charlottes Vale Creek, but named Queen Charlottes Creek on the digital 1:25,000 NSW (East) topographic sheet and the pdf topographic maps accessible on the Spatial Collaboration Portal https://portal.spatial.nsw.gov.au/portal/apps/sites/#/homepage/pages/map-viewers (accessed 28 July 2023).

2 Methodology

2.1 Variables of interest

The assessment focused on geomorphic characteristics of the watercourses in the vicinity of the proposed pipeline crossings that were relevant to the main risks associated with the pipeline during its operational phase:

- Geomorphic change will lead to exposure of the pipeline to fluvial forces, thereby putting the integrity of the pipeline at risk, and
- The presence of the pipeline (usually in combination with being exposed through geomorphic change) will interfere with natural geomorphic processes.

In consideration of the established risks associated with pipeline crossings of watercourses, and the guidelines of NSW Office of Water (2012), the variables of interest in this investigation were:

- The degree of confinement of the channel and extent of floodplain in unconfined, or partially confined settings,
- The calibre of the bed material,
- The depth of sediment assuming a mobile coarse-grain bedded stream,
- The structure and extent of riparian vegetation cover,
- The presence of knickpoints that could potentially migrate upstream to the crossings, and
- Historical observations of channel alignment change that could indicate potential future channel alignment change.

No attempt was made to ascertain, on the basis of available data, the historical or current rate of erosion or deposition, or stability of bed and banks, relative to what would be expected for the watercourses in an undisturbed setting.

All mapping undertaken for this report used Global Mapper Pro™ V25.0.3 Nov 19 2023 Build (Blue Marble Geographics) software.

2.2 Study area

The study area of this report is the watercourses and land in the vicinity of the proposed Bathurst Water Harvesting Scheme Pipeline, extending from the proposed Pump Station 1, 36 ML storage pond and Pump Station 2 at Morrisett Street to an 8 ML storage pond at the Bathurst Water Filtration Plant to capture stormwater run-off from drains and local catchments.

2.3 Topographic data

The study area is covered by DEM (digital elevation model) tiles produced by NSW Spatial Services, Department of Finance, Services and Innovation, available from ELVIS - Elevation and Depth - Foundation Spatial Data, Version 0.1.1.0 (http://elevation.fsdf.org.au/).

The study area was covered by the 2 x 2 km 1 m resolution DEM over the Bathurst region. The DEM was produced using TIN (Triangular Irregular Network) method of averaging ground heights to formulate a regular grid. This data set contains a ground surface model in grid format derived from Spatial Services Category 1 (Classification Level 3) LiDAR (Light Detection and Ranging) from an ALS50 (SN101). The model is not hydrologically enforced. The data used to create this DEM has an accuracy of 0.3 m (95% Confidence Interval) vertical and 0.8 m (95% Confidence Interval) horizontal. The data were collected over the period 21/07/2019 to 23/08/2019.

2.4 Aerial imagery

Current land cover was represented by an image dated 31/08/2022. Selected historical images were also obtained (Table 1).

Table 1. Aerial imagery used in this report.

Image date	Image reference	Image source
02/01/1964	1200_10_151 1200_09_188	Spatial Collaboration Portal Historical Imagery Viewer, NSW
12/03/1984	3370_3S_034	Spatial Collaboration Portal Historical Imagery Viewer, NSW
05/10/1989	3692_11_021	Spatial Collaboration Portal Historical Imagery Viewer, NSW
18/06/1998	4438_11_123	Spatial Collaboration Portal Historical Imagery Viewer, NSW
15/08/2013	NA	Six Maps downloaded from NSW Spatial Information Exchange (online)
31/08/2022	NA	Maxar (Vivid), downloaded from World Imagery (online)

2.5 Watercourse network

The drainage network was represented by the National Surface Hydrology Lines (Regional) downloaded from Australian Government (https://data.gov.au/dataset/surface-hydrology-lines-regional). The dataset is a collaborative effort by Geoscience Australia and state governments. The scale of the data ranges from 1:25,000 to 1: 250,000 across the continent. Geoscience Australia aggregates the data into a National Model and forms the surface water components of the Foundation Spatial Data Framework. In the area covered by the Project, these lines correspond to the hydrolines ('blue lines') on the 1:25,000 topographic map sheet.

2.6 River Styles

River Styles is a system for classifying stream geomorphic type based on valley setting, level of floodplain development, bed materials and reach-scale physical features within the stream (Brierley et al., 2011). The River Styles website (https://riverstyles.com/river-styles-framework/) explains the four stages of the River Styles Framework which encompass description of river morphology, interpretation of behaviour and prediction of river recovery potential. Stage 1 involves catchment-wide mapping River Styles, Stage 2 involves catchment-framed assessment of river evolution and geomorphic river condition, Stage 3 involves assessment of the future trajectory of change and geomorphic recovery potential, again, at the catchment scale, and Stage 4 uses information from Stages 1 – 3 to identify target conditions for river rehabilitation for different River Styles.

The NSW River Styles database was developed by NSW Department of Planning, Industry and Environment (DPIE), in consultation with Macquarie University (Fryirs et al., 2021). It is based on River Styles reports completed by various analysts in various agencies over the past two decades. For most Basins, the mapped stream network includes named and Third Order streams, including one Second Order and one First Order tributary of each. The database can be accessed at https://trade.maps.arcgis.com/apps/webappviewer/index.html?id=425c7364e9dc4a71a90c4ba353b8949f.

The NSW River Styles database includes four layers.

- The river diversity layer classifies reaches by River Style.
- The condition layer classes reaches as good, moderate or poor geomorphic condition, which is strongly linked to the degree of naturalness and extent of cover of riparian vegetation (Outhet and Cook, 2004; Outhet and Young, 2004a).
- The recovery potential layer combines assessment of both recovery potential and prioritisation to identify reaches with high, moderate or low recovery potential, or conservation reaches, which are

relatively intact and little or no recovery necessary, or strategic reaches that contain threatening processes that may impact on reaches with high conservation and rehabilitation value.

- The fragility layer classes reaches as low, medium or high fragility, which is the relative ease of adjustment of bed material, channel geometry, and channel planform when subjected to degradation or certain threatening activities (Cook and Schneider, 2006; Brierley et al., 2011).

The determination of stream fragility is based on the adjustment potential of channel attributes (geometry, size and connection to floodplain), planform (lateral stability, number of channels and sinuosity) and bed character (bedform and bed materials) (Cook and Schneider, 2006). Different stream types have characteristic levels of fragility (Outhet and Young, 2004b; Healey et al., 2012). Stream types with 'low fragility' are resilient or "unbreakable", those with 'medium fragility' have local adjustment potential, and those with 'high fragility' have significant adjustment potential (Cook and Schneider, 2006). Following on from this, the conservation and rehabilitation priority of stream reaches can be determined on the basis of geomorphic fragility and condition.

Streams reaches with low fragility that are in good geomorphic condition are rated the highest priority for protection, 'Conservation', which means protect from human disturbance. As explained by Cook and Schneider (2006), at a national scale, it is generally considered headwater reaches are the closest to being in an intact condition or have recovered to a near pre-disturbance state. Such streams are typically more resilient to change and are protected by their relative inaccessibility. However, streams of varied fragility can fall within the highest priority 'Conservation' category. The second priority for conservation and rehabilitation, 'Strategic', can contain streams with varied fragility. Reaches of moderate to low recovery potential are generally associated with areas that are more intensively used for agriculture. The lowest priority category of recovery potential is likely to contain high fragility streams in poor condition that have changed or are on the verge of changing to a different style.

River Styles mapping of the Central West was completed by Guy Lampert in 2010 for the Catchment Management Authority using aerial photography, topographic data and geological mapping, supported by field verification. The reach scale River Styles style, geomorphic condition and recovery potential were mapped for named and Third Order streams, including one Second Order and one First Order tributary of each. In the study area, three River Styles styles occurred in reaches of the Wambuul/Macquarie River and Queen Charlottes Creek crossed by the pipeline (Table 2).

Table 2. River Styles of the Wambuul/Macquarie River and Queen Charlottes Creek in reaches within the vicinity of the pipeline, description of geomorphic form and process of the long-term geomorphic state under 'good' condition. Source: drawn from unpublished River Styles documentation.

River Style	Usual position	Channel geometry	Channel pattern	Geomorphic units	Geomorphic process	Sediment transfer process	Floodplain linkage
Wambuul/Macquarie River							
Partly-confined valley setting, discontinuous floodplain, 10% to 90% of the channel abuts valley margin, continuous channel							
PCVS - Bedrock Controlled Gravel	Entrenched bedrock meanders in hard rock catchments.	Symmetric and often trench-like or compound channel.	Single. Bedrock or terrace spur controlled (i.e. 50% to 90 % of the channel length abuts valley margin). Narrow floodplain segments on all inside bends. Sinuosity dependent on valley shape and length of valley spurs.	*Channel zone*: Pools, riffles, local bedrock steps, compound point bars and point benches, chute channels. *Floodplain zone*: Arcuate, several levels, with levees, terraces, flood channels. Similar to Floodplain Pockets Gravel but has a floodplain on the inside of every bend.	Armoured cobble/gravel/sand. Pattern of behaviour depends on local valley setting, especially in relation to the nature of floodplain pockets. Adjusts through aggradation or degradation of the bed. Local channel expansion and floodplain reworking (stripping) takes place at bends. No bend migration.	Transfer or throughput are in balance* over the long term, but may vary from floodplain pocket to pocket, sometimes releasing sediment slugs. Source if incising.	Flooded 2 - 5 year unless incised.
PCVS - Planform Controlled Low Sinuosity Gravel	Straight or irregular upland valleys or where lowland valley narrows.	Symmetric.	Single, planform controlled (only 10% to 50% of channel length or apex of bend abuts valley margin). Low sinuosity or straight. Occasional short reaches with two channels separated by islands (recent avulsion).	*Channel zone*: lateral bars, islands in wider sections of channel, irregular riffles, may have elongate pools, benches. *Floodplain zone*: flood channels, palaeochannels, terraces, wetlands.	*Channel*: armoured gravel/sand. *Floodplain*: gravel or sand based, with vertically accreted fines above. Composite banks. In wider reaches, bends migrate downstream. Adjusts through aggradation or degradation of the bed.	Transfer or throughput are in balance* over the long term, but may vary from floodplain pocket to pocket, sometimes releasing sediment slugs. Source if incising.	Flooded 2 - 5 year unless incised.
Queen Charlottes Creek							
Unconfined valley setting, continuous floodplain, <10% of the channel abuts valley margin, continuous channel							
LUV CC – Low Sinuosity Sand	Uplands with narrow valley bottom, black soil plains.	Symmetrical, with low width-depth ratio.	Narrow single channel, low to moderate sinuosity, continuous narrow floodplain.	*Channel zone*: benches, small pools, small bars if any. *Floodplain zone*: flat-topped floodplain, levees, swamp, palaeochannels, flood runners.	Sand bed and suspended load with moderately cohesive banks. The channel has low rates of lateral movement but has phases of incision and subsequent lateral expansion/migration then recovery by bench deposition.	Sand throughput in balance*, or gradually accumulating. Source if incising.	Flooded 1 – 2 year unless incised.

* balance means sediment input equals output over the long term.

2.7 Geology

Lithology was from Department of Regional New South Wales NSW Seamless Geology, published 1 May 2019 and updated 28 April 2023 (https://data.nsw.gov.au/data/dataset/nsw-seamless-geology). The product

represents a seamless GIS compilation of the best available vector geology data for New South Wales. The data have been organised into a series of layers, or time slices, representing the major lithotectonic units of NSW. The study area contained two such lithological units (Table 3).

Table 3. Descriptions of lithological units found in the study area.

Unit Name	Age (medial)	Age (range)	Description	Deposition mode
Alluvium (Qa)	Quaternary	2.58 Ma to 0.00 Ma	Unconsolidated grey to brown to beige humic (±) micaceous silty clay, quartz-(±) lithic silt, fine- to medium-grained quartz-rich to quartz-lithic sand, polymictic pebble to cobble gravel (as sporadic lenses); sporadic palaeosol horizons	Terrestrial fluvial deposition
Bathurst Granite (Cbab)	Carboniferous	358.90 Ma to 298.90 Ma	Coarse-grained, porphyritic biotite granite.	NA

2.8 Riparian forest cover

The cohesive strength of riparian tree roots has been shown to stabilise river banks (Abernethy and Rutherfurd, 2000). Beeson and Doyle (1995) assessed 748 stream bends for stream erosion after large floods and found that the vegetated banks showed much less erosion than those with semi- or un-vegetated banks. Vegetation on the banks also reduces the velocity of water flowing through it, encouraging sediment accumulation (Lewis and Williams, 1984). Abernethy and Rutherfurd (1996) and Abernethy and Rutherfurd (1998) proposed that the stabilising effect of bank vegetation varied throughout the stream network, generally decreasing downstream. There is considerable debate in the literature regarding whether channels are more stable under tree or grass bank cover (Montgomery, 1997; Hession et al., 2008). However, in addition to geomorphic stability, riparian forests provide significant ecological benefits relative to the limited habitat variability and ecological diversity typically associated with banks that are grassed, or developed for agricultural or urban land use. For this reason, from an environmental management perspective, riparian forest is generally considered superior to other land cover types for the riparian zone. In River Styles geomorphic condition assessment, cover of riparian forest is a major determinant of the assigned class.

The Global Forest Change (GFC) project of Hansen et al. (2013) provides a relative indicator of spatiotemporal trends in forest loss dynamics globally. It provides data on tree cover (tree height >5 m) in the reference year 2000, as well as data on the removal of trees in subsequent years to 2020, if the canopy cover of a 25 × 25 m land unit (one LANDSAT pixel) falls below 30%. Annually updated GFC data are provided by the Global Land Analysis and Discovery (GLAD) laboratory at the University of Maryland, in partnership with Global Forest Watch (GFW). It was noted on the Global Forest Change 2000–2021 Data Download site (https://storage.googleapis.com/earthenginepartners-hansen/GFC-2021-v1.9/download.html) that while the data provide a relative indicator of trends, due to unquantified uncertainties, care must be taken when comparing change across any interval. It was suggested that the product not be used for definitive area estimation using pixel counts from the forest loss layers.

The GFC products include the following layers, all at approximately 25 m pixels:

- Tree canopy cover for year 2000 (treecover2000)
  Tree cover in the year 2000, defined as canopy closure for all vegetation taller than 5m in height. Encoded as a percentage per output grid cell, in the range 0–100.

- Global forest cover gain 2000–2012 (gain)
  Forest gain during the period 2000–2012, defined as the inverse of loss, or a non-forest to forest change entirely within the study period. Encoded as either 1 (gain) or 0 (no gain).

- Year of gross forest cover loss event (lossyear)
  Forest loss during the period 2000–2021, defined as a stand-replacement disturbance, or a change from a forest to non-forest state. Encoded as either 0 (no loss) or else a value in the range 1–21, representing loss detected primarily in the year 2001–2021, respectively.

- Data mask (datamask)
  Three values representing areas of no data (0), mapped land surface (1), and permanent water bodies (2).

The data were used to map the area of riparian zone tree canopy cover in the year 2021 over the study area. Tree cover in the year 2021 was determined from the 'treecover2000' data set, minus pixels representing forest lost during the period 2000–2021 in the 'lossyear' data set, plus pixels representing forest gained during the period 2000 – 2012 in the 'gain' dataset. There was no gain in forest cover over the study area.

2.9 Plant Community Type

The distribution of Plant Community Type (PCT) over the study area was mapped using Department of Planning and Environment (2019) State Vegetation Type Map: Upper Hunter v1.0. VIS_ID 4894 (https://datasets.seed.nsw.gov.au/dataset/state-vegetation-type-map-upper-hunter-v1-0-vis_id-4894).

2.10 Channel morphology

Channel morphology was characterised using the 1 m resolution DEM. Two 350 m long cross-sections were extracted over the Wambuul/Macquarie River at 2 m spacing. Long profiles were extracted at 2 m spacing along Wambuul/Macquarie River and Queen Charlottes Creek, extending upstream and downstream of the pipeline crossings. These profiles were of thalweg elevation, determined by extracting the minimum bed elevation at 2 m-spaced perpendiculars to the hydroline over a band covering the bed width.

Downstream variability of bed thalweg elevation was measured by calculating the prediction interval associated with simple linear regression between elevation and chainage of 2 m spaced points along the long-profiles.

Simple linear regression is a line of best fit that describes the relationship between x and y, which can be written as:

$$\hat{y} = b_0 + b_1 x$$

where:

$\hat{y}$ is the predicted value of the response variable, i.e., elevation

b_0 is the y-intercept

b_1 is the regression coefficient

x is the value of the predictor variable, i.e., distance

The prediction interval for a given value of x_0 is an interval around the predicted value $\hat{y}_0$ such that there is a 95% probability that the real value of y in the population corresponding to x_0 is within this interval. The formula to calculate the prediction interval for a given value x_0 is written as:

$$\hat{y}_0 \pm t_{\alpha/2, df=n-2}\, s.e.$$

where the standard error of the prediction ($s.e.$) is:

$$s.e. = S_{yx}\sqrt{1 + \frac{1}{n} + \frac{(x_0 - \bar{x})^2}{SS_x}}$$

and where:

$t_{\alpha/2,df=n-2}$ is the critical value of the t distribution for the specified significance level α divided by 2

S_{yx} is the standard estimate of the error

SS_x is the squared deviation of the x-values in the sample

The standard error of the prediction was interpreted to represent the potential bounds about which the elevation of the thalweg at any point along the river bed would likely vary over time, in response to scour and deposition processes associated with high flow events that mobilise the bed material. In reality, the elevation of the bed at any point would not vary randomly over time within these bounds, but would be influenced by river hydraulics, which manifest with a pattern that might be spatially consistent over time, especially in relation to the position of meanders and rock outcrops in the bed. Thus, the bounds defined by the standard error of the prediction were likely to over-estimate the maximum variation in bed elevation that would occur at any point over time.

2.11 Potential scour depth

Bed scour processes are natural, whereby the bed levels change during flood events if the bed material is mobile, and the bed morphology can be different after a flood event compared to before the event. While bed scour processes can be modelled to a certain extent, the change in bed morphology caused by a flood event is not predictable. There are four main bed material scour processes: (i) active layer bed scour (also called disturbance depth, live bed scour, or moving layer depth), (ii) general scour (longitudinally local contraction scour and bend scour affecting the entire cross-section), (iii) local-scale scour immediately adjacent to obstructions (here, large woody debris), and (iv) maintenance of pool-riffle morphology by scour. Of these, the most relevant threat to a buried pipeline is general scour.

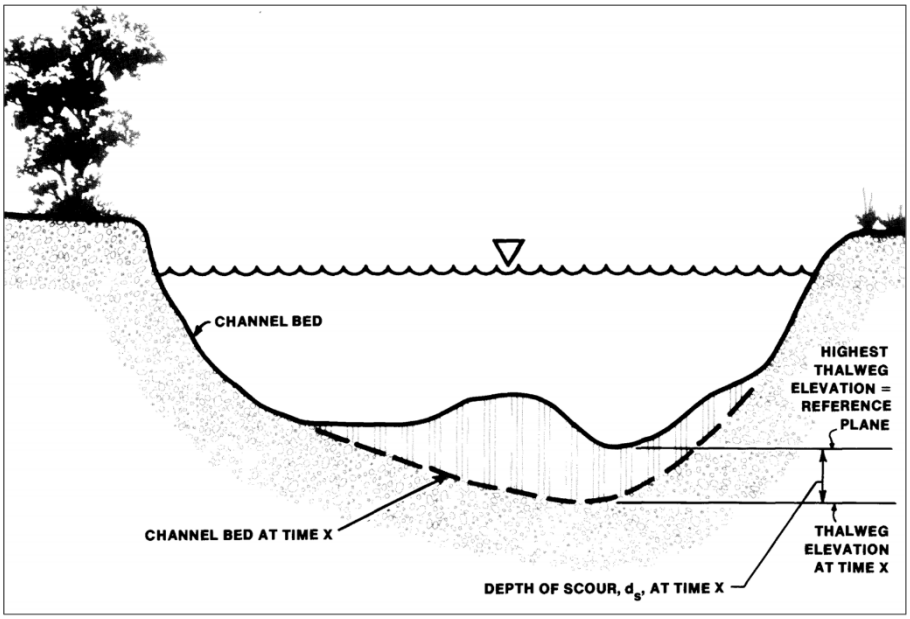
Blodgett (1986) measured general scour at 21 sites on streams with a range of bed material sizes (sand to cobble-size median diameter). The sites were free of obstructions that might cause local scour. Monthly or annual measurements of thalweg level were made over a period of time. Scour depth was defined as the depth of scour below a reference plane, which was set at the highest thalweg elevation measured during the period of observation (Figure 6). From these data, Blodgett (1986) derived the following best fit relationships (Figure 7):

$$\delta_{max} = 3.8{D_{50}}^{-0.115}$$

$$\delta_{av} = 0.84{D_{50}}^{-0.115}$$

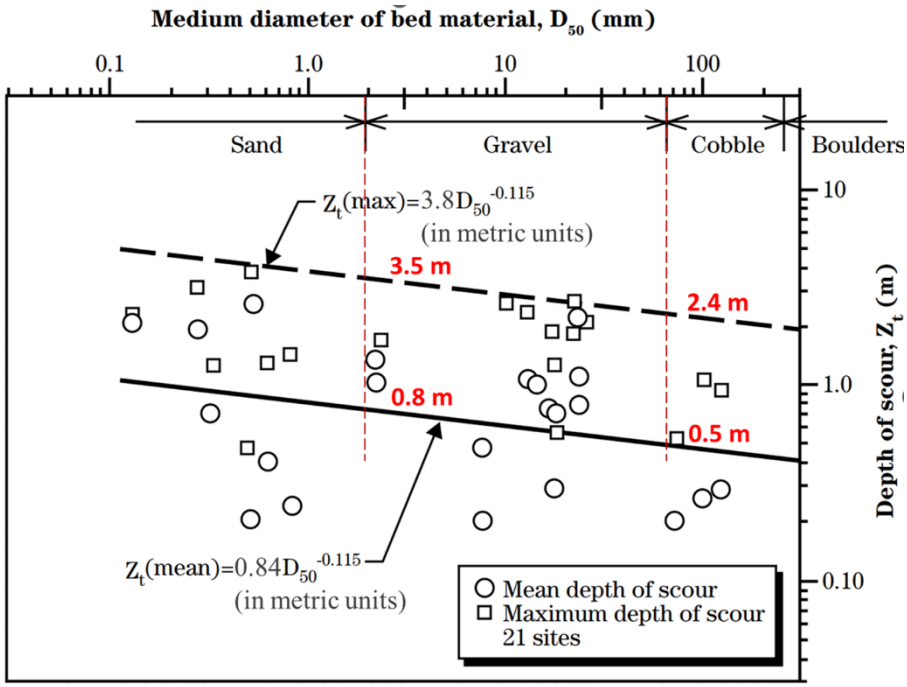
These equations predict that over the gravel range of bed material size, mean scour depth ranges from 0.5 m to 0.8 m, and the maximum scour depth ranges from 2.4 m to 3.5 m (Figure 7). Wambuul/Macquarie River is classified by River Styles as having a gravel bed and Queen Charlottes Creek is classified by River Styles as having a sand bed. For a sand bed stream, the predicted mean scour depth exceeds 0.8 m and the maximum scour depth exceeds 3.5 m (Figure 7).

Other equations that predict general bed scour have been listed and compared by various authors, including Pemberton and Lara (1984), Fischenich and Landers (1999), Lauchlan and May (2002), Bettess (2002) and Howard et al. (2021). However, these equations require knowledge of hydraulic and hydrologic variables from the site in question, which were not available in this case.



Copy of Figure 12 (page 51) Blodgett, J.C. 1986. Rock riprap design for protection of stream channels near highway structures, Volume 1 – hydraulic characteristics of open channels. US Geological Survey, Water-Resources Investigations Report 86-4127, Sacramento.

Figure 6. Definition sketch of channel bed general scour. Source: Blodgett (1986).



Modified from Figure TS14B–1 (page 1), Natural Resources Conservation Service 2007. Scour Calculations. Technical Supplement 14B, Part 654, National Engineering Handbook. US Department of Agriculture, 210–VI–NEH, August; itself a modified version of Figure 13 (page 52) Blodgett, J.C. 1986. Rock riprap design for protection of stream channels near highway structures, Volume 1 – hydraulic characteristics of open channels. US Geological Survey, Water-Resources Investigations Report 86-4127, Sacramento.

Figure 7. Relationship of scour depth to median size of bed material in the channel. Source: modified from Natural Resources Conservation Service (2007) and Blodgett (1986).

3 Existing Character of the Watercourses

3.1 Topography and geology

From downstream to upstream, the pipeline begins at the existing STP site, on the Wambuul/Macquarie River floodplain (Figure 8); it flows across the floodplain until it crosses the river over Gordon Edgell Bridge (Hereford Street); it enters the right bank floodplain of Wambuul/Macquarie River then follows the river on the right bank, within the main river channel, for approximately 816 m (Figure 8); it crosses the river to the left bank floodplain over Denison Bridge (Bridge Street); it follows a low levee on the left side of the Queen Charlottes Creek floodplain; it crosses across the creek's floodplain including under Queen Charlottes Creek (underboring); it then follows elevated land to the WFP (Figure 8).

The majority of the pipeline route passes within alluvium, with the remainder passing within basalt geology (Figure 9). The alluvium is unconsolidated (Table 3) and at risk of scour when subject to flood waters, especially if vegetation cover is poor.

3.2 River Styles

Wambuul/Macquarie River at the two bridge crossing sites is PCVS - Bedrock Controlled Gravel River Style (Figure 10). The cobble/gravel/sand beds of such rivers are armoured (resistant to scour) and take the form of pools, riffles, local bedrock steps, compound point bars and point benches, chute channels (Table 2). The reach is in moderate geomorphic condition (Figure 11). The factors likely to have led to a condition rating of moderate would be the degraded state of the riparian forest and altered hydrology. The reach was rated moderate fragility (Figure 12). Streams with moderate fragility have local adjustment potential. The reach was rated low recovery potential (Figure 13), which likely relates to it flowing through areas of intensive agricultural and urban land use.

The reach of Wambuul/Macquarie River downstream of the two bridge crossing sites, which could impact those sites if an upstream migrating erosion head cut forms there, is Planform Controlled Low Sinuosity Gravel River Style (Figure 10). The gravel/sand beds of such rivers are armoured (resistant to scour) (Table 2) although lacking bedrock controls, they are likely to be more at risk of bed incision if the sediment/hydrology balance is disturbed. The reach is in moderate geomorphic condition (Figure 11), likely due to the degraded state of the riparian forest and altered hydrology. The reach was rated moderate fragility (Figure 12) and low recovery potential (Figure 13), as for the upstream reach.

Queen Charlottes Creek at the underbore crossing site is LUV CC – Low Sinuosity Sand River Style (Figure 10). Such streams have sand beds with benches, small pools, and small bars if any. The moderately cohesive banks give rise to low rates of lateral movement (Table 2). The reach is in moderate geomorphic condition (Figure 11). The factors likely to have led to a condition rating of moderate would be the degraded state of the riparian forest. The reach was rated high fragility (Figure 12). Streams with high fragility have high adjustment potential. The reach was rated moderate recovery potential (Figure 13), which likely relates to it flowing through areas of intensive agricultural and urban land use.

Overall, the River Styles assessment suggests that Wambuul/Macquarie River at the two bridge crossing sites, which was in moderate condition due to disturbed riparian vegetation, would be relatively resistant to geomorphic change over time, and does not appear to be under threat of a bed instability migrating from the downstream reach. Queen Charlottes Creek at the underbore crossing site is more prone to geomorphic adjustment of the bed than Wambuul/Macquarie River, although the banks are relatively stable, despite the disturbed state of the riparian vegetation.

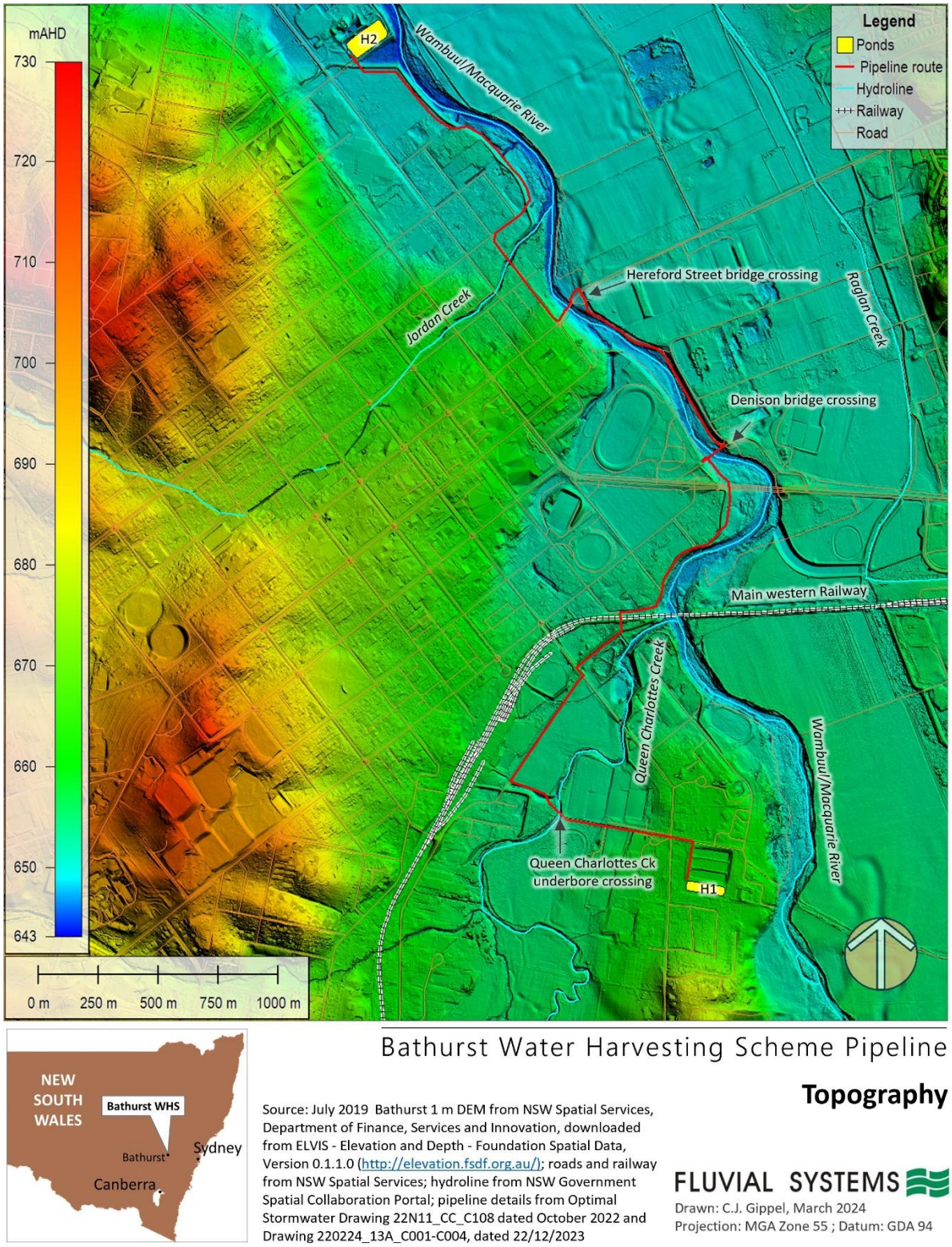


Figure 8. Topography of study area.

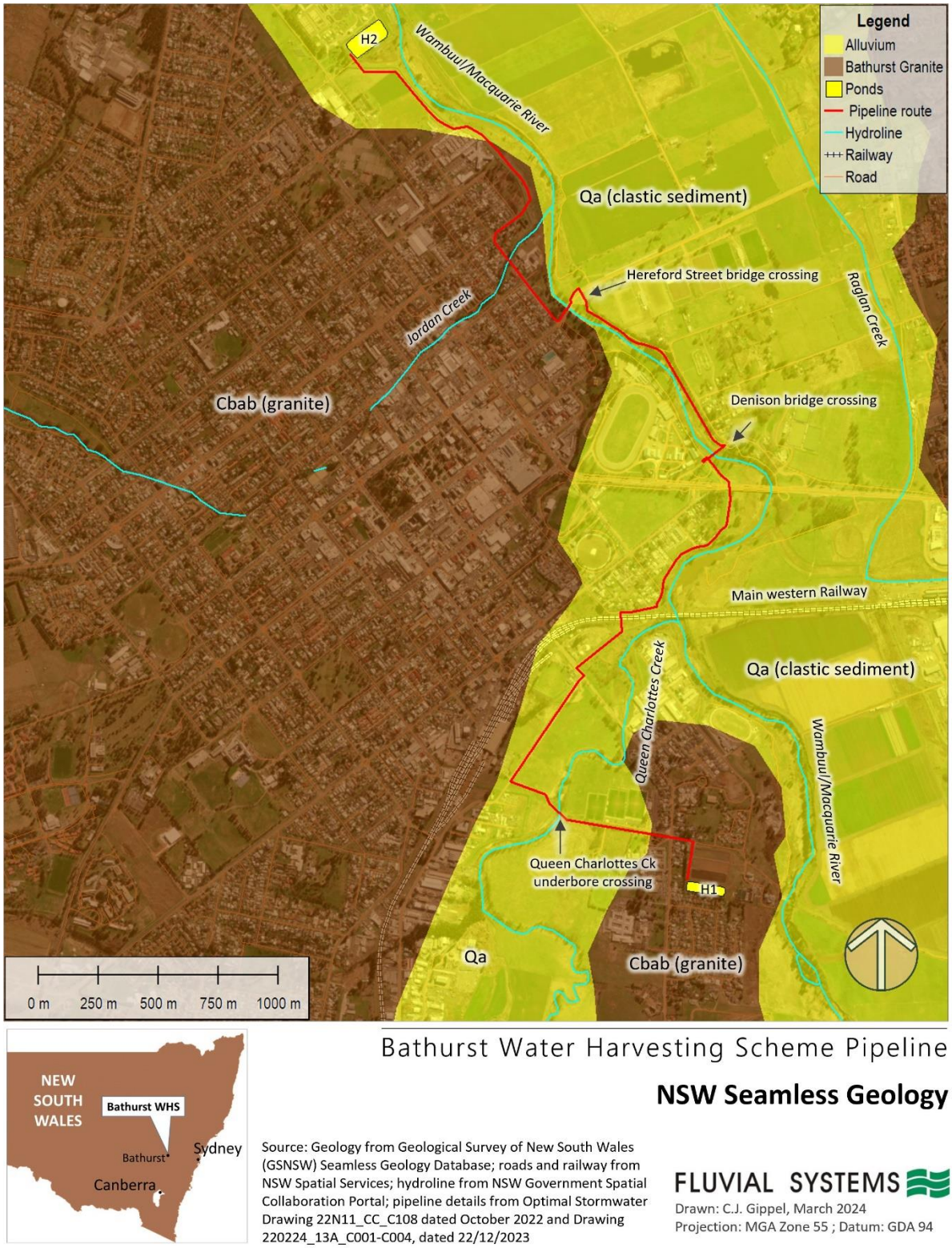


Figure 9. Geology of study area.

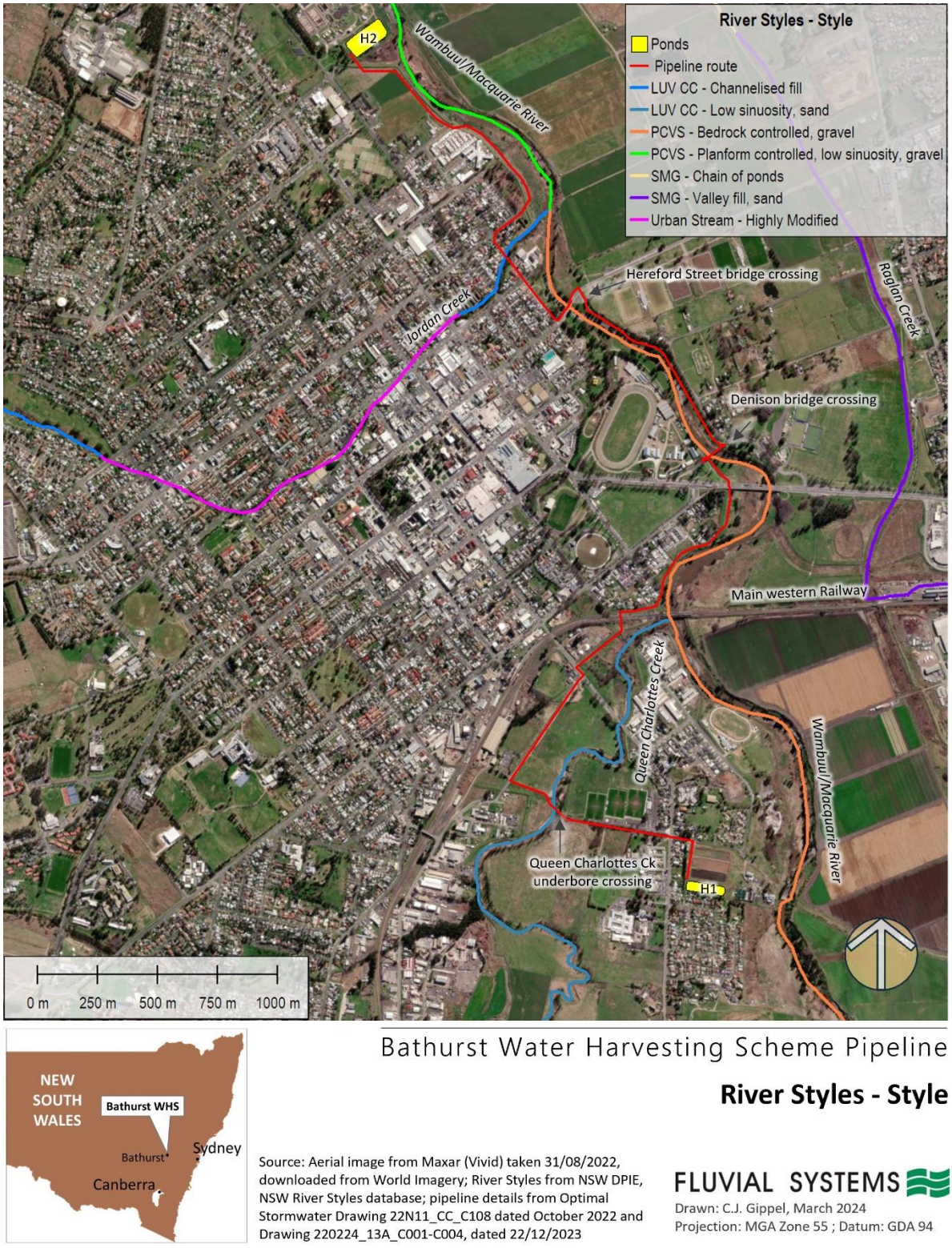


Figure 10. River Styles - Style of study area.

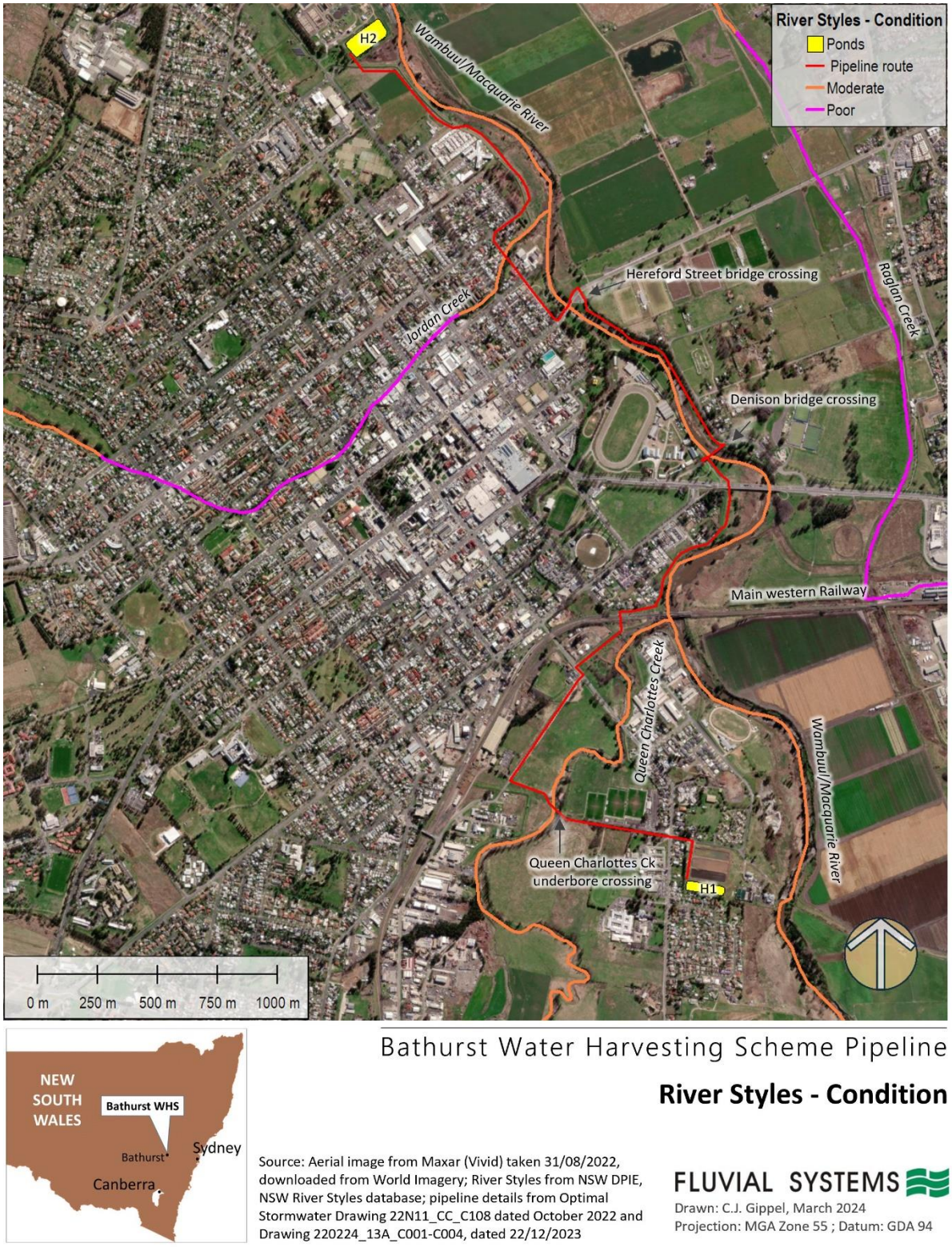


Figure 11. River Styles - Condition of study area.

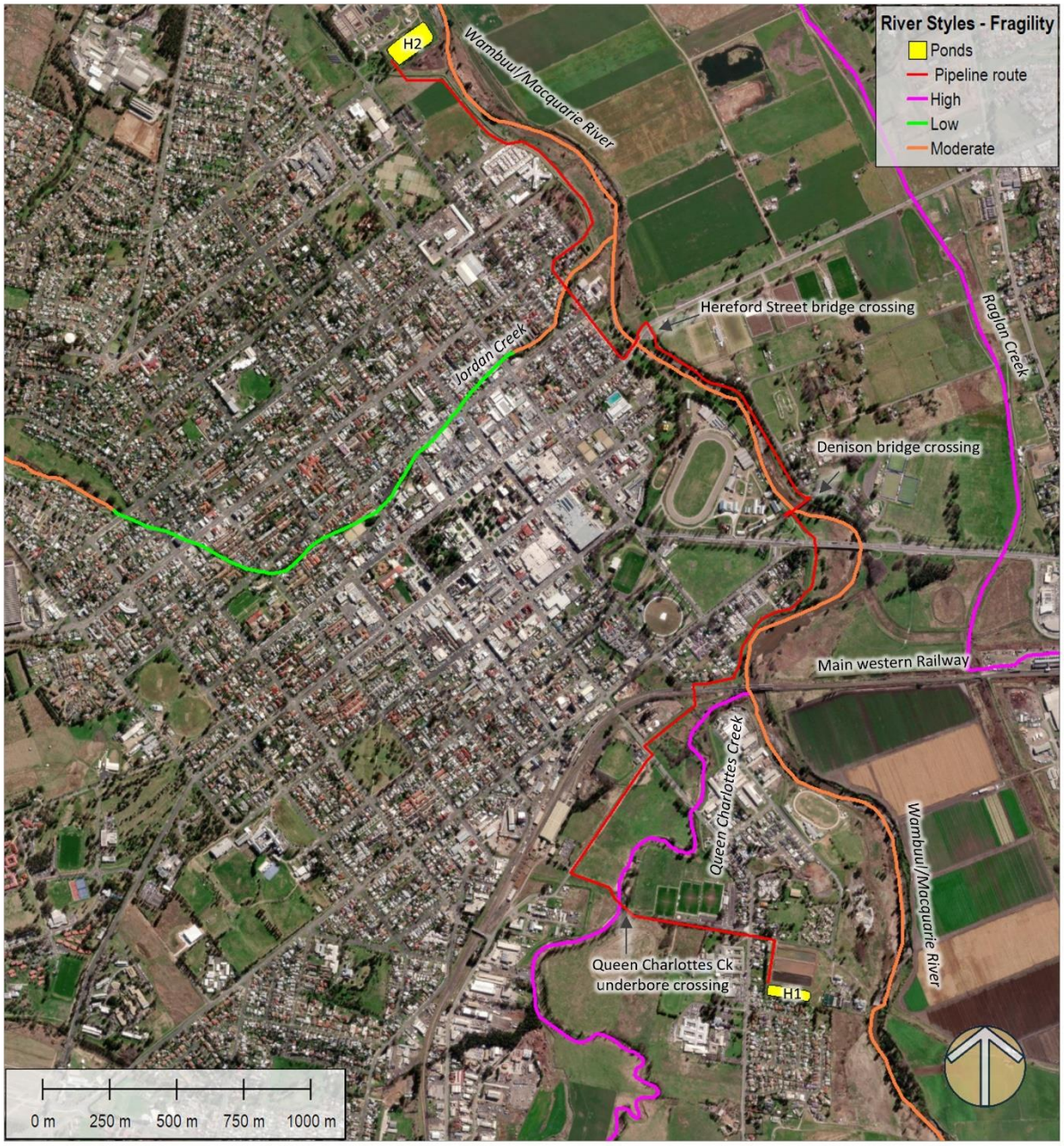


Figure 12. River Styles - Fragility of study area.

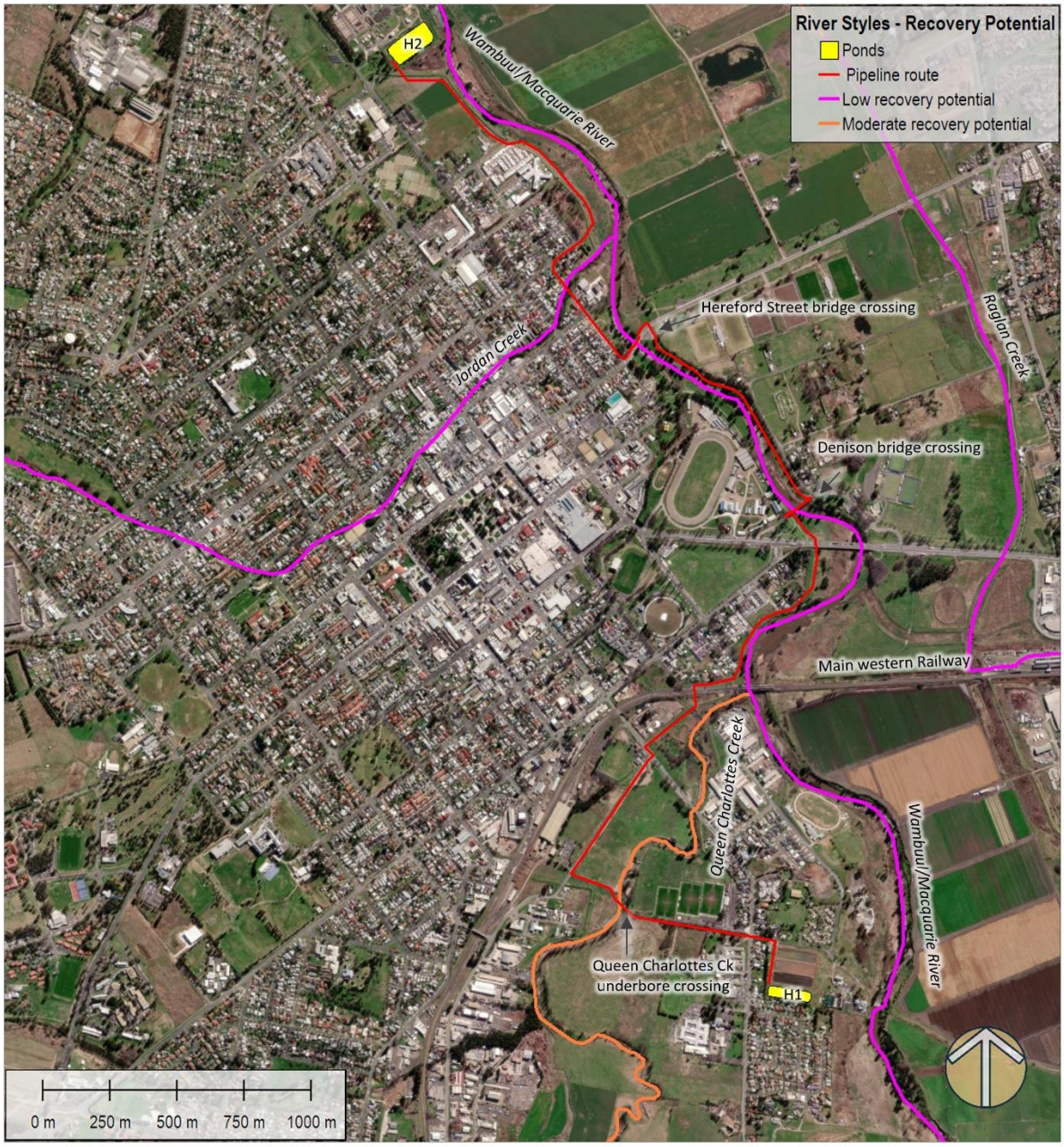


Figure 13. River Styles – Recovery Potential of study area.

3.3 Riparian vegetation condition

The native riparian vegetation on Queen Charlottes Creek and the Wambuul/Macquarie River between the bridge pipeline crossings (between Denison Bridge and Gordon Edgell Bridge) is PCT River Oak forest and

woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion. The distribution of this PCT, mapped using spatial analysis, was confined to a narrow riparian zone on both Wambuul/Macquarie River (Figure 14) and Queen Charlottes Creek (Figure 15) and was discontinuous on Queen Charlottes Creek (Figure 15).

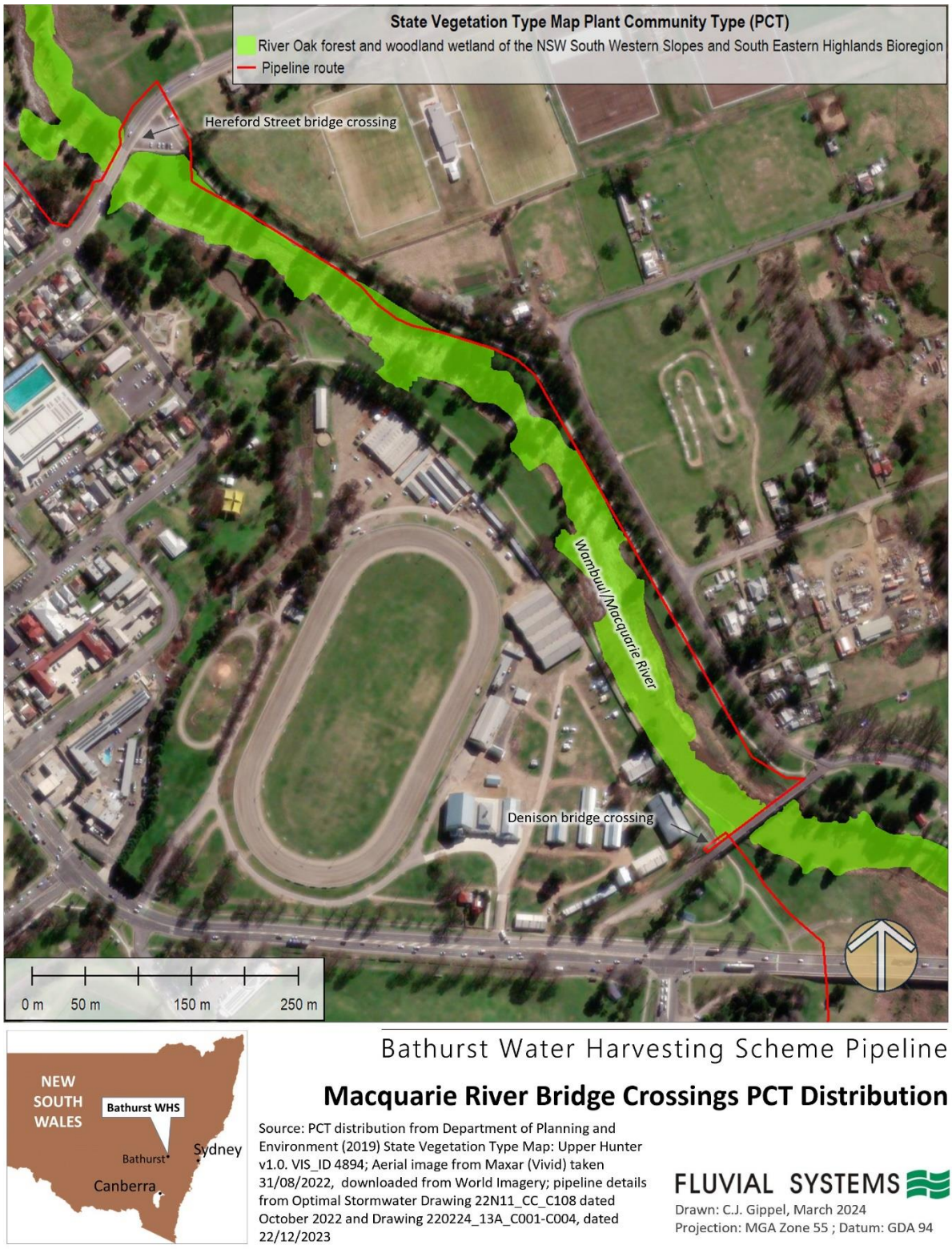


Figure 14. Plant Community Type (PCT) on the riparian zone of the Wambuul/Macquarie River in the vicinity of the two bridge pipeline crossing sites.

Figure 15. Plant Community Type (PCT) on the riparian zone of Queen Charlottes Creek in the vicinity of the underbore pipeline crossing site.

The structure and cover of the riparian vegetation in the vicinity of the underbore pipeline crossings on both Wambuul/Macquarie River (Figure 16) and Queen Charlottes Creek (Figure 17) was not classified forest by the algorithms and 25 m pixel satellite imagery data used to determine the Global Forest Cover (GFC) forest

canopy cover at year 2021. Trees are so sparse in the area that the GFC algorithms mis-classified some urban and agricultural land pixels as low canopy cover (<10%) forest (Figure 16 and Figure 17).

Overall, the data suggest that, across the study area, the riparian vegetation is in poor condition relative to the forest that would be expected in an undisturbed riparian zone in this location.

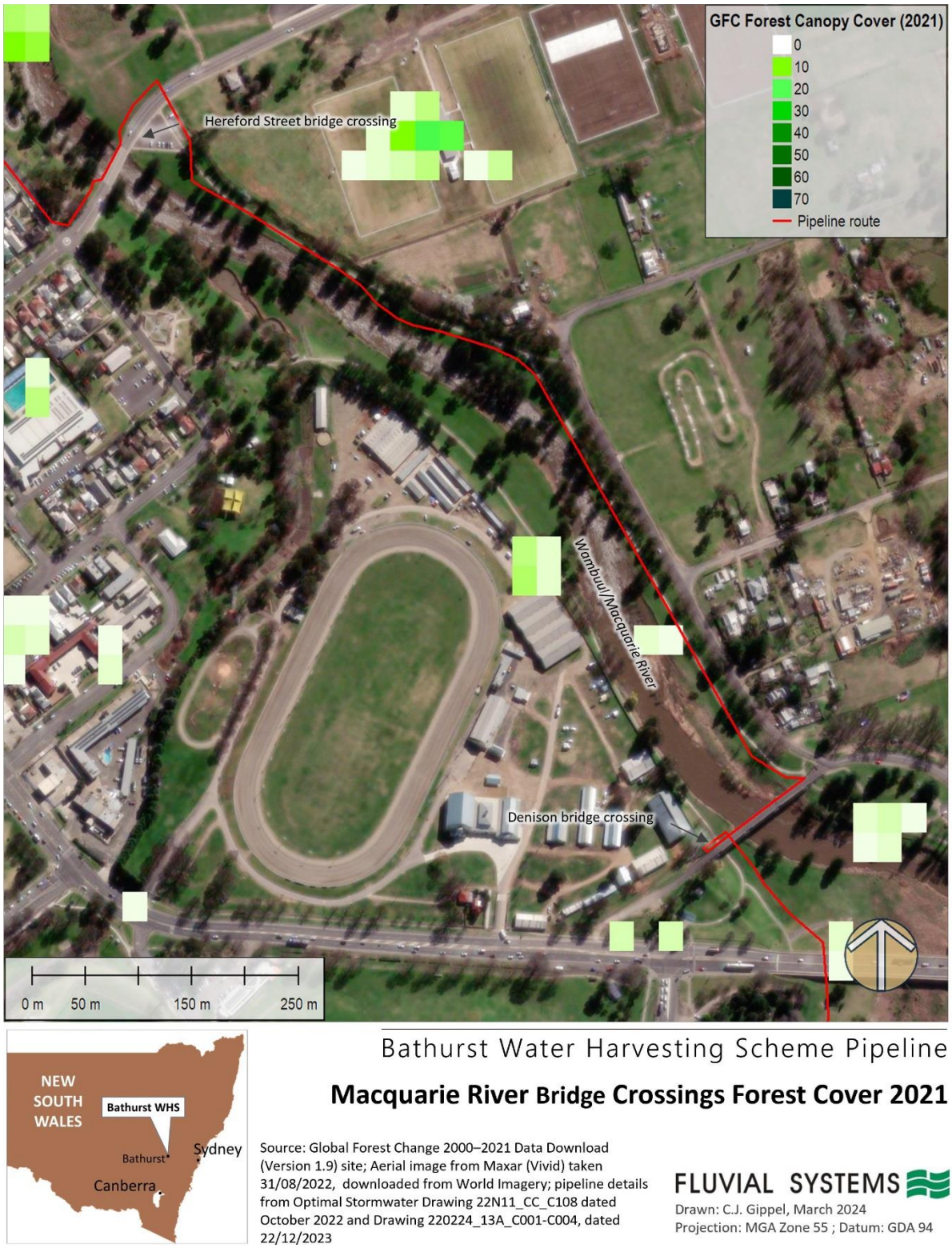
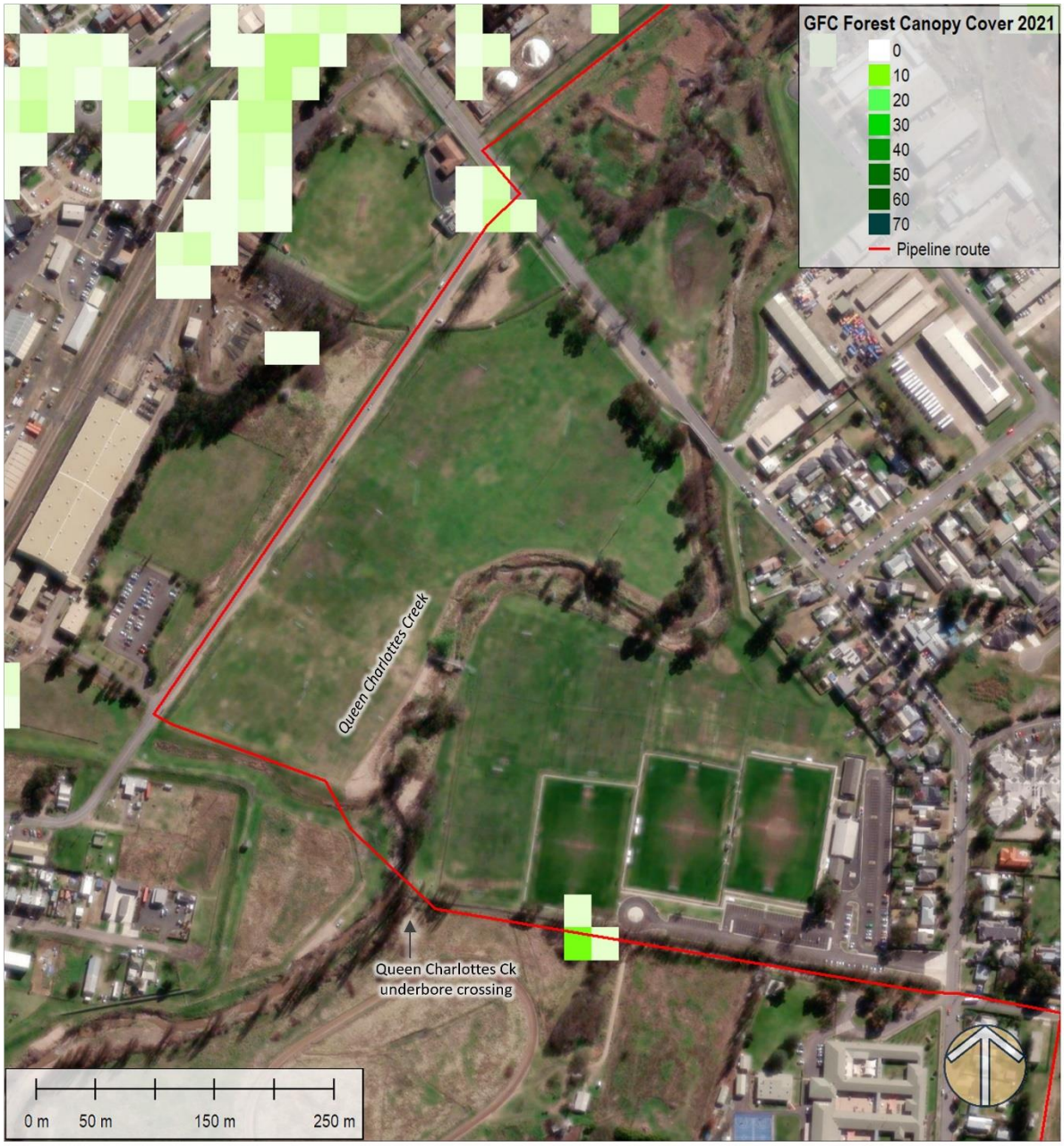
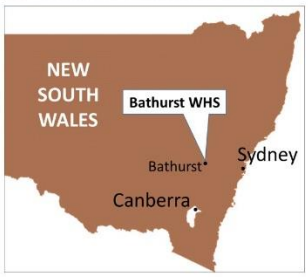


Figure 16. Global Forest Cover (GFC) forest canopy cover at year 2021 in the area of the Wambuul/Macquarie River in the vicinity of the two bridge pipeline crossing sites.





Bathurst Water Harvesting Scheme Pipeline

Queen Charlottes Creek Underbore Forest Cover 2021

Source: Global Forest Change 2000–2021 Data Download (Version 1.9) site; Aerial image from Maxar (Vivid) taken 31/08/2022, downloaded from World Imagery; pipeline details from Optimal Stormwater Drawing 22N11_CC_C108 dated October 2022 and Drawing 220224_13A_C001-C004, dated 22/12/2023

FLUVIAL SYSTEMS

Drawn: C.J. Gippel, March 2024

Projection: MGA Zone 55 ; Datum: GDA 94

Figure 17. Global Forest Cover (GFC) forest canopy cover at year 2021 in the area of Queen Charlottes Creek in the vicinity of the underbore pipeline crossing site.

3.4 Historical channel position stability

3.4.1 Wambuul/Macquarie River

Historical imagery of the area of the Wambuul/Macquarie River in the vicinity of the two bridge pipeline crossing sites (between Denison Bridge and Gordon Edgell Bridge) was obtained and rectified (georeferenced) for years 1964 (Figure 18), 1984 (Figure 19), 1989 (Figure 20), 1998 (Figure 21), 2013 (Figure 22) and 2022 (Figure 23). Allowing for limitations due to image distortion, shadows, reflections, photographic resolution, and variable river flows, the position of the river channel was relatively stable between 1964 and 2022. Between 1964 and 1984 (Figure 18 and Figure 19) there was a noticeable reduction in riparian tree cover. Between 1984 and 1989 (Figure 19 and Figure 20) there was a noticeable straightening of the low flow channel in the middle of the reach between Denison Bridge and Gordon Edgell Bridge, near Stephens Lane. This change appears to have been engineered to reduce the threat posed by potential channel migration to the road on the edge of the right bank, rather than being a natural change. By 2013, the right side of the channel between Denison Bridge and Gordon Edgell Bridge had been landscaped, grassed and a shared pathway installed (Figure 22).

3.4.2 Queen Charlottes Creek

The historical imagery suggested that the position of Queen Charlottes Creek channel in the vicinity of the underbore pipeline crossing site was stable between 1964 and 2022, so only three historical images are provided in this report, from 1964 (Figure 24), 2013 (Figure 25) and 2022 (Figure 26). There was a noticeable change to the channel position about 500 m downstream of the pipeline crossing site some time between the 1998 and 2013 images. This involved channel straightening in association with construction of a 480 m long levee on the right bank between south of Russell Street to Upfold Street, to protect adjacent buildings.

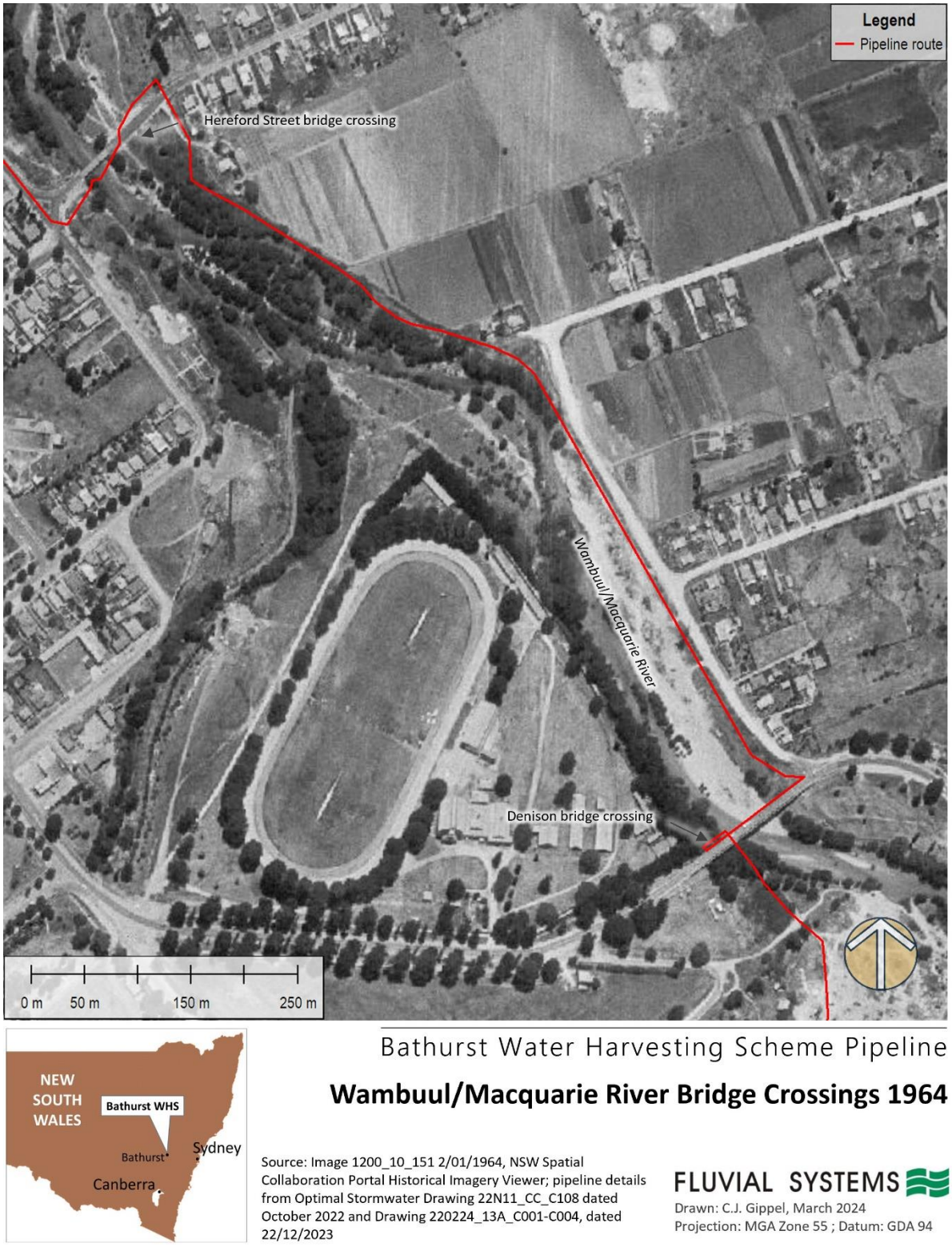


Figure 18. Aerial imagery from 1964 in the area of the Wambuul/Macquarie River in the vicinity of the two bridge pipeline crossing sites.

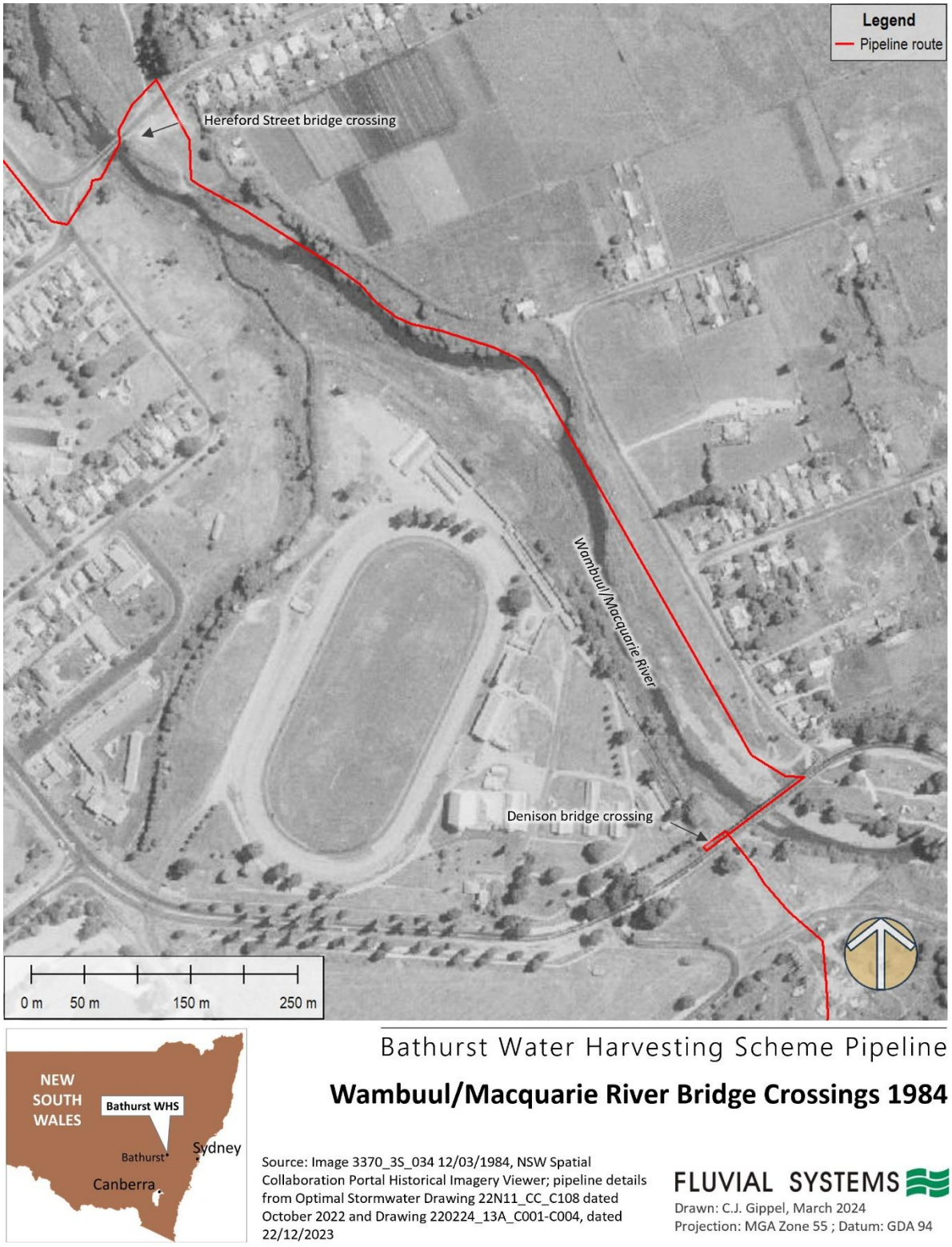


Figure 19. Aerial imagery from 1984 in the area of the Wambuul/Macquarie River in the vicinity of the two bridge pipeline crossing sites.

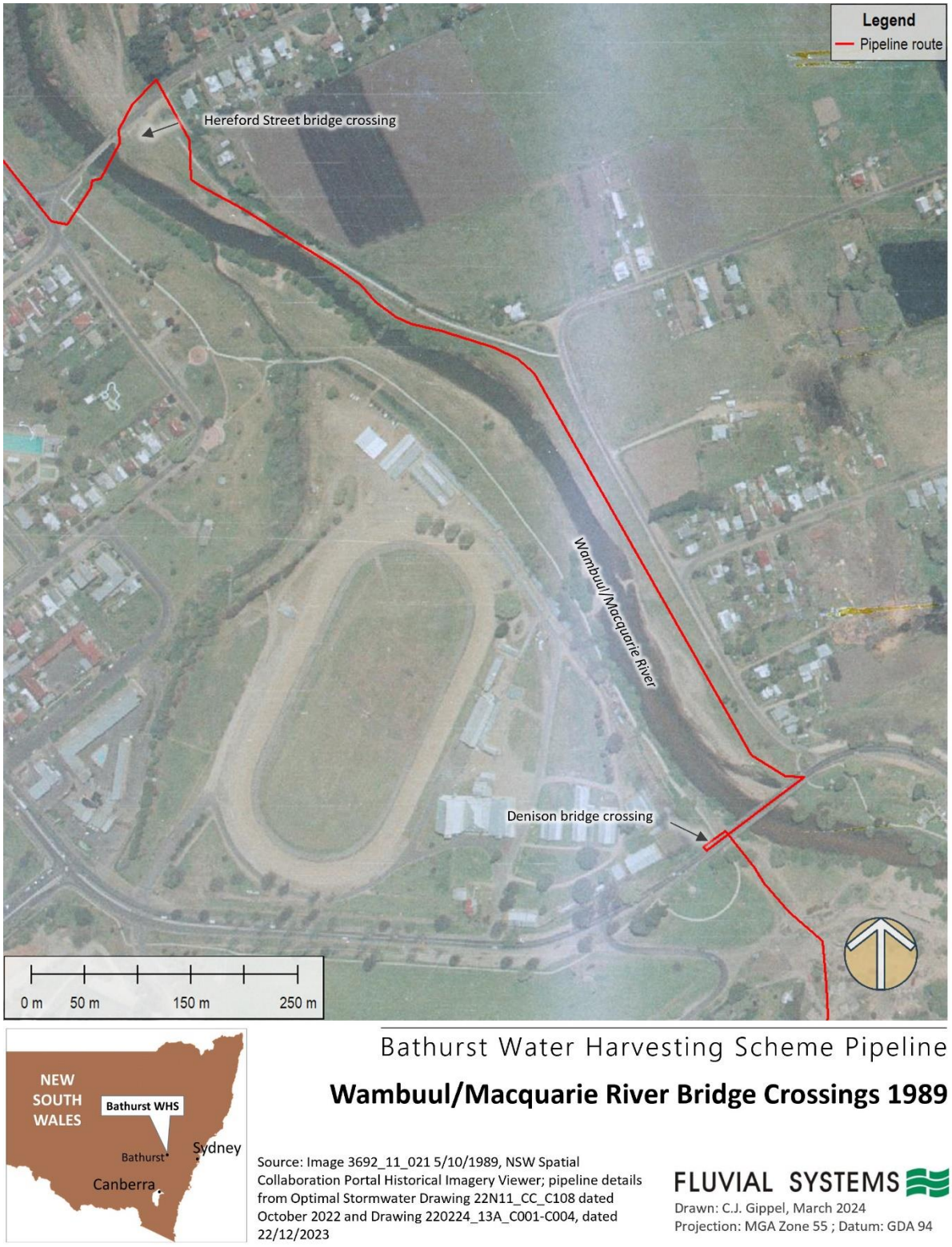


Figure 20. Aerial imagery from 1989 in the area of the Wambuul/Macquarie River in the vicinity of the two bridge pipeline crossing sites.

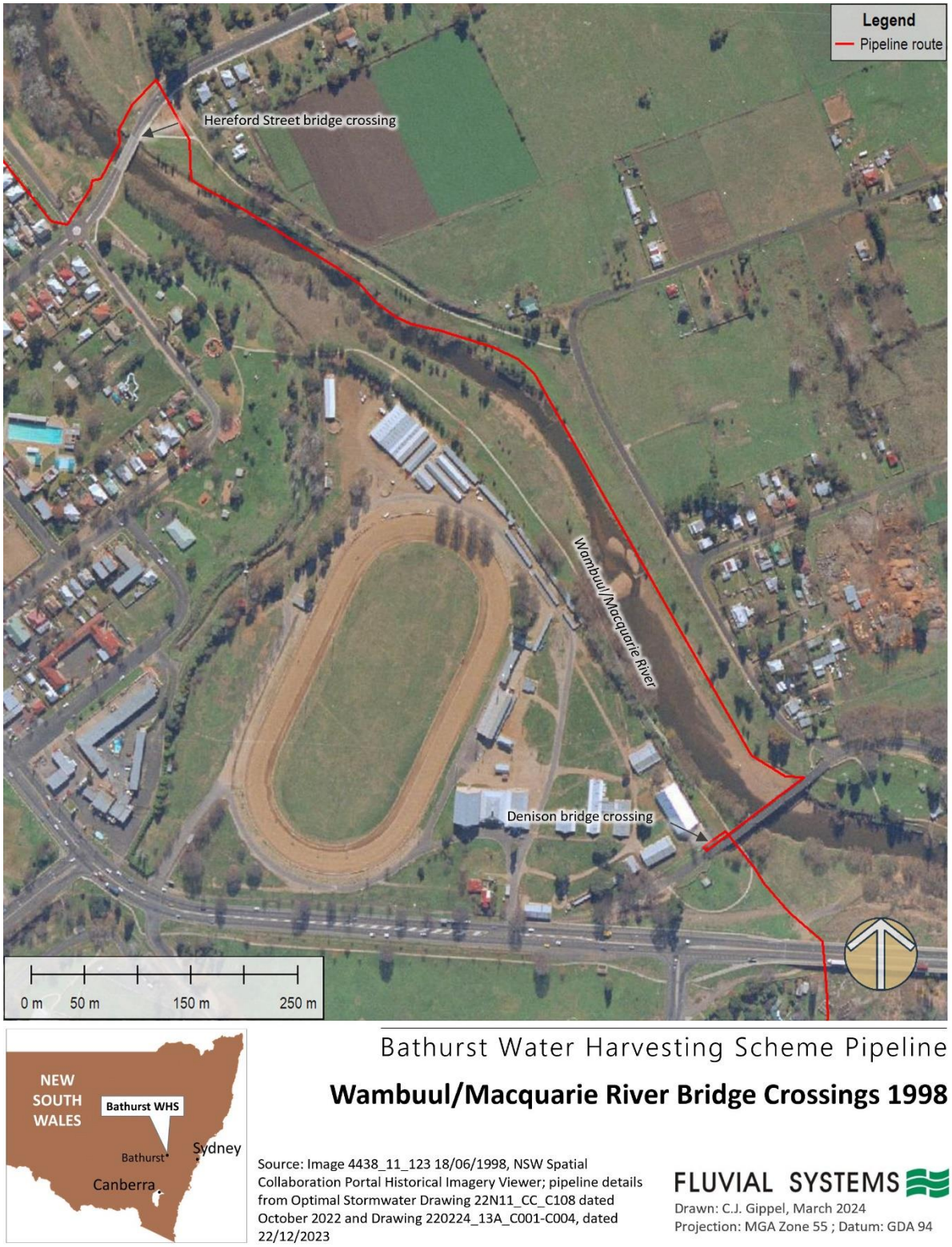


Figure 21. Aerial imagery from 1998 in the area of the Wambuul/Macquarie River in the vicinity of the two bridge pipeline crossing sites.

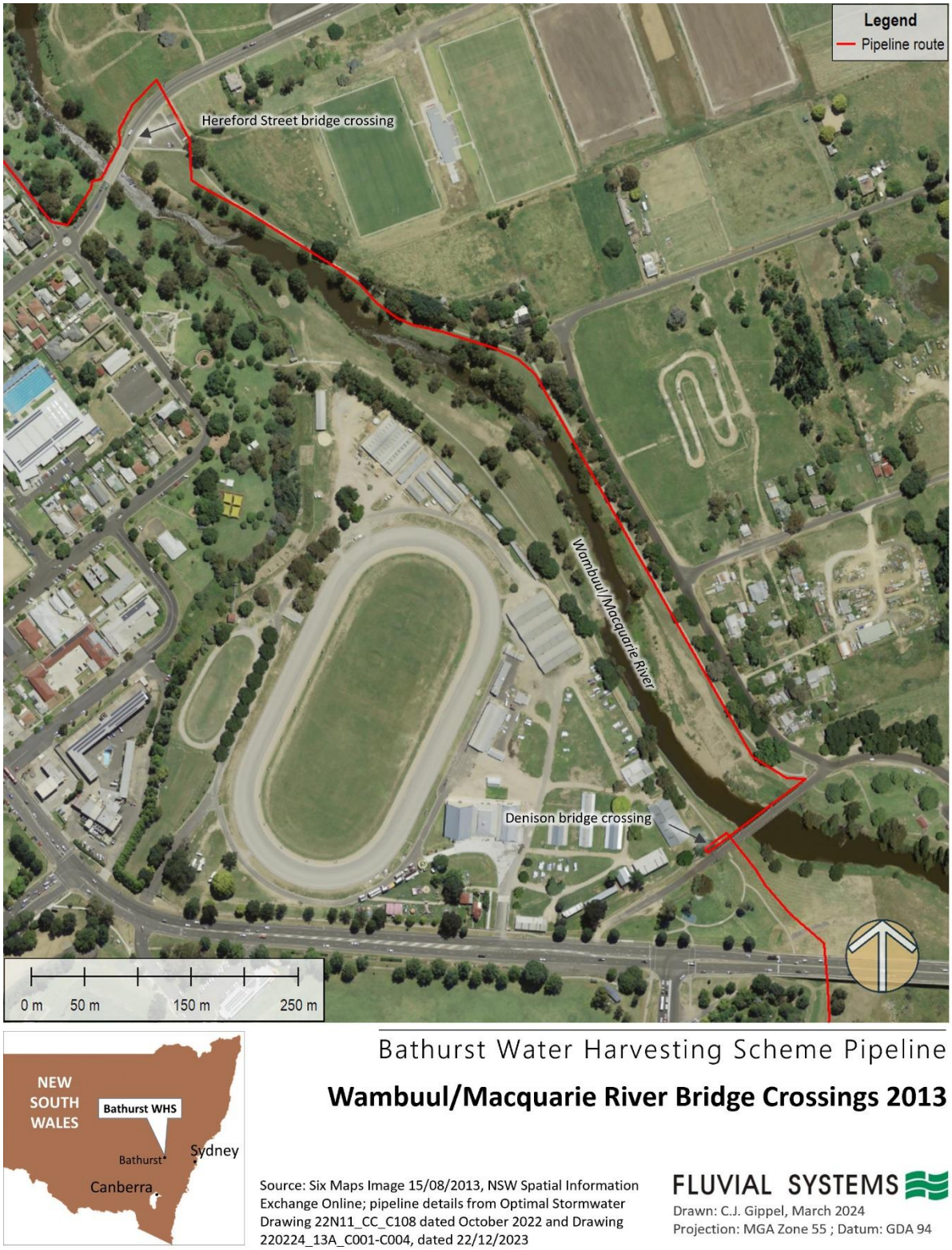


Figure 22. Aerial imagery from 2013 in the area of the Wambuul/Macquarie River in the vicinity of the two bridge pipeline crossing sites.

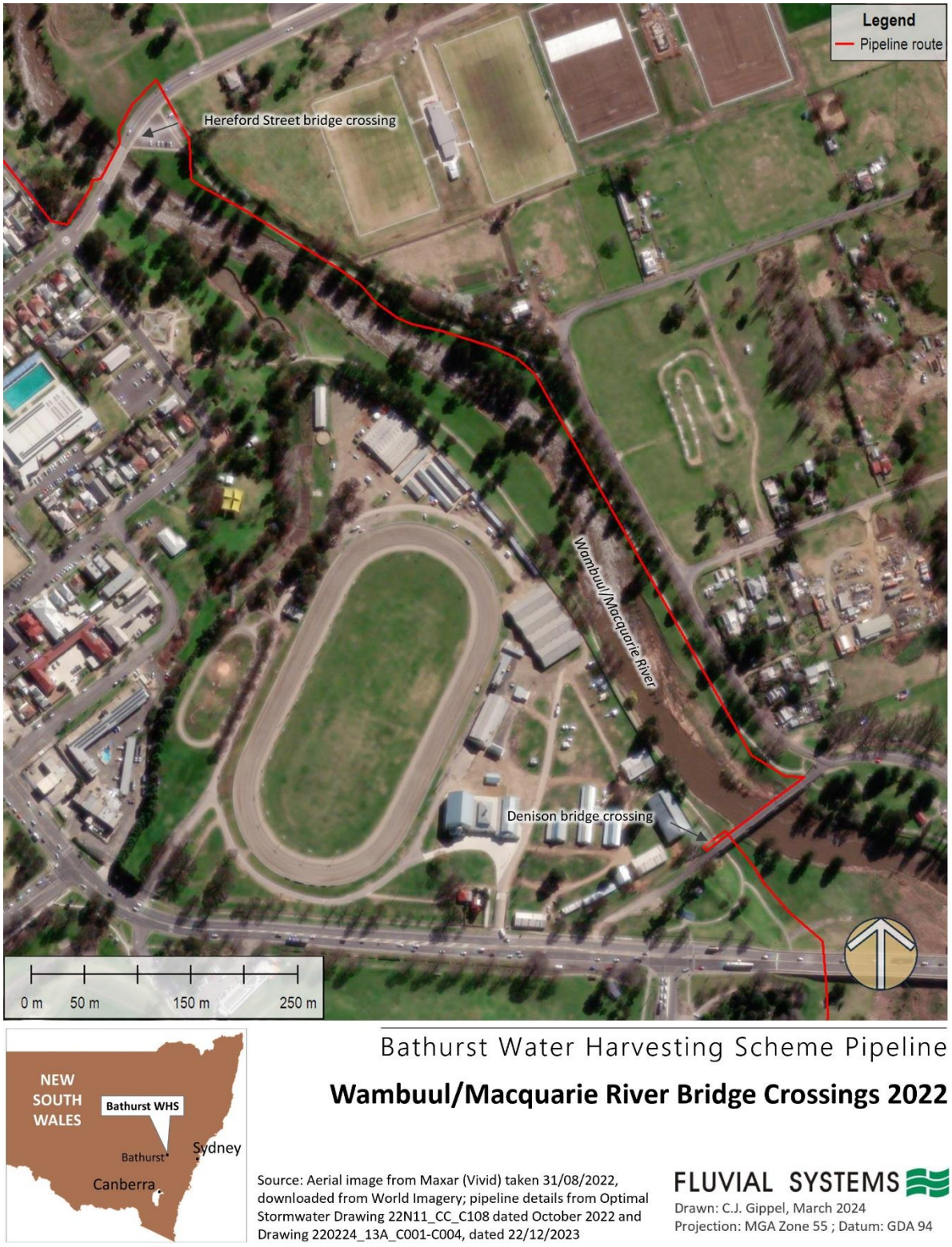


Figure 23. Aerial imagery from 2022 in the area of the Wambuul/Macquarie River in the vicinity of the two bridge pipeline crossing sites.

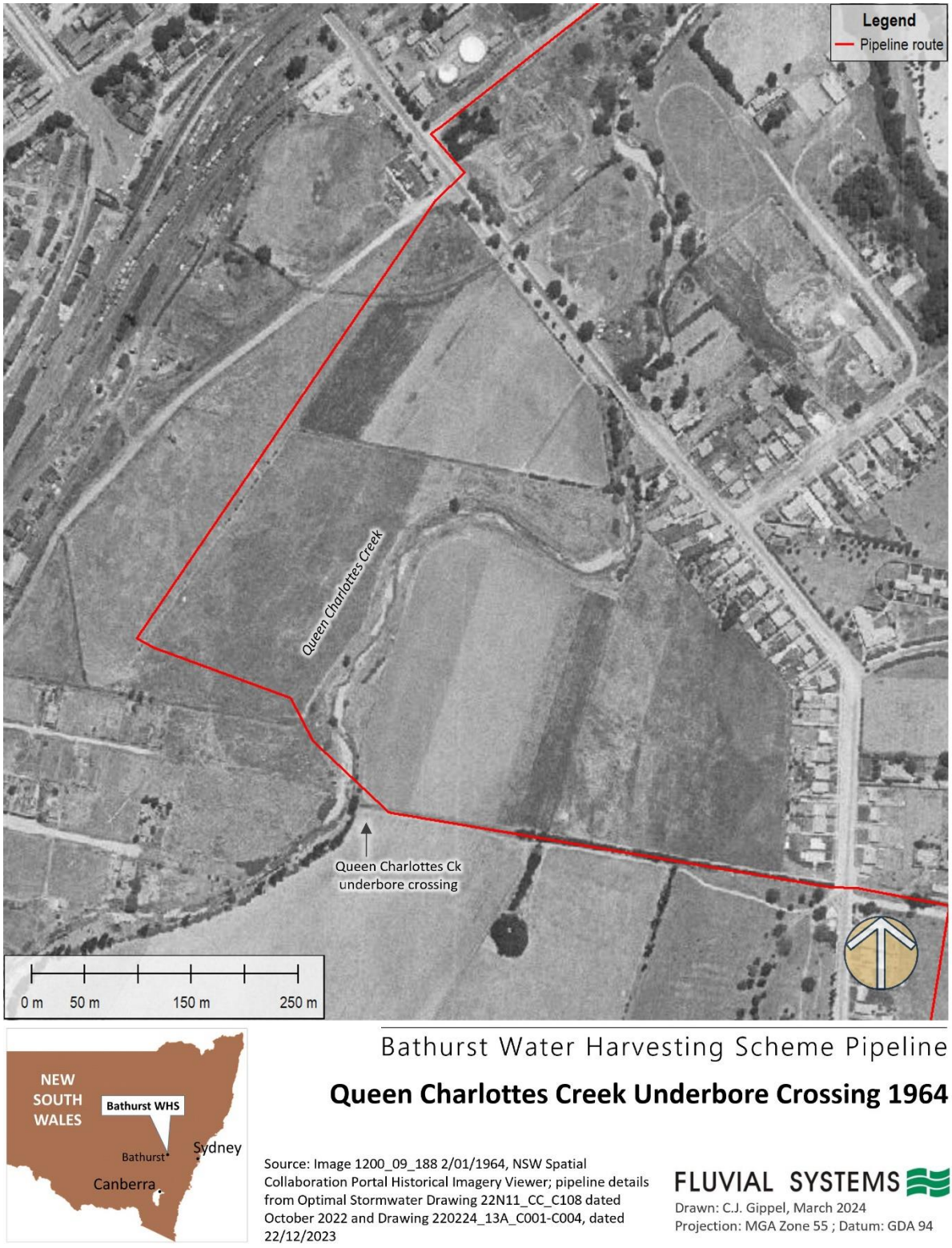


Figure 24. Aerial imagery from 1964 in the area of the Queen Charlottes Creek in the vicinity of the underbore pipeline crossing site.

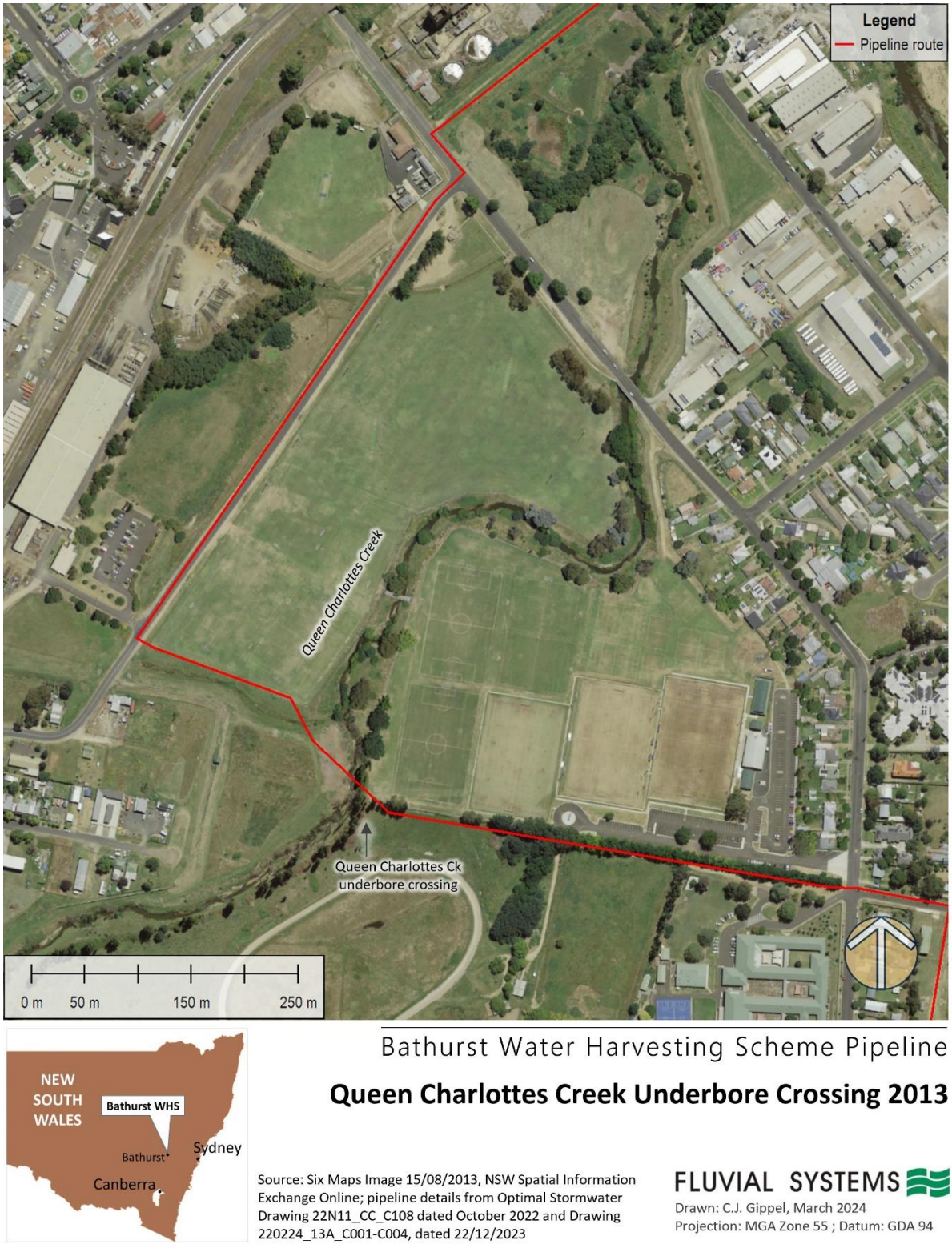


Figure 25. Aerial imagery from 2013 in the area of the Queen Charlottes Creek in the vicinity of the underbore pipeline crossing site.

Figure 26. Aerial imagery from 2022 in the area of the Queen Charlottes Creek in the vicinity of the underbore pipeline crossing site.

3.5 Channel morphology

3.5.1 Cross-section Wambuul/Macquarie River

Two cross-sections were extracted from the LiDAR-derived DEM in the 816 m long reach between the bridge pipeline crossing sites (between Denison Bridge and Gordon Edgell Bridge) (Figure 27) to illustrate the position of the pipeline in relation to channel morphology. In this reach it is proposed to bury the pipeline using the trenching method. These cross-sections illustrate that the pipeline in this reach is routed within the main river channel, at ground level around 2 – 3 m above the base of the channel (Figure 28). The channel in this area could become geomorphologically active under extreme flood conditions; there is evidence of historical change in the position of the low flow channel near Stephens Lane, sometime between 1984 and 1989.

Optimal Stormwater Drawing 22N11_CC_C126 (A) shows detail of the below ground installation of the pipeline along the right side of the river channel upstream of bridge crossing 1 (Gordon Edgell Bridge, Hereford Street). The depth from ground surface to pipeline cover varies over the range 0.8 – 2.51 m. At that depth, under most flood conditions, the risk of scour of the sediment above the pipeline, and subsequent exposure of the pipeline, would be negligible, provided the ground surface cover is maintained in good condition (grass, trees, paving). Under extreme flood conditions, exceeding 1%AEP, there is a low risk of channel scour that could expose the below ground pipeline.

3.5.2 Thalweg long-profiles of Wambuul/Macquarie River and Queen Charlottes Creek

Thalweg long-profiles were generated for Wambuul/Macquarie River and Queen Charlottes Creek over the entire study area (Figure 29). Details of the thalweg profiles were generated for the reaches of Wambuul/Macquarie River (2442 m long) and Queen Charlottes Creek (1915 m long) within which the bridge pipeline crossings sites were located (Figure 30). The standard error of the prediction ($s.e.$) was calculated for each profile. The average total width of the $s.e.$ bounds were 0.79 m on Wambuul/Macquarie River and 0.85 m on Queen Charlottes Creek (Figure 30). These values are an indicator of the maximum vertical variation in the elevation of the bed at any point over time. At the locations of the watercourse pipeline crossing sites, the expected maximum scour of the thalweg was: Wambuul/Macquarie Hereford Street Bridge crossing, 0.34 m, Denison Bridge crossing, 0.57 m, and Queen Charlottes Creek, 0.78 m (Figure 30).

3.6 Predicted potential maximum bed scour

The equations of Blodgett (1986) predict that over the gravel range of bed material size, which could apply to Wambuul/Macquarie River, mean scour depth that could be expected during a large flood ranges from 0.5 m to 0.8 m, and the maximum scour depth ranges from 2.4 m to 3.5 m (Figure 7). Bed scour of Wambuul/Macquarie River under flood conditions would pose negligible threat to the pipeline where it emerges from the ground ad rises to the bridges.

For a sand bed stream, which could apply to Queen Charlottes Creek, the predicted mean scour depth that could be expected during a large flood exceeds 0.8 m and the maximum scour depth exceeds 3.5 m (Figure 7). These predicted scour depths would be an over-estimate of potential maximum scour of the sand-bed Queen Charlottes Creek, as the rivers surveyed by Blodgett (1986) to obtain the empirical data for his equations were considerably larger than Queen Charlottes Creek[3], and the phenomenon of scour is scale-dependent.

[3] The rivers included Sacramento River, Rio Grande, San Juan River, Colorado River, Hassayampa River, Santa Maria River, Santa Cruz River, Klamath River and Hoh River (Blodgett, 1986, p. 50).

Figure 27. Topography of Wambuul/Macquarie River in the reach between the bridge pipeline crossing sites, showing location of two cross-sections used to illustrate channel morphology.

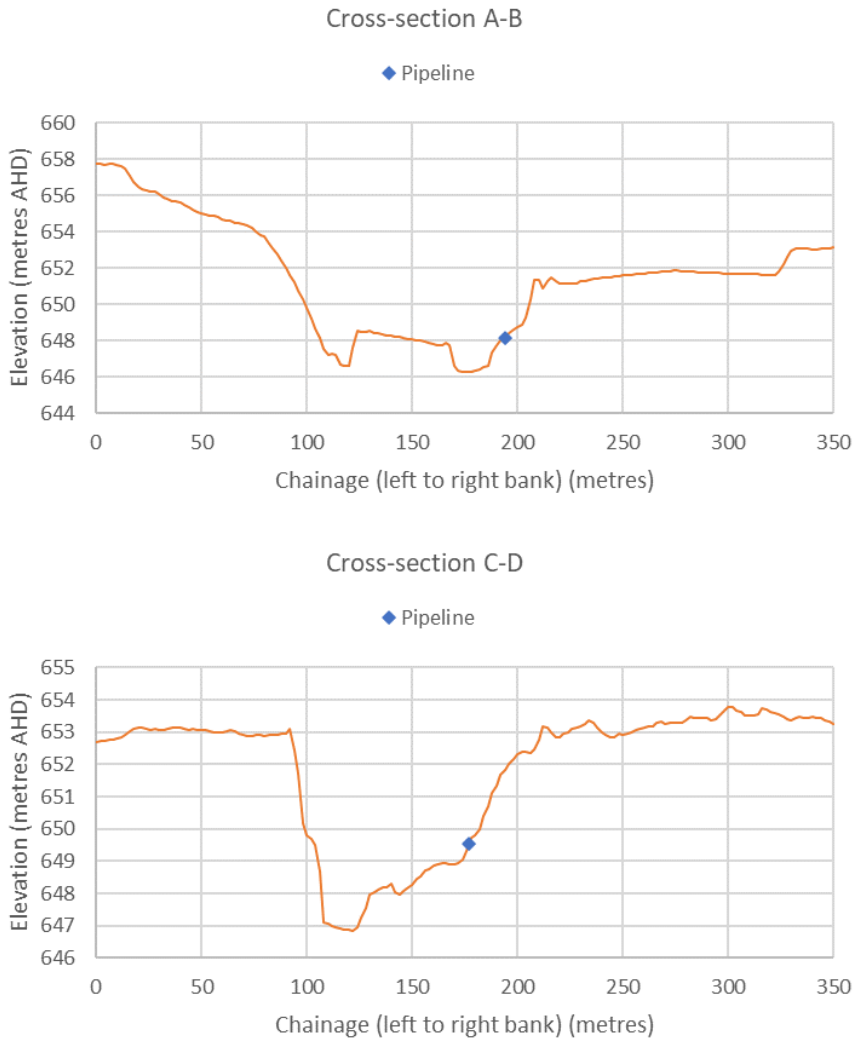


Figure 28. Two cross-sections from Wambuul/Macquarie River in the reach between the bridge pipeline crossing sites used to illustrate the position of the pipeline in relation to channel morphology.

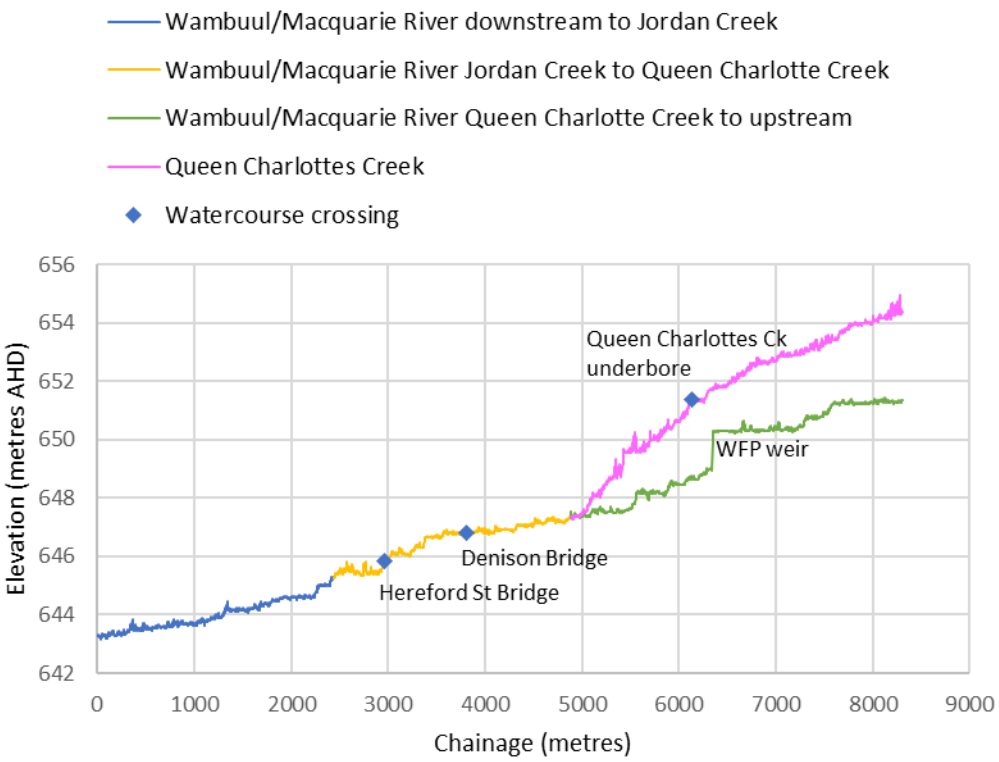


Figure 29. Thalweg long-profiles from Wambuul/Macquarie River and Queen Charlottes Creek over the study area.

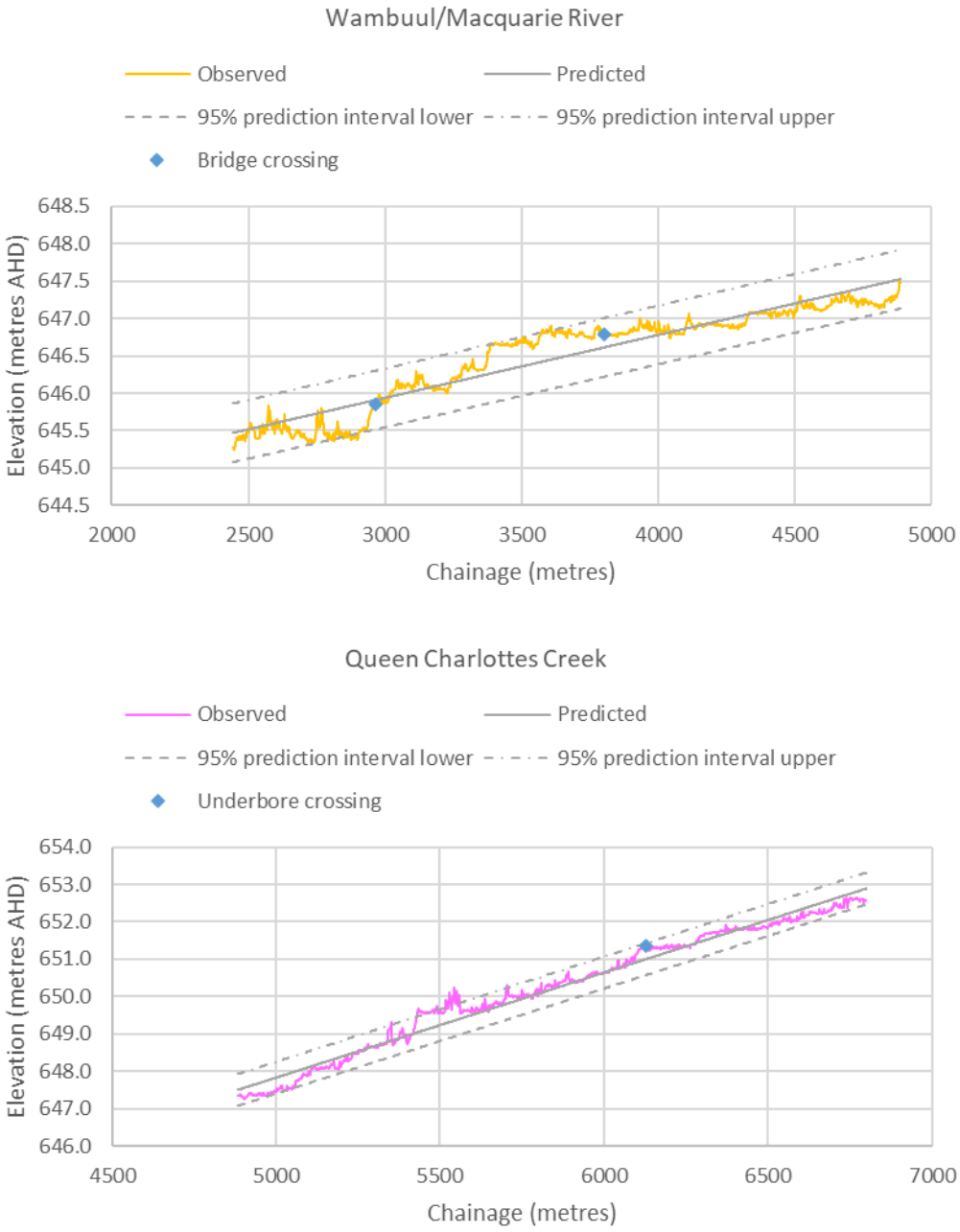


Figure 30. Thalweg long-profiles from Wambuul/Macquarie River (top) and Queen Charlottes Creek (bottom).

4 Existing Macquarie River bridge structures and attached pipelines/service conduits

The character of the existing bridge structures and attached pipelines/service conduits is illustrated by Figure 31, Figure 32, Figure 33, Figure 34 and Figure 35. These images depict stable banks and ground cover at instances where a pipe goes into or comes out of the ground within the riparian zone.

Figure 31. Denison Bridge from western bank looking towards eastern bank, where service conduits enter the ground horizontally, downstream side of bridge. Source: Premise.

Figure 32. Denison Bridge from western bank looking towards eastern bank, where existing water main emerges from ground to bridge, downstream side of bridge. Source: Premise.

Figure 33. Denison Bridge from eastern bank looking towards western bank, showing existing water main affixed to downstream side of bridge. Vertical section of proposed pipeline will be attached to the downstream side of the second pylon in the foreground of the photograph. Source: Premise.

Figure 34. Hereford Street Bridge from eastern bank looking towards western bank, downstream side of bridge. Source: Premise.

Figure 35. Hereford Street Bridge looking at eastern bank, downstream side of bridge. Source: Premise.

5 Assessment

5.1 Characteristics of the Macquarie River over the pipeline alignment

Where the proposed pipeline emerges from the ground to the bridge decks, the geology is unconsolidated alluvium, at risk of scour when subject to flood waters, especially if vegetation cover is poor. The existing ground vegetation cover at these locations was observed to be intact (grass), with good resistance to scour.

The Macquarie River at the bridge pipeline crossing sites is PCVS - Bedrock Controlled Gravel River Style. The cobble/gravel/sand beds of such rivers are armoured (resistant to scour). The river in this reach is in moderate geomorphic condition, with the factors likely to have led to a condition rating of moderate being the degraded state of the riparian forest and altered hydrology. The reach was rated moderate fragility, which means it has local adjustment potential. The reach was rated low recovery potential, which likely relates to it flowing through areas of intensive agricultural and urban land use. Overall, the River Styles assessment suggests that Macquarie River in the vicinity of the two pipeline bridge crossing sites would be relatively resistant to geomorphic change over time and does not appear to be under threat of a bed instability migrating from the downstream reach.

The native riparian vegetation on the Macquarie River over the pipeline alignment is River Oak forest and woodland wetland of the NSW South Western Slopes and South Eastern Highlands Bioregion. The distribution of this PCT was confined to a narrow riparian zone. The structure and cover of the riparian vegetation was not classified forest at year 2021. Trees are so sparse in the area that some urban and agricultural land pixels were mis-classified as low canopy cover (<10%) forest. Overall, the data suggest that the riparian vegetation is in poor condition relative to the forest that would be expected in an undisturbed riparian zone in this location, but ground cover (grass) was intact.

Historical imagery of the reach of the Macquarie River over the pipeline alignment suggested that the position of the river channel was relatively stable between 1964 and 2022. Between 1964 and 1984 there was a noticeable reduction in riparian tree cover. Between 1984 and 1989 there was a noticeable straightening of the low flow channel in the middle of the reach between Denison Bridge and Hereford Street Bridge, near Stephens Lane. This change appears to have been engineered to reduce the threat posed by potential channel migration to the road on the edge of the right bank, rather than being a natural change. By 2013, the right side of the channel between Denison Bridge and Hereford Street Bridge had been landscaped, grassed and a shared pathway installed.

Overall, the reach of the Macquarie River over the pipeline alignment is not prone to exceptional channel erosion or depositional processes. The most effective way to minimise the risk of erosion within the vicinity of the pipeline alignment would be to maintain ground surface vegetation cover in good condition.

5.2 Geomorphic risk associated with the pipeline alignment on Macquarie River

The geomorphic risk to the ground and vegetation cover of the Macquarie River around the four instances (one on each side of the two bridges) where the pipeline emerges from the ground to the bridge structures within the riparian zone is negligible. The main reason for assigning negligible risk is that the proposed pipeline would be attached to the downstream sides of the bridge structures and would not increase the existing surface areas of the bridge structures. Therefore, addition of the pipelines would have minimal impact on the hydraulic characteristics of the flow as they lie in the lee of the flow, where the flow would vary from essentially dead water to shedding vortices, depending on flow rate and degree of submersion.

An additional reason for assigning negligible geomorphic risk to the ground and vegetation cover at Denison Bridge is that the vertical pipe sections are located high on the bank just within or above the 1%AEP flood level on relatively gently sloping vegetated land that has demonstrated geomorphic stability over historical time. There is no evidence of bank erosion at the points where the existing water mains connect from the ground to the bridge structure.

An additional reason for assigning negligible geomorphic risk to the ground and vegetation cover at Hereford Street Bridge is that the pipeline emerges horizontally from the ground directly onto the side of the bridge deck, i.e. there are no vertical pipe sections. There is no evidence of bank erosion at the points where the existing water and sewerage mains connect from the ground to the bridge deck. This area of bank is fortified by the bridge abutment and gabions.

Between Denison Bridge and Gordon Edgell Bridge the pipeline alignment passes within the main river channel, at ground level around 2 – 3 m above the base of the channel. A buried pipeline positioned within the channel has a higher risk of being exposed due to erosion compared to when positioned on the floodplain, but this risk is relatively low over the expected lifetime of the pipeline. This risk must also be balanced with much higher risks to Aboriginal heritage, existing road infrastructure, private land and dwellings, and sporting facilities (EMM, 2022; Premise 2024b) associated with excavation of the floodplain adjacent to the river.

5.3 Geomorphic risk associated with underboring Queen Charlottes Creek

Queen Charlottes Creek at the underbore crossing site is more prone to geomorphic adjustment of the bed than Wambuul/Macquarie River, although the banks are relatively stable. This is despite the disturbed state of the riparian vegetation. The vegetation structure data suggest that the riparian vegetation is in poor condition relative to the forest that would be expected in an undisturbed riparian zone in this location.

Historical imagery of Queen Charlottes Creek in the vicinity of the underbore pipeline crossing site suggests that the position of the channel was relatively stable between 1964 and 2022.

The proposed depth of drilling under the bed of Queen Charlottes Creek is adequate to achieve a low geomorphic risk of the pipeline being exposed by bed scour.

6 Conclusion

The objective of this report was to assess geomorphic risks associated with the operation of the 5.5 km long water pipeline to transfer water from PS2 to the proposed WFP Balance Pond at the WFP, with a focus on the three locations on the pipeline where it will cross the Wambuul/Macquarie River twice over bridges and cross Queen Charlottes Creek once using underboring.

The majority of the pipeline route passes within alluvium, with the remainder passing within basalt geology. The alluvium is unconsolidated and at risk of scour when subject to flood waters, especially if vegetation cover is poor. River Styles assessment suggests that Wambuul/Macquarie River at the two bridge crossing sites, which was in moderate condition due to disturbed riparian vegetation, would be relatively resistant to geomorphic change over time, and does not appear to be under threat of a bed instability migrating from the downstream reach. Queen Charlottes Creek at the underbore crossing site is more prone to geomorphic adjustment of the bed than Wambuul/Macquarie River, although the banks are relatively stable, despite the disturbed state of the riparian vegetation. The vegetation structure data suggest that, across the study area, the riparian vegetation is in poor condition relative to the forest that would be expected in an undisturbed riparian zone in this location.

Historical imagery of Wambuul/Macquarie River and Queen Charlottes Creek in the study area suggests that the positions of the channels were relatively stable between 1964 and 2022.

Between Denison Bridge and Gordon Edgell Bridge it is proposed to route the pipeline within the main river channel, at ground level around 2 – 3 m above the base of the channel. Along this 816 m length of pipeline it is proposed to bury the pipeline using the trenching method. When positioned within the channel, a buried pipeline has an elevated risk of being exposed due to erosion compared to when positioned on the floodplain. The proposed depth from ground surface to pipeline cover varies over the range 0.8 – 2.51 m. At that depth, under most flood conditions, the risk of scour of the sediment above the pipeline, and subsequent exposure of the pipeline, would be relatively low, provided the ground surface cover is maintained in good condition (grass, trees, paving). An alternative higher elevation route along the floodplain is not feasible due to the risk

posed to Aboriginal heritage, existing road infrastructure, private land and dwellings, and sporting facilities (EMM, 2022; Premise, 2024b).

The depth of drilling under the bed of Queen Charlottes Creek is adequate to achieve a low geomorphic risk.

The geomorphic risk to the ground and vegetation cover of the Macquarie River around the four instances (one on each side of the two bridges) where the pipe emerges from the ground to the bridge structures within the riparian zone was assessed to be negligible. Maintenance of this level of risk requires that the ground surface cover is maintained in good condition (grass, trees, paving).

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